AN ASIAN INDIAN DIETARY ACCULTURATION MEASURE: INSTRUMENT DEVELOPMENT AND VALIDATION

By

Sumathi Venkatesh

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

Human Nutrition – Doctor of Philosophy

2014

ABSTRACT

AN ASIAN INDIAN DIETARY ACCULTURATION MEASURE: INSTRUMENT DEVELOPMENT AND VALIDATION

By

Sumathi Venkatesh

Background: Asian Indian adults in the U.S. (~1% of the total population) have a high prevalence of type 2 diabetes (ranging from 17%-29%) and other diet-related problems. A key associative factor could be unhealthy changes in dietary practices because exposure to the host culture may potentially negatively change dietary behaviors and food preparation practices (dietary acculturation). An assessment of dietary acculturation using an appropriate and culturally sensitive measure is therefore critical for understanding if and how dietary changes occur in those who relocate to another country. This will facilitate the efficacy of culturally sensitive interventions.

Specific aims: The three specific aims of this study were: (i) to qualitatively examine the factors influencing the dietary acculturation behaviors of Asian Indian adults in the U.S., (ii) to develop a culturally sensitive, reliable and valid Asian Indian Dietary Acculturation Measure (AIDAM), and (iii) to examine the relationship between AIDAM scores and the risk for type 2 diabetes among Asian Indians.

Methods: For specific aim 1, eight audio-taped focus group discussions (2-5 members/ group) and assessment of typical weekday and weekend 24 hour dietary recalls were conducted with 30 Asian Indian adults in Michigan. Verbatim focus group transcripts and dietary recalls were qualitatively analyzed for generating themes. To accomplish specific aim 2, themes that evolved from the focus group discussions were used to generate items for the AIDAM, which was revised by 10 experts in nutrition/survey research and pre-tested with 12 Asian Indians. A web-based

study was conducted with 225 Asian Indians in the U.S. to determine the reliability and validity of AIDAM. A Rasch rating scale model was used to determine reliability and construct validity. To achieve specific aim 3, the Finnish Diabetes Risk Score (FINDRISC), a validated tool to determine diabetes risk in 10 years was completed with the web-survey. The associations between AIDAM and FINDRISC scores were examined using correlations and relative risk ratios.

Results: The key reported factors that emerged relative to modification of traditional eating behaviors were: social independence, social network influences, increased health awareness, sub-standard taste and increased cost of Asian Indian foods, time constraints, and convenience (specific aim 1). These findings were used for generating AIDAM items. The estimates from Rasch model analysis showed the 50 item AIDAM to be a reliable and valid measure with reliability of 0.88. The infit and outfit MNSQ statistics of the items were within the range of 0.58 – 0.61 indicating good model fit (specific aim 2). Comparison of AIDAM with FINDRISC scores showed that adaptation to the U.S. dietary practices by Asian Indians (AIDAM scores >2.8) increased the likelihood of developing type 2 diabetes (relative risk 1.6, confidence interval 1.02-2.51) (specific aim 3).

Conclusion: This dissertation: (i) documented dietary behaviors and influential factors of Asian Indian adults over time in the U.S., (ii) utilized findings for the development of a validated dietary acculturation assessment tool, and (iii) showed the association of AIDAM with type 2 diabetes risk. These findings are relevant for nutrition/health professionals to better understand Asian Indian food choices over time and health implications.

ACKNOWLEDGEMENTS

I am very thankful to my academic advisor Dr. Lorraine Weatherspoon who was very approachable as a mentor and was a great support for me both academically and otherwise. My sincere thanks to my guidance committee members Dr. Lorraine Weatherspoon, Dr. Won Song, Dr. Beth Olson, and Dr. Thomas Conner for their expert comments and inputs, which enhanced the quality of this research. I would like to acknowledge Dr. Marsha Carolan, Dr. Shabnam Momin, and Dr. Deepa Handu for revising the focus group guide for the qualitative piece of my dissertation, and Dr. Sudha Raj, Dr. Karmeen Kulkarni, Ms. Moushumi Mukherjee, Ms. Parul Shah, Ms. Rita Batheja, Dr. Ranjita Misra, Ms. Padmini Balagopal, Ms. Karen Clark, Dr. Ryan Bowles, and Dr. Merley Mathew who were the expert reviewers of the dietary acculturation instrument. I thank the Blue Cross Blue Shield Foundation of Michigan, the Michigan State University Graduate School, and The Alliance for Graduate Education and the Professoriate for providing funding support for my research. Last but not the least; I thank my family in India and a special thanks to my husband Dr. Venkatesh Balan and my daughters Supritha and Samyuktha for all the love and support.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1 - INTRODUCTION

I. Background

Diet-related health disparities exist in the United States (U.S.) as evidenced by the disproportionately high rates of chronic diseases such as type 2 diabetes, hypertension, and cardiovascular disease among racial/ ethnic minority populations (Cowie et al., 2009, Egan et al., 2010, Jolly et al., 2010). Asian Indians, the second largest Asian group in the U.S., constitute nearly 1% (3.2 million) of the U.S. population (U.S. Census Bureau, 2012). A high prevalence of diet-related chronic diseases, especially type 2 diabetes and cardiovascular disease and their risk factors have been documented among Asian Indians living in other countries when compared to the host population (Anand et al., 2000, Beckles et al., 1986, Dowse et al., 1990, Kanaya et al., 2010, Marine et al., 1969, Misra et al., 2010b, Simmons et al., 1992, Thai et al., 1987, Venkataraman et al., 2004, Zimmet et al., 1983). Dietary acculturation could be a possible explanation for the high prevalence of type 2 diabetes and associated complications among Asian Indians who relocate to the U.S.

When two or more cultures come into contact, psychological and cultural changes occur at individual and group levels termed **acculturation** (Berry, 2005). **Dietary acculturation** is the process that reflects the extent to which members of a migrating group adopt the eating patterns/ practices of their new environment (Satia-Abouta et al., 2002). Immigration and relocation potentially influence the acquisition of varying levels of new dietary behaviors. It is well known that individuals who immigrate/ relocate to other countries could have an altered dietary intake (compared to their native/ home country) by including new foods available in the host country or exclusion of foods consumed in the home country, which could be a consequence of dietary

acculturation (Dixon et al., 2000, Hubert et al., 2005, Jonnalagadda and Diwan, 2002, Raj et al., 1999). These changes may or may not be healthful. Therefore it is important to study if and how these changes occur and whether or not they result in healthy outcomes.

Methodologies currently used in the assessment of dietary behaviors/ patterns are subject to certain limitations. Traditionally, diet and acculturation were independently captured using different assessments to study dietary acculturation behaviors. Dietary assessment tools generally encompass dietary recalls, food frequency questionnaires, or food diaries. These measures will provide information about the nutrients and types of foods commonly consumed, but may not serve as a measure of the changes that take place after relocation to another country. Similarly, general acculturation scales or single item proxy measures (e.g. fluency in host language or duration in the host country) have been widely employed in nutrition research to examine the association between host country adaptation or lifestyle changes and specific health outcomes of interest. However, these measures are limited from a dietary behavior perspective. There is specifically a lack of culturally sensitive measures for use with Asian Indians that are solely designed for the purpose of assessing the dietary acculturation level.

Therefore, the primary goal of this study was to develop and validate a culturally sensitive dietary acculturation assessment tool for Asian Indians that can assess both dietary behaviors and acculturation as a single measure. The rationale was that although there have been dietary assessment tools used extensively to assess dietary quality in general in previous studies; there is an overall lack of instruments available for Asian Indian specific foods and/ or adoption of host culture foods. An increased understanding of culturally sensitive dietary patterns/practices is

critical for construction of an instrument that applies to a particular ethnicity. Therefore, survey items to determine if and how dietary changes occur after relocation to the U.S. were identified by examining the perceptions of a sample of Asian Indian adults.

In addition, it is not currently clear if and how dietary acculturation can demonstrate diet-related disease risk. A quantitative measure of the overall changes in dietary pattern may explain the diet-disease link and is hence an important consideration for diet-related chronic disease risk assessment. Although the primary goal of the research was to develop a culture-specific dietary acculturation instrument for Asian Indians, it was also important to test the value of the tool from a health perspective and demonstrate the potential for future use in either research or healthcare professional assessment. Therefore, we examined the relationship between the dietary acculturation level of Asian Indians and their risk for the development of type 2 diabetes. The disproportionately high prevalence of type 2 diabetes among Asian Indians in the U.S. (17%-29%) was the reason for choosing type 2 diabetes among other diet-related chronic diseases.

II. Specific aims

Specific aim 1: To qualitatively examine the factors influencing the dietary acculturation behaviors of Asian Indians in the U.S.

Specific aim 2: To develop a culturally sensitive, reliable and valid Asian Indian Dietary Acculturation Measure (AIDAM)

Specific aim 3: To examine if the dietary acculturation score is related to diet-disease risk, specifically type 2 diabetes among participating Asian Indians.

III. Significance

It was expected that the three specific aims would yield the following outcomes. First this study would provide a measure of dietary acculturation for use with Asian Indian adults in the U.S. This tool could be used to identify the trend in the dietary behavior and the dietary changes made due to host country environmental exposure. Second, findings would help to improve the understanding of nutrition/ health professionals about the quality of Asian Indian food choices and preferences. The high prevalence and risk factors for chronic diseases in conjunction with the remarkable increase in immigration/ relocation of Asian Indians to the U.S. makes this study timely and important. Third, the instrument was constructed in such a manner that in the future researchers and/ or healthcare professionals can use this instrument to examine the association between dietary acculturation and the risk factors for chronic diseases in the Asian Indian population. Therefore, the goal of the study was to make a significant contribution to the literature on how to assess dietary patterns of individuals who relocate to other countries. It is important to understand the specific dietary patterns of a particular ethnicity before offering dietary recommendations or developing intervention strategies. Such interventions are critical to long term advancement in the nutritional/ health status of this growing population.

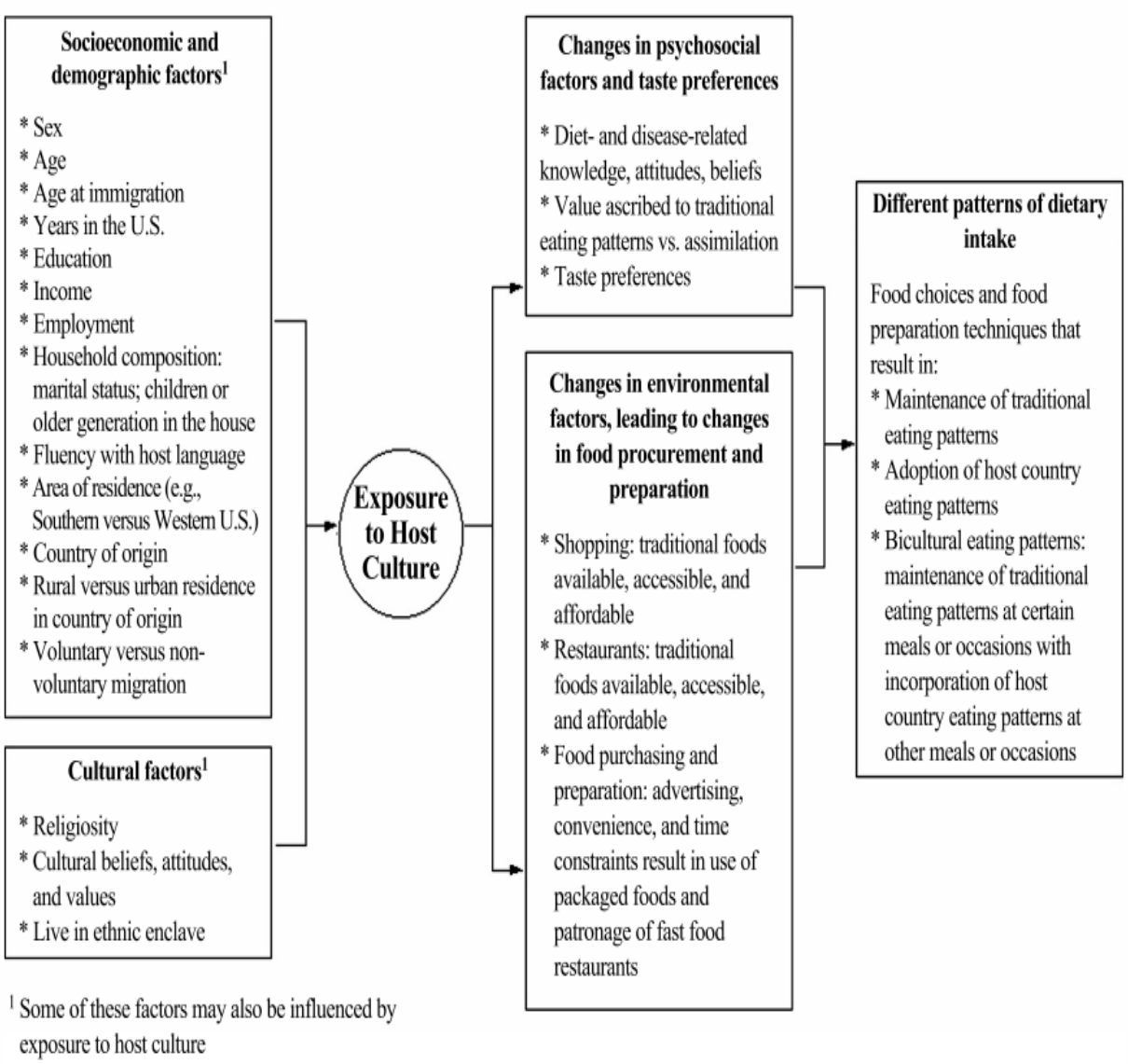
CHAPTER 2 - REVIEW OF LITERATURE

I. Theoretical Model for Dietary Acculturation

Dietary acculturation occurs when individuals who relocate to another country adopt at varying levels, the eating patterns and food choices of their new environment (Negy and Woods, 1992). Relocation to another country results in exposure to a new environment, which includes foods and food supply. According to the conceptual model of dietary acculturation, exposure to the host culture, socio-demographic (sex, age, age at relocation, duration in the host country, education, income, employment, marital status, generational characteristics of household members, fluency with host language, location of residence, country of origin, rural vs. urban residence in country of origin, and voluntary vs. non-voluntary migration) and cultural factors (religion, cultural beliefs, attitudes, and values, and residence in an ethnic enclave) could lead to psychosocial changes, changes in taste preferences, and changes in food purchasing and preparation (environmental changes) resulting in different patterns of dietary intake (Satia-Abouta et al., 2002) (see figure 1).

As indicated in the conceptual model, **socio-demographic factors** play a role in food choices and dietary behaviors. Age has been shown to be relate to the choice of foods such as higher fruit and vegetable consumption by older individuals versus higher fat consumption by those who are younger (McClelland et al., 1998, Kayrooz et al., 1998). Likewise, lower education, income, and lack of employment have been associated with increased fat intake (Eyler et al., 2004, Kayrooz et al., 1998). Longer duration in the host country and fluency in host country's language have been shown to be indicators of increased dietary acculturation due to increased exposure to the host culture (Lee et al., 1999, Raj et al., 1999, Satia-Abouta et al., 2000).

Figure 1. Proposed Model of Dietary Acculturation



Source: (Satia-Abouta et al., 2002)

Psychosocial factors (higher self-efficacy, belief about healthful eating, and social support from friends and family) were shown to be associated with healthier food behaviors and nutrition awareness such as increased consumption of fruits and vegetables, reduced fat intake and increased nutrition knowledge (Campbell et al., 1999, McClelland et al., 1998, Satia-Abouta et

al., 2004, Satia-Abouta et al., 2005, Watters et al., 2007, Watters and Satia, 2009). **Cultural factors** are important determinants of dietary practices. In the Asian Indian ethnic group, religious beliefs play a vital role in food selection. Vegetarianism is followed with varying degrees of strictness among several Asian Indian religious groups (Prashantham, 2008). Certain types of meat are strictly prohibited such as beef by Hindus and pork by Muslims (Prashantham, 2008). Culture also determines how one perceives body image and size, which further impacts dietary behavior and food choices. For example, the prevalence of eating disorders is less likely in certain cultures, which may be due to acceptance of larger body sizes (Breitkopf and Berenson, 2004, Kumanyika et al., 2005).

Lastly, **environmental factors** such as food availability, type of stores in the residential location, cost of food, and social support have all been shown to influence the selection of foods by individuals (Eyler et al., 2004, Vitolins et al., 2002). In a study by Satia-Abouta, environmental factors such as food quality, cost, convenience, and availability of foods were the major determinants and the most important contributors of dietary changes (Satia-Abouta et al., 2000). Therefore, an assessment of dietary acculturation should be comprehensive enough to include the assessment of the influence of these factors.

II. Dietary Patterns of Asian Indians relocated to other countries

Traditionally, refined carbohydrate such as dehulled white rice, semolina, and white flour have been consumed in excess in India (Radhika et al., 2009). In southern India rice is commonly consumed versus wheat in northern India (Malhotra, 1970, Prashantham, 2008). Practicing vegetarianism is common among Asian Indians of Hindu descent; however, the frequency of

consuming a vegetarian diet and how strictly it is followed may differ among individuals within this ethnic group (Prashantham, 2008). Food choices are to some extent determined by religion because typically beef is prohibited in Hinduism and Muslims do not consume pork or meat that is slaughtered inappropriately (Prashantham, 2008).

Dietary patterns and nutrient intake of Asian Indians who relocate to other countries have been shown to differ from traditional eating patterns in India. For example, higher energy and fat intake among Asian Indians in Britain was noted when compared to age, gender, and caste matched Asian Indians in India (Patel et al., 2006). The two studies that focused on acculturation/ duration of stay in the U.S. and dietary patterns of Asian Indians showed that dietary acculturation of Asian Indians was associated with frequent selection of western foods and replacement of traditional foods with western or other ethnic foods. Westernization of the Asian Indian diet was characterized by increased consumption of animal and saturated fat and convenience foods in the U.S. (Kulkarni, 2004). Increased consumption of alcohol, whole grain foods, fish, poultry, meat, salty snacks, and desserts were also noted. Contrarily, a decline in saturated fat and fiber content of foods and increased meat and convenience food consumption by Asian Indians after moving to the U.S has also been shown (Jonnalagadda and Diwan, 2002, Kulkarni, 2004).

Meal patterns of Asian Indians who relocate to western countries vary by the type of meal as many Asian Indian families adapt to a western breakfast and lunch that consists of non-Indian foods, but still consume an Indian dinner (Varghese and Moore-Orr, 2002). The typical foods consumed by Asian Indians during the week and the weekends also seemed to differ (Raj et al.,

1999). Traditional mixed dishes made with legumes, vegetables, and cereals decreased during the week because they require increased cooking time while the consumption of carbonated drinks, fruit juice, snacks, fruits, margarine, and alcoholic beverages increased (Raj et al., 1999). Jonnalagadda and Diwan examined the risk factors and nutrients of concern in the diet of Asian Indians in the U.S., which showed the diet of Asian Indians to be directly related to their weight status. Overweight status (BMI $\geq$25) was positively correlated with total fat intake ($r=.027$; $p<.05$) (Jonnalagadda and Diwan, 2002).

III. Measures of Acculturation for Asians and Relation to Food

As defined earlier, **acculturation** refers to the psychological and cultural changes that occur at individual and group levels when two or more cultures come into contact (Berry, 2005). **Dietary acculturation** occurs when members of a migrating group adopt the eating patterns/ practices of their new environment (Satia-Abouta et al., 2002). In studies that examined the dietary patterns of a migrating group, diet and acculturation were assessed with separate measures. Dietary assessment tools are generally in the form of dietary recalls, food frequency questionnaires, or food diaries, which may not adequately capture dietary changes that take place after relocation. On the other hand, acculturation scales or single item proxy measures (e.g. fluency in host language or duration in the host country) have been used as acculturation measures, which are limited from a dietary behavior perspective as they are not adequately captured. For example in a previous study, we used the *Suinn–Lew Asian Self-Identity Acculturation Scale (SL-ASIA)* scale, which had only a few items on dietary behaviors (Suinn et al., 1992, Venkatesh et al., 2013).

Most of the existing acculturation measures are single item 'proxy' measures such as language, generation level, citizenship, or duration of stay in the host country, while other scales include a few selected items on the assessment of food related behaviors (Cuellar et al., 1980, Griffith, 1983, Neff et al., 1987, Suinn et al., 1987). Single item measures, although easy to administer, may not be comprehensive enough to capture all the domains of dietary acculturation as postulated in the theoretical model of dietary acculturation. An instrument with multiple items therefore is preferred. In a review of acculturation scales for Asians by Suinn, he broadly classifies acculturation scales into two types: those that may be used for any culture also known as "pan-ethnic" scales and those which focus on values and behaviors (Suinn, 2010).

Pan-ethnic Scales: Pan-ethnic scales are acculturation scales that could be modified for any ethnic group. Examples include the Vancouver Index of Acculturation (VIA), Asian American Multidimensional Acculturation Scale (AAMAS), the Multicultural Acculturation Scale (MAS), and the Stephenson Multigroup Acculturation Scale (SMAS) (Chung et al., 2004, Ryder et al., 2000, Stephenson, 2000, Wong-Rieger and Quintana, 1987). The *Vancouver Index of Acculturation (VIA)* is a bidimensional instrument with twenty items. The scores range from 1 (low identification) to 9 (high identification). There are two sub-scores derived from this measure: the heritage sub-score and the mainstream sub-score. However, this scale lack items on dietary behavior (Ryder et al., 2000). On the other hand the other three scales included a few items on food behavior.

The *Asian American Multidimensional Acculturation Scale (AAMAS)* was developed by Chung et al., which has two items on food behavior which are (i) How much do you like the food of and

(ii) how often do you eat the food of (a) your own Asian culture of origin? (b) other Asian groups in America? (c) the White mainstream groups?. The three answer options are assessed on a scale of 1(not very well) to 6 (very well) (Chung et al., 2004). The *Multicultural Acculturation Scale (MAS)* was developed for individuals from Vietnam and has three items that asks about (i) foods eaten at home, how often (ii) Vietnamese and (iii) Anglo-American foods were cooked and consumed at home (Wong-Rieger and Quintana, 1987). While the *Stephenson Multigroup Acculturation Scale (SMAS)* has two items on food choice, which are: (i) I eat traditional foods from my native culture and (ii) I like to eat American foods (Stephenson, 2000). As indicated, these scales were not designed to exclusively measure dietary acculturation.

Values Scales: The two scales based on values are the *Asian Values Scale*, developed by Kim et al., which has 36 items and the *European American Scale for Asian Americans* by Wolfe et al. has 18 items to measure adherence to Asian cultural values by Asian Americans (Kim et al., 1999, Wolfe et al., 2001). However, these scales were intended to measure acculturation of the values of Asians, but not their behavior. Since dietary habits belong to lifestyle behavior changes, assessment of changes in diet was not the focus of these scales.

Behavior Scales: Examples of the behavior scales are the *Suinn–Lew Asian Self-Identity Acculturation Scale (SL-ASIA)* and the *Marin Acculturation Scale (MAS)* (Marin et al., 1987, Suinn et al., 1987). The SL-ASIA is the most widely used instrument for measuring dietary acculturation of Asians. There are two items in SL-ASIA that include food preference (i) at home and (ii) in restaurants. Participants respond to these questions by checking any of the following categories: (a) Exclusively Asian food, (b) Mostly Asian food, some American, (c) About

equally Asian and American, (d) Mostly American food, and (e) Exclusively American food. The SL-ASIA was intended to measure the overall acculturation level of Asians and hence the tool had only two items focused on dietary behaviors. On the other hand, the *Marin Acculturation Scale* was developed and revised by Gupta et al. for Chinese Americans, and the total scale includes 12 items on language choice and ethnic social relations. Unlike the SL-ASIA, this scale lacks items on food behaviors (Gupta and Yick, 2001).

IV. Scales used for Asian Indians

In addition to these general Asian measures, a few studies modified existing scales for use with Asian Indians such as the ARSMA-II by Farver et al. who investigated the influence of the family on acculturation, ethnic identity achievement, and psychological functioning among American-born Asian Indian adolescents (Cuellar et al., 1995, Farver et al., 2002). They modified the scale, originally designed for Mexican Americans, by substituting the word Asian Indian for Mexican. Both parents and adolescents completed the questionnaire and the study found positive correlations between parent and adolescent ratings of their self-identification and ethnic identity (Farver et al., 2002). Khairullah and colleagues used the *Bicultural Involvement Questionnaire (BIQ)* (originally developed to assess the acculturation of Cubans) on 629 first generation Asian Indians in the western New York region in the U.S. and examined its relation to participant sociodemographic characteristics. The study showed that the scale was suitable for use with Asian Indians to determine their acculturation level. However, out of the 24 scale items used in this study only one was on food, which is " I wish the food would be" and the response categories are (a) Indian all of the time, (b) Indian most of the time, (c) Indian and American

equally, (d) American most of the time, and (e) American all of the time (Khairullah and Khairullah, 1999, Szapocznik et al., 1978).

In a previous study, we modified the SL-ASIA for Asian Indians to examine the relation between acculturation and diabetes control (Venkatesh et al., 2013). The unidimensional SL-ASIA scale has 21 items that include items on language, identity, friendship choice, behaviors, generational background, and attitudes. The instrument measures the degree of acculturation with Asian culture at one end and the host culture at the other and was validated against generational differences and duration of stay in the host country (Suinn et al., 1992). Although, these measures have been shown to be successful in capturing the acculturation level of Asian Indians, they were not intended for measuring dietary acculturation. Therefore, these scales are limited to only a few items on food and dining behaviors, which may not be comprehensive enough to capture all the factors involved in food procurement, preparation, and consumption behaviors of the target population.

V. Measures of Dietary Acculturation

A few studies exclusively looked at dietary acculturation of ethnic groups that moved to another country by either developing new or by using existing assessments. A food-list developed by Yang et al was used to assess the dietary acculturation of Chinese who moved to Lincoln, Nebraska (Yang and Fox, 1979). They assessed the current food habits, prior practices, and changes in food consumption using a structured questionnaire. Food consumption was assessed both quantitatively (participants reported increase or decrease in the consumption of 47 food

items commonly used in American and Chinese cooking) and qualitatively (recent 24-hr dietary recall and one day typical menu).

Dietary acculturation was assessed using a Composite Adaptation Score (CAS) that was calculated from participants' responses to questions on whether participants liked or disliked American foods; whether they miss Chinese foods; if they attempted to obtain ethnic foods from specific places; participant self-evaluation of dietary changes; their interest in American cooking; how they served the food; and the use of convenience foods. A higher score indicated increased changes in food habits. Scores were also assigned for the information on food consumption and the foods from the qualitative data were categorized into broader categories. The study showed a mean CAS score of 23 out of 47 possible points. Individuals older than 36 years, those who were fluent in English, those with American friends, and those who lived in dormitories scored higher, which was indicative of more dietary changes. Scores were higher for women (vs. men), those who were single (vs. married), and those with children (vs. those with none).

Satia-Abouta et al developed a western and a Chinese dietary acculturation scale, which was administered to 244 Chinese women in selected cities in the U.S. and Canada (Satia-Abouta et al., 2001). Qualitative in-depth interviews (n=30) and focus group discussions (n=2) were conducted to obtain information on participants' past and current dietary habits. Fifteen items were developed based on this information, which were then divided into two scales with 5 items in the Chinese and 10 items in the Western dietary acculturation scales, respectively. This scale was used along with separate acculturation (age at relocation and media preference) and dietary (food frequency questionnaire) measures to further examine the dietary patterns within the

Western and the Chinese dietary acculturation groups. The study showed that women who were young, who had 13 years of education or more, employed outside home, and stayed longer in the host country had higher western dietary acculturation scores. In addition western acculturation was associated with increased fruit and vegetable intake but also a diet high in fat. It was interesting to note that the Chinese dietary acculturation score was not associated with any of the dietary variables.

Lv et al. examined the association between participants' demographic characteristics and the current the dietary practices of 399 Chinese Americans in Pennsylvania (Lv and Cason, 2003). Length of stay in the U.S., English proficiency, and number of American friends were used as indicators of acculturation. A food frequency questionnaire was used to collect the past year's dietary intake. In addition to these, 10 questions on general food habits were included. This study documented age, gender, presence of children, and place of origin to be associated with dietary acculturation of Chinese Americans. Bojanic et al. examined the relationship of dietary acculturation and the dining behaviors of individuals from China, Taiwan, Hong Kong, and Macau who were residing in the U.S. (Bojanic and Xu, 2006). The study adapted the ARSMA-II scale for Chinese individuals to measure acculturation. Participants' frequency of dining out behaviors and their choice of restaurants were obtained. The study showed that the frequency of dining out was significantly higher among those with higher levels of acculturation.

Kim and colleagues examined the dietary acculturation and diet quality of Korean Americans and native Koreans (Kim et al., 2007). A food frequency questionnaire was used to collect dietary information and to calculate participants' diet quality using the revised Diet Quality

Index (scores ranging from 0 to 16 with a high score indicative of higher diet quality). The foods were then categorized as Korean, American, and common foods (consumed both in Korea and the U.S.). Although the Diet Quality Index did not differ between the groups, dietary acculturation assessed as frequency of dining out and consumption of American foods, and fast foods was higher among Korean Americans compared to native Koreans.

Pierce et al used confirmatory factor analysis to examine the dietary acculturation of Japanese Americans (Pierce et al., 2007). They created two latent variables named as the Japanese and the Western food factors (JFF and WFF, respectively). A culture specific food frequency questionnaire was administered to 636 second and third generation Japanese Americans in Seattle. Individuals who were second generation had higher JFF and lower WFF scores than the third generation. However, these scales included culture specific food items that do not allow adaptation of these measures to other ethnic groups.

VI. Dietary Acculturation Measure for Asian Indians

Varghese et al developed a measure to assess the dietary acculturation of Asian Indians who had moved to Newfoundland (Varghese and Moore-Orr, 2002). They constructed a questionnaire that consisted of five parts, which includes questions on sociodemographics, dietary practices, attitudes towards food selection, nutrition knowledge, and health and nutrition needs assessment. This study showed that Asian Indians continued to consume traditional foods for dinner while changes after relocation were evident in breakfast, lunch, and snacks with increased consumption of foods available in Canada. Increased consumption of meat and soft drinks were also noted. Changes in food preparation methods include spending less time in cooking, frequent baking, use

of microwave, barbequing, trying international foods, and increased canned foods, meat and cheese based dishes.

Many of the questions in the study by Varghese et al. are relevant to our study. Some of these include, questions on vegetarianism (yes/no question), changes made in the diet within the past one year, assessment of locally available alternate ingredients for cooking, subscales with responses ranging from often to never to assess foods commonly consumed in India and Canada, and statements on attitudes towards food selection for which participants responded on a four point scale from Agree to strongly disagree. Although this instrument could be used in capturing the dietary behaviors of Asian Indians, it lacked depth in the assessment of cultural, psychosocial, and environmental factors that were specified in the conceptual model by Satia-Abouta et al. as potentially influencing factors that may lead to changes in food procurement, preparation, and consumption.

Although the questionnaire used by Varghese et al. was appropriate to meet their study objectives, adaptation of their instrument may not be comprehensive enough for the purpose of our study, which is to develop a measure of dietary acculturation based on a grounded theory approach. Moreover, some of the questions used in their instrument that pertained to the dietary acculturation model were not embedded in the scale but served as separate questions. For example information on vegetarianism was collected using a yes/ no question and changes in food preparation methods were captured using an open ended question. Our study, however, aims to develop a scale that can be used to calculate dietary acculturation as a single score in a linear fashion.

VII. Justification for a Dietary Acculturation Scale

Dietary acculturation assessment measures are essential due to the rise in obesity and other diet-related chronic diseases in ethnic minorities. Cultural sensitivity and appropriateness of such measures are critical for developing dietary interventions aimed at attenuating the severity of diet-related health/medical conditions, especially among populations of color with high risk such as the Asian Indian. A review of literature on the instruments to measure dietary acculturation revealed a gap related to the comprehensiveness of the measures used for assessing dietary acculturation behaviors of Asian Indians who move to other countries, specifically the U.S.

Some of the measures used for determining acculturation did not focus on dietary acculturation alone but included several other indicators of acculturation. Although the behavior acculturation scales had a few items on food behavior, they did not provide any information about the factors that influence the food behaviors. The dietary acculturation scales developed for other Asian cultures such as the Chinese, Japanese, and Koreans contain culture specific foods that may not be applicable for Asian Indians. The instrument developed by Varghese et al. for Asian Indians in Canada is the closest to the scale visualized in our study of all the available measures. However, this scale did not include the cultural, psychosocial, and environmental changes, as specified in the Satia-Abouta dietary acculturation model, which was used as the theoretical framework for the current study (Satia-Abouta et al., 2002).

Furthermore, the unique contribution of dietary acculturation towards the risk for diet-related chronic disease among Asian Indians is not known yet. In order to understand if and how dietary patterns/practices relate to acculturation and risk factors for chronic diet-related diseases, ethnic

specific exploration within a host country or environment is essential. The gap in the current literature is on specific measures for the assessment of dietary acculturation for Asian Indians in the U.S. Such measures are important to increase understanding of underlying problems potentially related to dietary changes as a consequence of acculturation that may contribute to the adverse health outcomes in this population, such as type 2 diabetes.

The rationale for examining the risk factors for type 2 diabetes is the high prevalence of type 2 diabetes among Asian Indians who moved to the U.S (Balasubramanyam et al., 2008, Kanaya et al., 2010, Misra et al., 2010b, Rajpathak et al., 2010, Venkataraman et al., 2004, Wu et al., 2012). In addition, type 2 diabetes is a serious global problem. Therefore examination of a diet-disease link would provide an understanding of one of the environmental factors that may contribute to increasing the risk for this disease.

VIII. Type 2 Diabetes Prevalence and Risk Factors

Type 2 diabetes, is disproportionately high among Asian Indians, one of the fastest growing ethnic groups in the U.S. The prevalence of diabetes among Asian Indians in the U.S. was shown to be 17.4% to as high as 29% (Balasubramanyam et al., 2008, Kanaya et al., 2010, Misra et al., 2010b, Rajpathak et al., 2010, Venkataraman et al., 2004, Wu et al., 2012). These rates are much higher than Native American adults (14.9%), non-Hispanic blacks (12.8%), non-Hispanic whites (6.6%), and Hispanics (8.4%) in the NHANES 2005-2006 survey (Cowie et al., 2009, Harjo et al., 2011). Furthermore, Asian Indians in the National Health Interview Surveys (NHIS) for 1997 – 2000/2005 had a greater likelihood (OR: 2.7, 95% CI: 1.7 to 4.1) of having diabetes than non-Hispanic whites (Mohanty et al., 2005, Oza-Frank et al., 2009).

A higher diabetes prevalence among Asian Indians/South Asians (individuals from Pakistan, Sri Lanka, Nepal, and Bangladesh) residing in other countries than the host populations have been noted in countries with a considerable Asian Indian population, such as the United Kingdom, Canada, Singapore, Mauritius, Fiji, Trinidad, and South Africa (Anand et al., 2000, Beckles et al., 1986, Dowse et al., 1990, Marine et al., 1969, Thai et al., 1987, Zimmet et al., 1983). This trend among Asian Indians who relocate to western countries such as the U.S. could be partly attributed to dietary acculturation. If diabetes is not identified early or well controlled, the propensity to develop devastating complications is greatly enhanced, and may lead to increased medical costs and premature death.

Studies have shown that individuals with type 2 diabetes are at higher risk for stroke, heart disease, hypertension, neuropathy, retinopathy, nephropathy, foot ulcers, dental problems, blindness, and lower limb amputations than those without diabetes (Bunce and Wormald, 2006, Foley and Collins, 2007, Fox et al., 2006, Johannesson et al., 2009, Klein et al., 1996, Lehto et al., 1996, Mealey and Oates, 2006, Perneger et al., 1994, Ramsey et al., 1999, Saydah et al., 2004, Tsai et al., 2002). Type 2 diabetes also increases the cost burden since it has been shown to triple the medical cost compared to those without diabetes (Trogdon and Hylands, 2008). Screening and early detection is therefore imperative to capture high risk individuals (Groeneveld et al., 1999).

Obesity, sedentary lifestyle, race ethnicity (African American, Latino, Native American, Asian Americans and Pacific Islanders), first-degree relatives with diabetes, hypertension, impaired glucose tolerance/fasting glucose, abnormal lipid profiles, history of gestational diabetes or

delivery of macrosomic baby, polycystic ovary syndrome, hemoglobin A1c level>5.7, and other clinical conditions associated with insulin resistance such as acanthosis nigricans are risk factors for type 2 diabetes (American Diabetes Association, 2014). Asian Indians have additional genetic risk factors such as high prevalence of insulin resistance, abdominal obesity, and abnormal lipid profiles (Banerji et al., 1999, Chandalia et al., 1999, Enas et al., 2007, Misra and Vikram, 2004, Raji et al., 2001, Ramachandran et al., 2004). These genetic risk factors increase risk for type 2 diabetes at a relatively lower body mass index, which is in part due to their higher body fat percentage even with smaller waist circumferences (Banerji et al., 1999, Chandalia et al., 1999, Raji et al., 2001, Ramachandran et al., 2004).

In developing countries such as India, maternal malnutrition during the pre/postnatal stages may also increase fetal/ infant malnutrition resulting in poor organ development such as the pancreatic beta cells that could result in insulin resistance (Thrifty Phenotype Hypothesis) (Hales and Barker, 2001). This was demonstrated in a study that documented increased adiposity and circulating insulin in Asian Indian neonates compared to neonates of Caucasian origin (Yajnik et al., 2002, Yajnik, 2004). It has also been postulated that when exposed to western lifestyles, ethnic groups with a history of prolonged nutritional deprivation in the past may experience gene-environment interactions that may increase their susceptibility to metabolic disorders (Thrifty Genotype Hypothesis) (Bajaj and Banerji, 2004, Prentice et al., 2005). Lifestyle changes upon relocation may aggravate the existing genetic risk factors or could serve as additional risk factors.

Unhealthy dietary patterns and a sedentary lifestyle could also contribute to increased risk for developing type 2 diabetes. In a prospective cohort study of U.S. men in the Health Professionals Follow-up Study, two dietary pattern indices called the "prudent" (high intake of vegetables, fruit, fish, poultry and whole grains) and "western" (high intake of red meat, processed meat, French fries, high-fat dairy products, refined grains, and sweets and desserts) indices were developed and validated (van Dam et al., 2002). At the follow-up period, after twelve years, the study showed the western diet to be associated with increased risk of type 2 diabetes. On the other hand the prudent dietary pattern was associated with a lower risk for the disease.

The risk of developing type 2 diabetes could be reduced by consuming a healthy diet and engagement in increased physical activity (Lindström et al., 2003, Tuomilehto et al., 2001). The beneficial effect of a healthy diet and physical activity for the prevention of type 2 diabetes was documented in the Finnish Diabetes Prevention Study using a randomized control trial of 522 overweight individuals (mean age: 55$\pm$7) with impaired glucose tolerance. The intervention group received individualized counseling to reduce body weight, total fat, saturated fat, and to increase fiber and physical activity. A significant decrease in weight was observed after 12 months in the intervention group (mean weight loss was 4.2 Kg in the intervention vs. 0.8 in the control group). After 4 years, the cumulative incidence of diabetes was 11% in the intervention group, while it was double (23%) in the control group, which is a 58 percent reduced risk of diabetes due to the intervention (Lindström et al., 2003, Tuomilehto et al., 2001).

Thus, healthy dietary behaviors play a significant role in preventing or delaying the onset of type 2 diabetes. Among individuals who relocated, cultural orientation of the diet has been shown to

be influential in the development of risk factors for type 2 diabetes in various ethnic groups. One of the challenges that individuals who relocated may encounter is adjusting to the host culture diet. Among Japanese men in Hawaii, retaining a traditional lifestyle was associated with reduced risk for type 2 diabetes. Although carbohydrate consumption was high among those who were low acculturated, fat and animal protein intake was lower. In addition, increased physical activity was noted (Huang et al., 1996). In a Multi-Ethnic Study of Atherosclerosis, high acculturation was associated with increased diabetes prevalence among non-Mexican origin Hispanics, but the association was not evident among Mexican-origin Hispanics or Chinese individuals (Kandula et al., 2008).

The contrary may also be possible. For example, analysis of the National Health and Nutrition Examination Survey (NHANES) 1999–2002, showed that the likelihood of developing diabetes increased among Hispanic adults was highest among those with low acculturation (Mainous et al., 2006). Similarly, decreased acculturation was associated with increased risk for diabetes in Arabs in the U.S. (Jaber et al., 2003). Furthermore, in addition to diabetes, studies conducted on various ethnic populations have shown acculturation to the mainstream culture could result in poor diet and ultimately other negative health outcomes such as increasing rates of obesity, hypertension, and coronary artery disease risk (Aldrich and Variyam, 2000, Dixon et al., 2000, Hubert et al., 2005, Kaplan et al., 2002, Marmot and Syme, 1976). Therefore, acculturation in relation to disease risk may not be the same across different ethnicities. Moreover, these studies did not focus on dietary acculturation and hence did not use acculturation measures that are exclusively constructed for capturing dietary acculturation.

Thus, despite the increasing prevalence of diet-related chronic diseases among Asian Indians, there is no single valid and reliable measure of dietary acculturation (Kanaya et al., 2010, Misra et al., 2010b, Simmons et al., 1992, Venkataraman et al., 2004). This was a major focus of the current study as well as to test the diet-disease link, specifically with regard to risk for type 2 diabetes within the context of dietary acculturation, specifically a single measure that quantitatively determines the extent of adaptation of Asian Indians to a host country's dietary practices. Behavioral acculturation (e.g. adaptation of host country's dietary behaviors) occurs sooner than values acculturation for Asian Americans (Kim et al., 1999). Since dietary habits fall under behavior acculturation, a behavior scale would be the appropriate approach to meet the purpose of this study. The reliability and validity of such measures are critical for accurate measurement of the underlying domains and for the reproducibility of results when administered using a different sample.

CHAPTER 3 - METHODS

The study was approved by the Institutional Review Board of Michigan State University (MSU IRB) (appendix 1). To accomplish the three specific aims of the study, two phases (qualitative and quantitative) of data collection were conducted. A qualitative study consisting of focus group discussions was conducted to accomplish specific aim 1 while specific aims 2 and 3 were achieved through a quantitative web-based cross-sectional survey. The two phases of the study are described in detail below.

I. Phase 1 (Qualitative)

A qualitative study was conducted to accomplish specific aim 1 of the study, which is to qualitatively examine the factors influencing the dietary acculturation behaviors of Asian Indians in the U.S. Participants were recruited until data saturation by sending an electronic research flyer (appendix 2) to Asian Indian organizations in Michigan. Interested participants provided informed consent (appendix 3) and completed a sociodemographic questionnaire in private (appendix 4). Eight audio-taped focus group discussions guided by a structured focus group guide (appendix 5) accompanied by two 24 hour recalls of each participant's typical weekday and weekend dietary intake (appendix 6) was conducted to examine the dietary behaviors of participating Asian Indians.

The questions for the focus groups were based on the PRECEDE (Predisposing, Reinforcing, and Enabling Constructs in Educational Diagnosis and Evaluation) model and a thorough review of relevant literature (Green, 1999). According to this model, behavior is influenced by preceding (attitudes, beliefs, and values), reinforcing (social support), and enabling (skills and resources)

factors. The focus group questions addressed these domains and were reviewed by three experts in nutrition and/or qualitative research to determine the appropriateness of wording and content (Appendix 7).

Focus group discussions were conducted in English in a room at a local library or in a university classroom. A primary and an assistant moderator of Asian Indian origin conducted the discussions and recorded notes, respectively. Within a week after the focus group discussions, one 24 hour weekday and one weekend typical day dietary recall was conducted by phone by the primary moderator. A $20 gift card incentive was given to participants who participated in the focus group sessions and completed the two dietary recalls.

Participants' socio-demographic data was analyzed for descriptive information. Qualitative data was transcribed verbatim and individually coded by the primary and the assistant moderator. A codebook was developed with the theoretical domians, themes, codes, rules for application and illustrations to facilitate the coding process (appendix 8). Coding disagreements were discussed until consensus after coding each focus group transcript. Themes were generated based on the conceptual model of dietary acculturation (Satia-Abouta et al., 2002). Asian Indian and non-Indian foods, their preparation methods and portion sizes were determined from the dietary recalls.

II. Phase 2 (Quantitative)

A cross-sectional study was conducted by administering a web-survey to a national sample of 225 Asian Indian adults in the U.S to accomplish specific aims 2 and 3, which were: to develop a

culturally sensitive Asian Indian Dietary Acculturation Measure (AIDAM) and determine the reliability and validity by testing with a national sample of Asian Indian adults in the U.S. (specific aim 2) and to examine the relationship between the dietary acculturation score of the participating Asian Indians and their risk for type 2 diabetes (specific aim 3).

Items for the AIDAM were generated from the themes that emerged in our qualitative analysis for specific aim 1. A food frequency questionnaire consisting of Asian Indian and non-Indian foods was developed from the 24-hour dietary recall data analysis. The AIDAM and the food frequency items were revised by 8 Asian Indians who were either registered dietitians or experts in nutrition research, one expert in survey research, and one expert in data analysis (appendix 9). The AIDAM was pilot tested with 12 Asian Indian adults who participated in the focus group discussions to determine appropriateness of content. The pilot test results are shown in appendix 10. The institutional review board of Michigan State University approved the revised instruments.

The sample size for the web-survey was calculated based on Rasch rating scale models that are employed for attitudinal rating scales and for most purposes a sample between 108 and 243 is recommended (Linacre, 1994). Recruitment of participants and administration of the web-survey was performed through Qualtrics research suite (Qualtrics, 2009, Provo, Utah, USA. Version. 12,018). For Asian Indian panel recruitment, Qualtrics Research Suite used Research Now Group, Inc (formerly known as E-Rewards, Inc, headquartered in Plano, Texas), a recognized market research company that rewards consumer panelists for time spent taking market research surveys. Research Now uses an incentive scale which is based on time increments and the

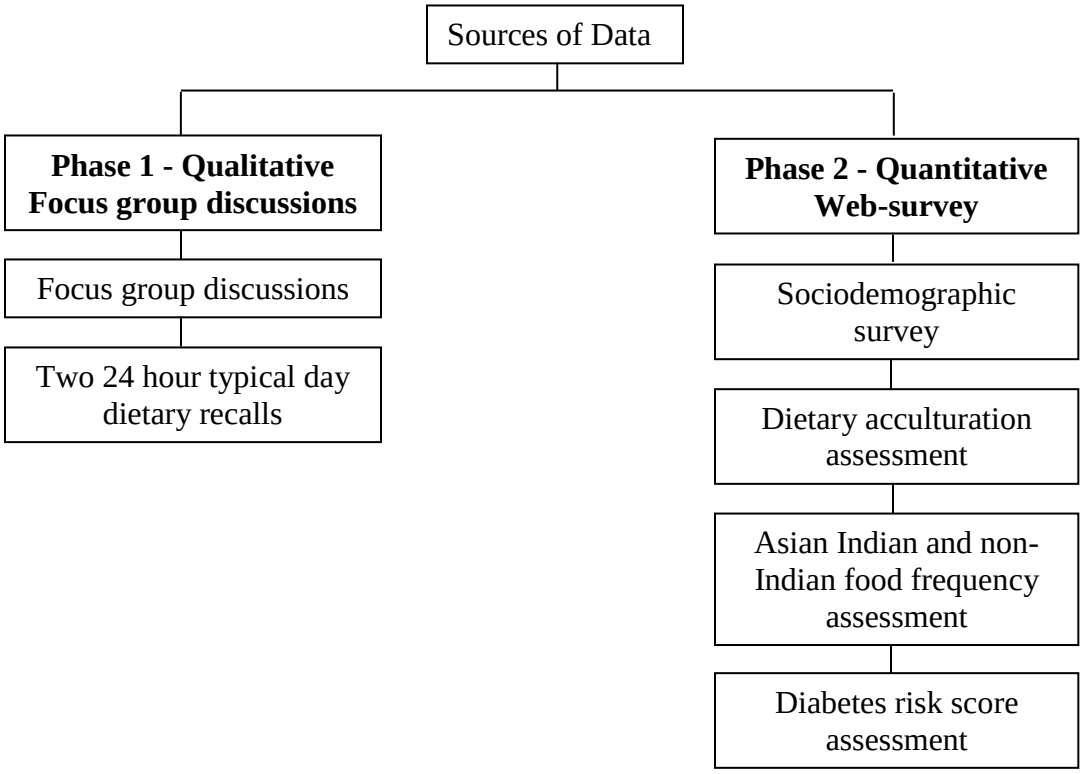
panelist profiles. The incentive amount is variable and based on the profile of the target sample. After completing surveys participants are allowed to redeem from a large range of gift cards, points programs, and partner products or services. For example, our study participants earned e-rewards currency for completing the survey. A wide net of 1408 emails were sent to Asian Indians and 289 participants clicked on the entry link. A total of 225 participants completed the survey, which is a response rate of 16%. The location of residence (in the U.S.) of the 225 participants is provided in appendix 11. Demographic profile of participants and non-participants were similar, as shown in appendix 12.

Interested and eligible participants (Asian Indians $\geq$ 18 years) provided informed consent (appendix 13) and completed the following survey items: (i) participant sociodemographic, diet, and health care questions (appendix 14), (ii) the food frequency items (appendix 15), (iii) the Finnish Diabetes Risk Score (FINDRISC), a tool to calculate participants' risk for developing type 2 diabetes in ten years (appendix 16), and (iv) the AIDAM (appendix 17). A detailed description of the assessments are provided in chapter 4 - manuscript 2.

Participants sociodemographic characteristics were analyzed for descriptive information using Statistical Package for Social Sciences (SPSS) (version 20.0, 2011, Chicago, Illinois, SPSS Inc.). To accomplish specific aim 2, construct validity and reliability estimations were performed through WINSTEPS (Rasch measurement software version 3.74 Beaverton, Oregon) to determine model fit. Validity was also determined by examining the correlations between AIDAM (calculated using participant responses for the dietary acculturation items) and (ii) the scores obtained for Asian Indian (AI-FFQ) and non-Indian (NI-FFQ) food frequency items

(participant responses provided in appendix 18). Linear regression analysis was conducted with AI-FFQ and NI-FFQ scores as predictors and AIDAM score as the outcome by controlling for sociodemographic variables. Association between participants' predictive diabetes risk score (calculated using FINDRISC assessment) and AIDAM were examined using correlations and linear regression analysis to accomplish specific aim 3.

Figure 2. Figure showing the two phases of data collection



CHAPTER 4 - RESULTS

I. Manuscript 1 (specific aim 1)

Factors influencing dietary acculturation of Asian Indians in the U.S.

Abstract

Background: Asian Indians, one of the fastest growing ethnic groups in the U.S. (~1% of the total population) have a high prevalence of several diet-related diseases. Exposure to a new culture may change taste preferences, food procurement and food preparation of individuals who relocated, leading to changes in their dietary pattern (dietary acculturation) that could have an impact on their health.

Objective: The objective of this study is to qualitatively examine the factors influencing the dietary acculturation behaviors of Asian Indians in the U.S.

Methods: Thirty Asian Indian adults in a Midwestern state in the US participated in eight audiotaped focus group discussions (2-5/ group) conducted in a public library/university. Two Asian Indian researchers independently analyzed focus group transcripts verbatim for theme generation. Emergent themes were analyzed using the constant comparison method.

Results: The sample (n= 16 males and 14 females) consisted of a variable group of Asian Indians, which included members from different generations, religions, and places of origin in India. Key reported factors that led to modification of traditional behaviors were: social independence; social network influences; increased health awareness; sub-standard taste and increased cost of commercial Asian Indian snacks/ restaurant foods; and time constraints and convenience.

Conclusion: This study elucidated the factors that contribute to dietary acculturation of Asian Indians. These findings were utilized for the development and validation of an Asian Indian dietary acculturation instrument that can be used nationally and internationally, to improve the understanding of nutrition/health professionals about Asian Indian food choices and preferences.

Introduction

Asian Indians constitute about 1% of the U.S. population and are the second largest Asian group in the U.S. (U.S. Census Bureau, 2012). Asian Indians in the U.S. have a high prevalence of diet-related chronic diseases, which is also higher than that of the host population, especially type 2 diabetes (17% to as high as 29% in Asian Indians vs.13.1% in non-Hispanic blacks, 8.7% in Mexican Americans, and 7.4% non-Hispanic whites) (Kanaya et al., 2010, Misra et al., 2010b, Selvin et al., 2014, Simmons et al., 1992, Venkataraman et al., 2004). The prevalence of type 2 diabetes among Asian Indians who relocated to the U.S. has also been shown to be higher than the diabetes prevalence in India (7.3% urban and 3.1% rural) (Mohan et al., 2008). Although genetic factors play an important role in the development of diet-related chronic diseases, it is equally important to investigate the environmental risk factors. One such risk factor is unhealthy dietary intake. In the case of individuals who relocated to another country, dietary acculturation could be an important variable of interest. Dietary acculturation is the extent to which members of a migrating group adopt the eating patterns/ practices of their new environment (Satia-Abouta et al., 2002).

The traditional Asian Indian diet is predominantly carbohydrate based. More specifically there is increased usage of refined grains such as dehulled white rice, semolina, and white flour (Radhika

et al., 2009). There are different patterns of dietary intake even within the Asian Indian ethnic group, with rice as the staple in the southern India while wheat is consumed in large quantities in the north (Malhotra, 1970, Prashantham, 2008). Upon relocation, the diets of Asian Indians undergo changes, which may also affect the nutrient composition of the diet as well. For example, an increased intake of energy and fat intake was documented among Asian Indians in Britain when compared to age, gender, and caste matched individuals in India (Patel et al., 2006).

Meal preparation practices of Asian Indians differ between the week and the weekends due to the complexity and time involved in preparing Asian Indian foods (Raj et al., 1999). Traditional mixed dishes made with legumes, vegetables, and cereals decreased during the week because they require increased cooking time (Raj et al., 1999). A study among Asian Indians in Newfoundland, Canada showed that Asian Indians changed their meal preparation practices by frequently baking, barbecuing, using a microwave, and including canned foods, which are traditionally not frequently employed for Asian Indian meal preparation (Varghese and Moore-Orr, 2002). The reasons quoted for such changes were lack of time, lack of availability of ingredients for traditional cooking, and cooking was perceived as more interesting with the use of modern equipment (Varghese and Moore-Orr, 2002).

In the U.S., the diet of Asian Indians has been shown to consist of frequent selection of non-Indian foods and replacement of traditional foods with other ethnic or western foods. Asian Indians in the U.S. were shown to consume more of animal fat and saturated fat, convenience foods, alcohol, whole grain foods, fish, poultry, meat, salty snacks, and desserts when compared to their diet in India (Kulkarni, 2004). Contrarily, another study showed a decline in saturated fat

and fiber content of the foods consumed by Asian Indians after relocation to the U.S. (Jonnalagadda and Diwan, 2002).

These changes happen because immigration and relocation results in exposure to a new environment, which includes new foods and food sources (Satia-Abouta et al., 2002). It is well known that individuals who relocate to western countries may have an altered dietary intake with the inclusion or exclusion of certain foods as a consequence of dietary acculturation (Dixon et al., 2000, Hubert et al., 2005, Jonnalagadda and Diwan, 2002, Raj et al., 1999). Along with socio-demographic and cultural factors, exposure to a new host culture may lead to collective changes in psychosocial factors, taste preferences, as well as food procurement and preparation methods thereby leading to different patterns of dietary intake (Satia-Abouta et al., 2002).

According to the conceptual model of dietary acculturation proposed by Satia-Abouta, these socio-demographic factors include: gender, age, age at relocation, duration in the host country, education, income, employment, marital status, presence of children or seniors in the household, fluency with host language, country of origin, rural vs. urban residence in country of origin, and voluntary vs. non-voluntary migration. The cultural factors are religion, cultural beliefs, attitudes, and values, and residence in an ethnic enclave. The psychosocial changes include diet and disease related knowledge, attitude and beliefs, values ascribed to traditional eating practices and host country assimilating patterns, and changes in taste preferences. Lastly, the environmental contributors are: availability, accessibility, and affordability of traditional foods at stores and restaurants, and changes in food procurement and preparation due to media influence, time constraints, and availability of packaged and convenience foods (Satia-Abouta et al., 2002).

For any population of concern, nutrition assessments/ interventions should take into account various sociodemographic, social, cultural, and environmental factors of the target audience instead of addressing a single component. In order to understand if and how dietary patterns/practices relate to acculturation and risk for chronic diet-related diseases, ethnic specific exploration of dietary practices within a host country or environment is essential. This information will be useful for interventions targeted to specific audiences of different cultures. Therefore, we explored these concepts specifically relative to Asian Indians in the U.S.

The purpose of this study was to conduct a qualitative study to determine the factors that contribute to dietary changes among Asian Indians in the U.S. More specifically we investigated cultural, environmental, and psychosocial factors that can contribute to dietary acculturation in this population. We used focus group discussion methodology because group interaction would facilitate exchange of experiences and views and will help to gain an in-depth understanding from the target group perspective. The goal was to determine the factors that influence dietary acculturation behaviors of Asian Indians who relocate to other countries so that these findings could be utilized for the development of an Asian Indian culture specific dietary acculturation tool. This is an important step for facilitating the assessment of dietary changes of this target group.

Methods

The study was approved by the Institutional Review Board of Michigan State University (MSU IRB). Audio-taped focus group discussions were conducted in East Lansing, Michigan between November 2012 and January 2013 to identify survey items that are specific for Asian Indians. Participants for the focus group discussions were recruited from Asian Indian organizations in

Michigan until data saturation. Although this was a convenience sample, Michigan is composed of a considerable proportion of Asian Indians with varying professions that is comparable to the U.S. census data (U.S. Census Bureau, 2012). Subjects of Asian Indian descent who were $\geq$ 18 years old and who were able to read and converse in English were included in the study. Since Asian Indians are a linguistically diverse population, focus group discussions were conducted in English for ease of understanding participant responses without an interpreter. In addition, conducting discussions in English and audio-taping facilitated data transcription, coding accuracy and confirmation of themes.

The focus group discussion sites were determined based on the convenience of eligible participants. All the discussions were conducted either in the study room of a local public library or a university classroom. The size of the focus groups ranged between two and five participants. An Asian Indian moderator followed the focus group procedures accompanied by an assistant moderator, also of Asian Indian descent who was present to record the discussions, take notes, and assist with technological needs (Krueger and Casey, 2009). Both the moderators had nutrition background. The primary moderator was trained in qualitative research and the secondary moderator in focus group methodology.

Participants signed a consent form and self-completed a short socio-demographic questionnaire. On the same occasion, focus group discussions guided by a structured guide were conducted for approximately one to two hours based on the size of the group. Every participant had an opportunity to speak and was allowed to politely agree or disagree with the other participants. At the end of the discussion participants were encouraged to discuss any other information related to

their dietary practices that were not covered by the focus group questions. A total of eight focus groups were conducted to reach saturation.

Focus group guide

A focus group guide consisting of questions based on the PRECEDE (Predisposing, Reinforcing, and Enabling Constructs in Educational Diagnosis and Evaluation) model was developed by a thorough review of relevant literature (table 1). The PRECEDE model (Green, 1999) has been previously shown to be successful in dietary behavior assessment studies in various populations such as non-Hispanic blacks, non-Hispanic whites, Hispanics, and Asians (Chang et al., 2004, Devine et al., 2007, Satia-Abouta et al., 2000, Satia-Abouta et al., 2001, Wenrich and Cason, 2004). According to this model, behavior is influenced by preceding (attitudes, beliefs, and values), reinforcing (social support), and enabling (skills and resources) factors. The questions for our focus groups included these important parameters of interest. This model has also been used to guide qualitative focus group interviews to study the dietary behaviors of Chinese Americans for the development of a dietary acculturation scale (Satia-Abouta et al., 2000, Satia-Abouta et al., 2001). Three experts in nutrition and/or qualitative research validated the focus group guide by determining the appropriateness of content as well as clarity of questions. Two pilot interviews were conducted with non-native individuals (Asian Indian and Indonesian) in the U.S. to check for interpretation and clarity of the questions.

Table 1. Focus group questions based on the PRECEDE model

Focus group questions	Theoretical construct
What are some of your favorite foods? *Probe: They could be Asian Indian, western, or other ethnic foods*. Why are they your favorites?	Predisposing
What are some new foods that you started eating after coming to the U.S.? *Probe: Why?*	Enabling
After coming to the U.S., how have you made any changes to the types, amount and/or the number of times you eat meals?	Enabling
How do you choose the foods that you want to eat on a certain day? *Probe: Who does the cooking at home? How do you think the internet, TV, radio, or magazines here affect what you buy or eat?*	Predisposing
What are some changes that you made in your eating habits to suit the needs of your family? *Probe: e.g. elderly with medical conditions, school going children, etc.*	Reinforcing
How do you decide what places to go out and eat? What are the types of foods that you eat in restaurants?	Enabling
What are some Indian foods that you wish you could get here in the U.S.? How do you make up for those items?	Enabling
What are your preferences for snack foods that you buy?	Enabling
When you go grocery shopping for foods, how do you decide what you want to buy?	Enabling
What are some typical dishes that are cooked at home or purchased from the store when you invite your American friends? *Probe: How is this different when you invite your Indian friends?*	Reinforcing
What do you typically contribute when you attend potluck social gatherings? *Probe: How does it vary between Indian and American social gatherings?*	Reinforcing
How are the foods that you eat outside your home different from what you eat at home? *Probe: e.g. workplace, school, road trips, etc.?*	Predisposing
How do you think the types of foods in the U.S. has changed your health? *Probe: What are some things that you like or dislike about the Indian diet? What are some things that you like or dislike about other non-Indian foods in the U.S.?*	Predisposing
When you were in India, what would you typically eat during the week days and weekends?	Enabling
How did your religion determine what you ate in India? How has this changed since you came to the U.S.?	Predisposing
Do you want to say anything else about your eating habits in the U.S.?	

Questions based on PRECEDE conceptual model (Green, 1999)

Typical day dietary recalls

Two typical day 24 hour recalls, one representing a weekday and one a weekend, were conducted by phone within a week of each focus group to assess the type of foods consumed, their preparation methods, and portion sizes. The recalls were administered by the primary moderator, who was trained to use the validated USDA multiple pass method (Conway et al., 2003, Conway et al., 2004). Each dietary recall took approximately 15 to 20 minutes to complete. A list of foods and beverages consumed during a typical 24 hour period was collected with mealtime occasions, a description of preparation methods, and corresponding portion sizes. To account for variability, dietary recalls were collected for a typical weekday and a weekend day. All the participants completed the dietary recalls and a $20 gift card incentive was given to participants for completing both the focus groups and the dietary recalls.

Data analysis

Participants' socio-demographic data was analyzed using SPSS (version 20.0, Chicago, Illinois, SPSS Inc.). Focus group discussions were transcribed verbatim and individually coded by the two moderators. The coding process was facilitated by a codebook, which consisted of the domains, themes, codes, rules for application, and illustrations. Coding disagreements were discussed after coding each focus group transcript until consensus. Themes were examined by organizing and managing the data using Nvivo (version 8.0, QSR International) software for qualitative research. Asian Indian and non-Indian foods consumed during each meal occasion were identified from the information obtained from the dietary recalls.

Results

Table 2. Participant characteristics (n=30)

		n (%)
Age (years)	18 - 30	14 (46.7)
	31 – 50	11 (36.7)
	> 50	5 (16.7)
Relocation age	0-3 years	5 (16.7)
	3-30 years	20 (66.7)
	>30 years	5 (16.7)
Generation	1st	25 (83.3)
	2nd / relocated before age 3	5 (16.7)
Gender	Male	16 (53.3)
	Female	14 (46.7)
Religion	Hindu	24 (80.0)
	Other (Muslim, Sikh, Christian, none)	6 (20.0)
Educational level	≤Bachelors	8 (26.7)
	≥Masters	22 (73.3)
Employment	Employed full time	12 (40.0)
	Other (employed part time, home maker/ unemployed/ retired)	10 (33.3)
	Student	8 (26.7)
Annual household income	<$20,000	5 (16.7)
	$20,000 - $75,000	11 (36.7)
	>$76,000	13 (43.3)
	Did not disclose	1 (3.3)
Marital status	Single	9 (30.0)
	Married	21 (70.0)
Duration of stay in the US	< 15 years	18 (60.0)
	≥ 15 years	11 (40.0)
No. members in the household	1	2 (6.7)
	2	13 (43.3)
	≥2	15 (50.0
Language spoken at home	Mostly Indian	12 (40.0)
	Mostly English	6 (20.0)
	Indian and English equally	12 (40.0)
Lived in a country other than US and India	Yes	4 (13.3)
	No	26 (86.7)

Sample Characteristics

Participant demographic characteristics are depicted in table 2. There were 16 males and 14 females. About half of the participants were between 18 and 30 years (n=14). The majority were

married (n=21), Hindu (n=24), had a master's degree or higher education (n=22), and were first generation Asian Indians (immigrants and non-immigrants) or had relocated to the U.S. before age 3 (n=25). A larger proportion of the participants were either working fulltime (n=12), or were students (n=8) of which five students had lived in the U.S. for less than five years. Eleven participants had lived in the U.S. for 1 to 5 years, while 13 participants and 6 participants had been in the U.S. for 6 to 20 years and $\geq$ 20 years, respectively. The majority of the participants lived with either their friends or family members (includes spouse, children, or parents). A larger proportion of the participants spoke mostly Indian (n=12) or both English and Indian languages equally (n=12) at home. Four participants had lived in at least one country other than India and the U.S., which included Japan, Taiwan, Singapore, Malaysia, Indonesia, and the U.K. for a period of 1-5 years.

Typical weekday and weekend dietary intake of participants

Table 3 shows the Asian Indian and non-Indian foods typically consumed by participants. It was evident from the recalls that second generation Asian Indians who were born in the U.S. or participants who had relocated to the U.S. before age three (n=5) did not select Asian Indian foods for most of their meals and snacks. All the participants (n=30) did not consume Asian Indian foods for breakfast, especially during weekdays. The breakfast items mostly consisted of milk based beverages and non-Indian breads or hot or cold breakfast cereals. However, during the weekends a few participants (n=7) chose to eat Asian Indian foods typically consumed for breakfast in India such as idly, dosa, upma or pongal.

Unlike breakfast a larger proportion of participants consumed at least one Asian Indian food for lunch both during weekdays (n=19) and weekends (n=20). The foods that participants chose for lunch were Asian Indian breads such as rotis/ chapatis or rice accompanied by a vegetable or meat curry in addition to other foods such as salads, sandwiches, pasta, pizza or frozen non-Indian lunch entrees. During the weekends a few participants (n=4) consumed lunch at restaurants or resident dining halls.

Dinner foods during weekdays and weekends consisted of predominantly Asian Indian items, which included but were not limited to Asian Indian breads (rotis/chapattis, paratas), rice, meat or vegetarian curry, dal, idli, dosa, upma, and mixed rice dishes. Many participants (n=16) indicated that they would typically eat at restaurants, visit friends' houses or invite guests for dinner, or eat dinner at other social gatherings. Three male participants said they would typically consume alcoholic beverages such as whisky, wine or beer during the weekends. Participants were likely to select Asian Indian sweets and savory products for afternoon snacks when compared to mid-morning or evening snacks. A considerable amount of breakfast breads and cereals, dried fruits and nuts, sweet yogurt, non-Indian meals (sandwiches, pasta/spaghetti, noodles, pizza), and non-Indian dessert consumption, and frequent dining out especially during weekends at other ethnic restaurants was also evident from the dietary recalls.

Table 3. Participant consumption of non-Indian, common, and Asian Indian foods (n=30)

Non-Indian foods[a]	Common foods	Asian Indian foods[b]
- Green tea - Cappuccino - Hot chocolate - Protein shake - Greek yogurt/ flavored yogurt - Cereal (honey oats and bran, corn flakes, square wheat, raisin bran, shredded wheat, honey nut cheerios, honey bunch of oats, cheerios) - Oatmeal (regular, flavored) - Bread (whole wheat, multigrain, raisin bread, oat nut, banana bread) - Pita/flat bread - Wheat bagel - Pancakes - Waffle - French toast - Cereal bar (Nature valley oats, Granola chocolate chips) - Mac and cheese - Rolls - Sandwich - Burger - Spaghetti - Pasta - Frozen Lean Cuisine entrees - Fried rice - Brown rice - Burritos - Flour tortillas - Pizza (cheese, pepperoni, barbeque chicken, vegetarian, and chicken pizza)	- Milk (whole/reduced fat/ fat free) - Yogurt/ homemade yogurt - Buttermilk - Coffee - Tea (black, herbal) - Soda (mountain dew, diet coke) - Fruit smoothie - Carrot juice - Orange juice - Cheese - Almonds - Walnuts - Mixed nuts - Peanuts - Cashew nuts - Dates - Raisins - Steamed egg whites - Scrambled eggs - Boiled eggs - Egg omelet - Vegetable salad - Lettuce - Cucumber - Baby carrots - Tomato - Olives - Apple - Berries - Banana	- Indian tea - Indian buttermilk - Lassi - Quinoa - Dosa - Idli - Upma (rice, sooji, bread) - Pongal - Chapatis/Rotis - store bought frozen chapattis - Rice - Indian mixed rice dishes (vegetable pulao, spinach rice, yogurt rice, rice pulao, meat biryani) - Stuffed paratas - Store bought frozen chapattis, naan and paratas - Wheat dosa - Idli - Barley - Poori - Maggie noodles - Ragi dish - Sambar - Channa masala - Vegetable sabji - Indian style vegetable stir fry - Vegetable kuruma - Store bought frozen kuruma - Indian style meat curry (beef, chicken, turkey, fish)

Table 3 (cont'd).

Non-Indian foods[a]	Common foods	Asian Indian foods[b]
- Chicken tenders - Canned beans - Grilled salmon - Canned condensed soup - Frozen corn - Noodles - Tortilla chips - Multigrain wheatables - Cheese crackers - Wheat thins - Barbeque chips - Veggie straws - Brownies - Cheesecakes - Non-Indian cookies e.g. Oreo, Chocolate chip - Digestive biscuits - Donuts - Fruit snacks - Dark chocolate - Sweetener - Peanut butter - Creamer - Margarine - Syrup - Salad dressing - Feta cheese - Cream cheese - Mustard - Pesto sauce - Sweet and sour sauce - Pasta sauce - Salsa - Magic whip - Jelly	- Pear - Orange - Grapes - Strawberries - Prunes - Apricots - Popcorn - Potato chips - Chocolates - Biscuits - Ice cream - Cupcakes - Cookies - Cake - Candy - Sugar - Brown sugar - Honey - Butter - Whisky - Wine - Beer	- Vegetable/and bean curries - Indian style vegetable stir fry - Rasam - Dal (lentils) - Pulikuzhambu - Murukku - Banana chips - Spice mixture (snack) - Puffed rice - Indian sprouts - Pohas (flattened rice) - Indian savory snacks - Biscuits commonly found in India e.g. Marie, Milk bikkis, Parley-G - Asian Indian rusk - Indian sweets - Kheer - Carrot halwa - Chutney (coconut, peanut, coriander, onion, tomato) - Spice powder - Herbal ginger powder - Pickles - Ghee - Papad

[a]Dining out - Breakfast at a café on weekends, eat at cafeteria/ resident dining halls eat at Mexican, Chinese, Thai, Italian, and Mediterranean restaurants

[b]Dining out – Restaurant (Indian, Pakistani), eat at temple, eat at friends' houses and host guests

Thematic findings

Eight themes evolved and were organized within the three domains of the dietary acculturation model (Satia-Abouta et al., 2002) as follows:

(i) psychosocial factors and taste preferences – social network, health and nutrition, media, and taste preferences

(ii) environmental factors – food purchasing, food preparation, and restaurants

(iii) cultural factors – religious and cultural beliefs

Within each theme facilitators of dietary acculturation and traditional food consumption were identified and discussed separately. Facilitators were focused on the domains specified in the dietary acculturation model by Satia-Abouta (Satia-Abouta et al., 2002).

Facilitators of dietary acculturation

Social network (Family, friends and others, work place, and social events): Participants specified that their spouses were influential in them trying new foods at restaurants, including non-Indian foods when eating at home, initiating cooking and eating meat for those who were vegetarian, controlling food portions, and altering salt or spice level. *"…my husband forced me to like he said why don't you try? Always you are cooking at home. I mean it's been two years since I lived in the US and the first 6 months I never came out. I always cooked at home. I never ate out. Then okay I should come out, started trying out and at that time…so that's when I started the Mexican and then the pancakes. And even now it's not my favorite but I can survive on that" – (303, female, age 27, relocation age 25).*

Similarly when a family member had a medical problem (e.g. type 2 diabetes) or when a family member in the health care field incorporated health awareness, it impacted the dietary habits of the entire family, which led to including healthy foods, avoiding deep frying, and tweaking recipes to make foods healthy. *"But the one thing that I learned also a lot like you know it's like reading the label. Like thanks to name of participant's daughter again otherwise I would never. I would just look at the stuff whatever attracts me go and buy that. But she'll always look at the saturated fat, the trans-fat blah blah blah…she put it in my head too. So when I buy things I have to read through all that labels too and buy" – (202, female, age 46, relocation age 30).*

Children under eighteen years were influential in the dietary habits of parents. Many participants/ parents (n=10) mentioned that they started preparing and eating the foods that their children preferred, which were mostly non-Indian foods. Similarly, second generation participants (n=5) who were either born in the U.S. or had relocated to the U.S. before age three and were in college/ graduate school and living away from their parents said that their meals were not structured anymore and that they tended to cook simple and easy non-Indian foods since they were alone (due to lack of an Asian Indian social network). Participants who were vegetarians indicated that they did not impose a vegetarian diet on their children and therefore their children were allowed to eat non-vegetarian foods. *"once we had kids like I said, we started making foods more that would, that they would also eat…so um you know just trying to have foods like peanut butter and jelly sandwiches, which we would never buy for ourselves and never eat ourselves once we moved from India…Mac and cheese you know those kind of things which the kids eat was only brought into the home because of kids" – (402, female, age 51, relocation age 23).*

In addition to family, other individuals such as friends and colleagues and a fitness trainer also played an important role in the dietary habits of participants. Participants mentioned that they would get recipes from their friends, try different ethnic foods with their friends or colleagues, and eat foods cooked by non-Indian friends. They also indicated sometimes eating lunch with friends/ colleagues at non-Indian restaurants on work days (n=6). Eight participants said that they preferred to eat non-Indian foods at the workplace. One of the reasons given by four participants was that the foods tended to have strong aromas. *And the work place most of the time…I feel like you know at a work place like especially when you open your lunch box and then it gives that smell. I am not comfortable with you know, that you know that kind of a feeling. Like I just try to you know, keep something like that is not going to like, strong in aromas and stuff like that" - (202, female, age 46, relocation age 30).*

When asked about social events with Asian Indians and non-Indians, it was interesting to note that three participants perceived that food allergies were common among non-Indians, hence the preference was to take them to restaurants rather than preparing home cooked meals from a safety perspective. Two participants mentioned that certain foods such as fried Asian Indian items are made only for social events. Three male participants indicated that alcohol consumption generally increased during social events. *"And of course some alcohol like beer you know once in a week or month with friends yeah. It was there back in India but after coming here, it's kind of like uh but it was kind of becoming like uh you know social event I would say" – (505, male, age 40, relocation age 35).*

Health and nutrition: Greater health awareness in the U.S. was perceived as a key reason for achieving weight control (n=5) and increasing dietary intake of healthy non-Indian foods (n=10).

A few participants (n=9) said that they gained weight in the U.S.; however, three said that it was during the initial years but they later lost the weight. In this respect, reducing portion sizes and making healthy food selections that included salads and "healthy" sandwiches were important changes that were made gradually over a period of stay in the U.S. *"my rice consumption has gone down and also spice…I lost uh lost lot of weight…I feel okay this is good. And plus you know of course we included like sandwiches and these kind of things especially for afternoon lunch so that's kind of good and now after coming here, becoming more you know, becoming more health conscious" – (505, male, age 40, relocation age 35).* Excessive salt, excessive oil, energy dense Asian Indian party/ restaurant foods were considered as negative aspects of the Asian Indian diet, which could have led to reduced consumption of such foods and replacement with healthy alternatives such as salads and sandwiches. *"Um uh with the Indian food…some dishes use a lot of oil and a lot of fat. So there can be a lot of unhealthy dishes" – (701, male, age 19, relocation age 3 months).*

Overall, numerous perceived positive changes in dietary behaviors in the U.S. were mentioned by participants. The majority of the participants (n=21) said that they had incorporated healthy habits, which were: consuming a healthy breakfast, switching to healthy ingredients, eating more protein, including healthy alternatives for snacks, including salads, replacing white rice with whole wheat products, consuming a balanced meal, avoiding "junk" foods, reducing the use of processed and packaged foods, reducing the intake of carbohydrates, reducing salt, controlling portions, and regulating meat intake. *"so we have tried to control the portion lately and have split the meals. So it is more frequent with smaller portions. Yeah, and then we also cook*

breakfast most of the time, yes…yeah mostly but it is a twist on the Indian food like use oats instead of rice" – (603, female, age 29, relocation age 23).

On the other hand, participants also mentioned increased consumption of meat, rice, coffee, and less healthy foods in the U.S. Ease of availability of energy dense desserts, a plethora of fast food outlets, and increased availability and consumption of processed and less healthy foods were perceived as negative aspects of the diet in the U.S. Different patterns of eating between weekdays and weekend was also evident. Healthier choices were made during the week compared to the weekends (n=2). *"Yeah, overall the nutritional value, the content, the calorific value is very high in American foods. That's what I thought. Um I love pecan pie but if you look at the saturated fat, cholesterol content, it restricts how much you can eat. Same is true with any of the fast foods." – (501, male, age 44, relocation age 33).*

For some, increasing age and income determined food choices. For example, five participants said that they started eating healthy and practiced portion control after a certain age. With regard to income, healthy foods such as fruits and vegetables were perceived to be expensive in the U.S. and hence less healthy food options (e.g. fast foods) were considered as more affordable for those with limited income sources. This was especially true for students as expressed by a participant who was a student as follows: *"Yeah I think cost comes before health and then once you have a little affordability, then you put health also into the equation yeah" – (603, female, age 29, relocation age 23).*

Media: The influence of media in food choices of participants was mainly in the form of either trying out recipes or foods shown on the television or by searching the internet for recipes and

nutrition information. Participants said that they would do the following when asked about the role of media in their food choices: eat foods advertised or shown on cooking channels, search for new recipes or adapt some of the recipes to suit the Asian Indian palate, and learn about nutrition and health information (e.g. watching Dr. Oz show). One participant said that he tried the foods that he watched in Hollywood movies during his childhood. *"Uh I had a fancy about US when we were growing up as kids and we see a lot of Hollywood movies. So in those movies we get to see stuff like uh some kind of western food and steak was one and there are several other things. So probably to copy what I was dreaming of in my childhood years, I wanted to try all these things. And then I took a liking to it naturally, that is how I would say" – (101, male, age 39, relocation age 24).*

Taste preferences: When asked about their favorite non-Indian foods, the following were mentioned by a few participants: chicken noodles, chicken noodle soup, vegetarian patties, chicken sandwiches, doughnuts, peanut butter, western desserts, soda, pizza, and different cuisines such as American, Mexican, Italian, and Thai. *"I like Mexican food too. It's really easy to make. It doesn't take as long as like Indian food" – (703, female, age 20, 2nd generation).* A few participants mentioned reducing the amount of food or portion sizes consumed during every meal in the U.S. compared to what they would consume in India (n=6). *"In India especially like there is no concept of portion size, I guess. Like you know like if you go out, like if you are going out to some relative's house, you have to take the second helping. Otherwise it's like, even at home if you don't take the second helping they say like what's happening to you, and are you ill?...So I feel like my portion size is much under control here"- (603, female, age 29, relocation age 23).*

According to a few participants, consumption of the following foods increased in the U.S.: Alcohol, meat, fish, coffee, fruits, soda, burgers, soups, chocolate, ice-cream, milk, sandwiches, fast foods, salads, and peanut butter. *"I take quite a lot of alcohol after coming here because of access to it" – (101, male, age 39, relocation age 24).* On the other hand consumption of rice, spicy foods, sweets, and potato chips decreased over time. *"I reduced the rice and because of awareness…so reduced a little bit rice and increased the chapatti, chapatti and so lunchtime at least three times a week we take chapattis" – (502, male, age 41, relocation age 28).*

Almost all the participants indicated that breakfast is the meal that had completely changed compared to their diet in India. Breakfast items in the U.S. included cold and hot cereals, sandwiches, toast, and cereal bars versus traditional foods such as idli, dosa, roti, upma, etc. for breakfast in India. *"We used to eat idly, dosa and upma for breakfast in India and have a lunch and dinner and in between one snack with tea in the evening. And after coming over here that changed to bread and cereals in the morning but it's healthy though" – (104, female, age 39, relocation age 27).* Similar to breakfast, many participants chose to eat non-Indian foods for lunch, especially participants of second generation or those who relocated when they were less than 3 years. Second generation participants also mentioned consuming non-Indian foods for dinner. Participants did however mention both Asian Indian (e.g. murukku, sev, and Asian Indian sweets such as burfi) and non-Indian foods (sweets such as pie, donuts and salty savories such as cheetos, and doritos) as their preferred snacks.

Restaurants: Those who enjoyed a variety of non-Indian restaurants (n=13) said access and availability were key motivating factors. *"Yeah, I think uh you start eating different foods*

because of the availability of the foods and um just having different options to be able to choose from that are common options…I would say the same thing Italian, you know Mexican um Thai food because Thai food was not very common in India at all when we moved here in the 80's (1980" – (402, female, age 51, relocation age 23).

While another participant with young children said he would prefer a restaurant with a play area for children, two participants said that they would choose restaurants that served alcohol and non-vegetarian foods. Restaurant selection was also based on special offers, recommendations/ reviews and location or mode of delivery for those who did not have transportation facilities. During road trips most participants (n=19) said they would consume non-Indian foods most of the time such as pizza, sandwiches, fast foods, soft drinks, beverages, and milk shakes. Three participants said that they would try the regional specialties in the location where they travelled. Cost of Asian Indian fast foods/ street foods was perceived to be expensive in the U.S. Seven participants said that they disliked Asian Indian restaurants because of poor service and poor quality of the food. The foods served at Asian Indian restaurants were considered as less healthy and not as delicious as home cooked food. *"As a family, we don't choose Indian at all because we think Indian food is better at home than at the restaurant…uh American restaurants are good because my son likes to have some barbecued pork ribs…and then if we want to have some spicy food we go to Thai" – (101, male, age 39, relocation age 24).*

Food preparation: Food preparation evolved as an important determinant of non-Indian food preference due to time, availability of ingredients and cooking ability constraints. Four participants especially mentioned that Asian Indian foods are usually elaborate, complicated, and

are very time consuming to prepare. *"Umm I like American food. Just cause like it's really easy to get. Like go to fast foods and get something. I know like Indian food there is like this entire process, like you need pots and pans, and cooking everything. I don't know how to do any of that" – (702, male, age 19, relocation age 3).* This was clearly evident in breakfast food choices (oatmeal and cereal). A few modifications to Asian Indian cooking were also discussed such as: substituting frozen in lieu of fresh vegetables, integrating chutneys in sandwiches, adding non-Indian vegetables in Asian Indian foods, and using olive oil for tempering. *"Basic change I have made is I, I have started cooking Indian food in olive oil" – (401, female, age 49, relocation age 23)*

Food purchasing: The major impact of food purchasing behavior relative to non-Indian food consumption was through cost and ease of access to non-Indian food choices e.g. meats for vegetarians, fruit and fruit juice varieties, and frozen vs. fresh vegetables. When discussing the availability of Asian Indian foods in the U.S., participants said that they were not able to obtain certain Asian Indian varieties of bananas, mangoes, greens, seafood, and sweets in the store that they shopped or in the place where they lived. Furthermore, it was deemed that the taste of fruits differed from what they had consumed in India.

One recent Asian Indian (residing in the U.S. for less than a year) alternatively expressed a preference for milk, eggs and bread in the U.S. compared to India. The same participant also mentioned that he switched to western snacks and sweets since similar Asian Indian foods were priced high and of poor quality. Participants who were students were especially concerned about the cost of food rather than the quality. Although organic foods were considered as good quality

they were considered expensive and hence only participants who were wealthier chose to buy them. *"Yeah cost factor and taste both of them…in India I used to take Indian sweets and Indian mixture type of things regularly. Here uh depending on this uh since it is more expensive and taste is not so good, so I changed to American snacks. Yeah it's basically donuts and uh of course these muffins we say there in India we call them as cupcakes so I used to take those also" – (802, male, age 48, relocation age 47).*

Because some participants preferred specific stores for specific Indian items (e.g. regular supermarkets, halal meat store, Asian store, bulk grocers, and Asian Indian stores), distance was a limiting factor for those participants who did not have a car. Therefore, they purchased from stores with more non-Indian choices. *"So putting all the plus and minus together so whenever my friend goes to Meijer then I have to go. And I don't know when he'll go again. So factor like that are there" – (801, female, age 22, relocation age 22).*

A large proportion of participants also said they were disappointed with the quality of Asian Indian products and the freshness of ingredients in the Asian Indian grocery stores where they regularly shopped, hence the frequent selection of non-Indian alternatives. Nutrient information and expiration dates on package labels were especially limited. *"So it's like whenever you go to Indian stores, as long as you are an Indian you will take it. That's what they take it as granted. Because I sometimes even don't see the manufacturing date. Forget about the nutrition things" – (201, male, age 24, relocation age 21).*

Religious and cultural beliefs: Eight participants said that they had relaxed some of their religious beliefs in the U.S by eating non-vegetarian foods (those who were vegetarians) or foods prohibited in their religion (e.g. beef or pork). A large proportion of participants perceived that there were limited options for vegetarians in this country. *"I am big on vegetables so but that's the biggest problem in this country, the variety of vegetarian you know…the vegetables in India is like plenty. Like you have so much that you can choose from and it doesn't have to repeat every day but here you are stuck to this cauliflower or broccoli or green beans and carrots and like you know the variety" – (202, female, age 46, relocation age 30).* Four participants mentioned that in the U.S. they had relaxed the practice of avoiding eating meat consumption on religious designated days as strictly practiced by their family in India. *"Yeah I grew up vegetarian. My father in fact atheist, but you know didn't believe in bringing any meats. But uh coming here yes sometimes we ate hamburgers that time. Very rarely, but like just maybe, maybe I remember 5-6 times I have eaten hamburger"- (401, female, age 49, relocation age 23).*

Six participants indicated that their children influenced their decision to deviate from their religious beliefs and cook and allow them to eat non-vegetarian foods or to eat prohibited meat outside home. *"But there is no restriction for my kids and my husband…I buy, like non-vegetarian is concerned I buy chicken, I buy goat or lamb and then I buy shrimp and fish. Fish couple of varieties. But my, they, outside my house my daughter eats like sausage, pork…hot dogs and whatever, whatever they. I don't cook or anything" – (301, female, age 36, relocation age 24).*

Facilitators of traditional food consumption

Social network (Family, friends and others, work place, and social events): A few participants perceived exposure to Asian Indian foods important for transferring Asian Indian values to their children. At least three participants mentioned that they reduced the spice level of foods to encourage the children to eat home cooked Asian Indian foods. *"I cook everything but I make sure that the spice is less. If I put a little spice, I put little ghee or oil something to make them to eat. So yeah that has changed drastically" – (301, female, age 36, relocation age 24).* One participant said that his children would take Asian Indian foods to school, while another participant after a cycle of cooking Asian Indian and non-Indian foods for the children, switched back to cooking Asian Indian foods to promote the Asian Indian foods. However, to include a variety in the diet, non-Indian foods were cooked at home for children.

Young adults (mean age: 20.8$\pm$2.95) who were either born in the U.S. or had relocated to the U.S. before age three (n=5) and also had parents in the U.S. perceived that access to traditional foods facilitated by parents was an important factor for consumption. *I go home quite a bit to eat, but if I'm on my own I don't eat as regularly as I should…my mom like when I was really little we used to have Indian food almost every day…and then since I live close to home, my mom drops off a lot of food too" – (703, female, age 20, 2nd generation).* From the parent's perspective, however, exodus of children for college or work increased the likelihood of consumption of more traditional food. Food purchasing was also impacted as they were no longer purchasing the non-Indian foods that their children were fond of. *"for the family, for the dinner and all its always you know more of a Indian thing like just one sabji and one roti and something" – (404, female, age 51, relocation age 23).* A second-generation female participant

noted that her non-Indian friends preferred Asian Indian food. *"If I had my friends from like school over there were not Indian, they would actually prefer to have Indian food" – (703, female, age 20, 2nd generation).*

Elders (e.g. participants' parents) from India who visited family in the U.S. for a limited period of time were also influential in the selection of Asian Indian foods. Participants (n=6) mentioned that Asian Indian foods were always cooked at home when seniors were present. This was true when dining out as well even though they were limited by specific restaurant choices that are acceptable for visitors from India. *"…like when parents come we pretty much have like breakfast like my mom prepares something like upma or something and then lunch and dinner. Then in between some snack like samosa or pakoda…So when parents come it's, it was different" – (504, female, age 28, relocation age 22).*

Asian Indian foods were served for both non-Indian and Asian Indian guests, which included traditional and regional specialty Asian Indian foods, meat based spicy foods, simple and easy foods, "can't go wrong" type of foods, and rice based Asian Indian dishes such as pulao. The spice level of the foods played an important role in foods consumed/ served during non-Indian social events. *"most of the American friends that I had, always loved Indian food. So and they like spicy food too. So we didn't have to go down on the spice levels. May be we will incorporate some American stuff like salsa, dips and stuff but everything else is pretty Indian, yeah" – (102, male, age 27, relocation age 21).*

Health and nutrition: While greater health awareness was perceived as a positive influence by many, it was interesting to note that three participants were concerned that increased emphasis on food and health may sometimes result in negative consequences such as inadequate food consumption, being overly conscious about calories and nutrients, and increased stress about food and health. *"I think the stress level like I look at the ingredient label all the time. It is crazy like I never looked at all of these things in India…more aware or more psychotic, it's a little bit crazy now" - (304, male, age 31, relocation age 24).*

From a health perspective, participants were keen on preparing home cooked Asian Indian meals as it was perceived by some to be healthy as there are many fresh produce items and ingredients included instead of preservatives typically added in the prepackaged foods. The Asian Indian foods were referred to as being wholesome and satisfying even though others were of a contrary opinion. Therefore, Asian Indian foods were considered healthy since they included healthy snack options, healthy spices, and fresh produce. More specifically, Asian Indian foods (e.g. roti with vegetable sabji or rice with lentils) were considered healthy when consumed in moderation.

Media: The media was primarily used for learning recipes. One female participant said that she was passionate about cooking and hence would find recipes from the internet that could also include Asian Indian foods. *"Um you know, something some that are different you can look up, yeah on the TV and on the web. I do browse a lot on food; I really love food and cooking too…so then I actually go buy for the recipe (Moderator: is it mostly Indian?) anything yeah"- (603, female, age 29, relocation age 23).*

Taste preferences: Participants were asked about their food choices and dietary behaviors during their stay in India either before relocating to the U.S. (for participants of first-generation) or when they went on trips to India (for participants of second-generation and those who relocated before age three). The majority of the participants ate home cooked meals most of the time when they lived in or travelled to India although they had the opportunity to try other cuisines. In the U.S., it is during dinner that Asian Indian foods were increasingly consumed compared to the other meal occasions. Three participants mentioned that bland foods and salads did not suit their Indian palate since they were not accustomed to eating such foods in India. *"As far as I'm concerned I don't want to eat it (non-Indian foods) because it doesn't suit my palate, as simple as that. And I think their food is very very very very bland. Because their vegetarian is you know poached potatoes and salad" - (302, male, age 62, relocation age 60).*

Participants' favorite Asian Indian items included Asian Indian sweets, snacks, biscuits, tea, Asian Indian style chicken dishes, dosa, regional specialty foods, curries, meat dishes, rice dishes, spicy vegetarian foods, potato dishes, and Asian Indian toast. When discussing the foods that participants were not able to obtain in the U.S., the majority recollected Asian Indian street foods/ fast foods typically known as "chats" (e.g. bhel puri, pani, puri, and vada pav), Asian Indian sweets, beverages, breakfast items, and snacks, the varieties of greens versus spinach or other selected greens available in the U.S., varieties of root vegetables, and festival foods. *"I kind of miss the uh chats uh Pani Puri. I kind of miss the idly, vada, but I mean I started to make that but I really miss the chat and yeah Pani Puri, Bhel Puri, Masala Puri and stuff" – (504, female, age 28, relocation age 22).*

Restaurants: Eight participants said that they preferred to eat at Asian Indian restaurants. It was perceived that Asian Indian restaurants in the location where participants lived were not as good as the ones in big cities in the U.S. Therefore, a few participants said that they would often drive to big cities that are close by to eat at Asian Indian restaurants. One participant said that her family would only go to restaurants that serve halal meat (meat permissible for consumption by a Muslim) due to religious restrictions. *"In our case we actually look for Halal food. Like we can't eat everything so that narrows down our choices again" – (504, female, age 28, relocation age 22).*

The preference for traditional foods was evident in the concern expressed by ten participants, that limited Asian Indian options were available for vegetarians in the U.S. especially when travelling. Hence a few participants (n=12) indicated that took home cooked Asian Indian foods, especially if they are accompanied by visitors from India. *"Wherever we go, we make rice and puliyodharai and Lays…our latest addition this time was to buy a rice cooker…you go to a hotel and then you don't know what to eat. So if you have a rice cooker, yogurt is available then and you just, and for the south Indian anybody the rice and dahi (yogurt) is more than enough" - (302, male, age 62, relocation age 60).*

Food preparation: Participants often prepared and consumed Asian Indian foods mainly for dinner (n=17). Participants who cooked Asian Indian foods said that they had the ability to prepare complicated Asian Indian foods, could prepare the foods in large quantities during the weekend and saved some for other occasions, purchased food processors that are needed to cook Asian Indian foods, and obtained help from their relatives in India if they needed directions to cook Asian Indian foods. *"I mean you can't keep eating, I mean you can't keep same things for*

month's right so you need to learn new things. I used to call my mom and used to ask the recipe how to cook something" – (601, male, age 25, relocation age 24). Alternatively, to satisfy traditional food preferences, purchasing frozen Asian Indian breads (naan/ rotis) and ready to eat curries on days that they were busy also occurred.

Food purchasing: Although the variety of products were not as extensive as those available in India, participants perceived that the availability of Asian Indian products had increased over the past few decades and that they were able to obtain almost every Asian Indian food product in the U.S. According to a few participants, availability of Asian Indian food products differed based on location in the U.S. Participants who were particular about purchasing good quality Asian Indian groceries and produce said that they would shop at another big city in the state on a regular basis. *"These days I think we are getting almost everything that we want but it is region specific…But even here, I think from the Indian store I think we have at least 90% of the stuff that we get in India and if you go to Detroit we get much more, many more options, California, Texas, you have everything" – (102, male, age 27, relocation age 21).*

Religious and cultural beliefs: Eleven participants said that they had maintained religious restrictions such as being a strict vegetarian (Hindu), avoiding beef and pork (Hindus and Muslims), and consuming only halal meat if they were Muslim. Three participants mentioned that similar to India, they avoided eating meat on religious designated days in the U.S. Religious dietary restrictions were also imposed on children as mentioned by one participant. *"Being religious, uh religion made a difference in introducing food to my kids. I introduced chicken to them, fish to them, but never really meat. Beef never, never and somehow pork also"- (401, female, age 49, relocation age 23).*A few participants (n=4) who were strict vegetarians regarded

themselves as 'picky eaters' since even the aroma of non-vegetarian foods was bothersome. They mentioned that it was unacceptable for them if the same gloves were used to serve meat and vegetarian food. *"when I am eating every bite of that food it's there like you know she put the same hand in all those things and she made my food, which I don't relish" – (202, female, age 46, relocation age 30).*

There were other factors pertaining to religion that impacted the dietary behaviors of participants or their families. One participant mentioned that her son avoided eating beef after attending a religious camp. A second-generation female participant said that her husband came from a staunch Hindu family and she strictly avoids beef after her marriage. *"He (participant's husband) is half Hindu, so he was brought up with the idea that beef is really bad for you so he never touches beef and he's really strict about that. I will eat a soup if it's a beef broth, he won't touch it. So I mean to that level" - (403, female, age 26, 2nd generation).* A male participant who had tried various types of meat that are uncommon (e.g. alligator meat) said that he refrained after realizing that his parents disapproved. One male participant, who started eating steak after coming to the U.S., mentioned that he experienced social stigma while eating with his friends and felt guilty.

Discussion

Our study objective was to investigate the factors influencing dietary acculturation based on the theoretical model proposed by Satia-Abouta (Satia-Abouta et al., 2002). In the three domains that we qualitatively analyzed (cultural, psychosocial, and environmental), exposure to new foods played a role in the following key factors that were related to dietary acculturation: (i) social

independence, (ii) social network influences for consuming non-Indian foods, (iii) increased health awareness, (iv) sub-standard taste and increased cost of Asian Indian snacks/ restaurant foods, and (v) time constraints and convenience.

Social independence

Participants recollected living in a closely connected family setting with extended family members in India. Hence a family member who was primarily responsible for meal preparation determined their food choices. In contrast, in the U.S., participants were responsible for their own meals. Thus the social independence along with the exposure to new food environment led to self-determination of food choices, which in some cases happened to be preference for and exploration of new and uncommon foods (Pettys and Balgopal, 1998).

Social independence also impacted religious beliefs of participants (Bharmal et al., 2013). Among Asian Indians in California, religiosity was found to be lower among those with higher dietary acculturation to the host culture (Bharmal et al., 2013). In our sample, religious restrictions such as avoidance of certain (e.g. beef or pork) or all meat products and religious fasting on religious designated days by eating exclusively vegetarian foods were relaxed by a few participants upon relocation. On the other hand traditional religious dietary practices were still rigidly practiced by some participants who were influenced either by their family or place of worship.

The two predominant religions of India, namely Hinduism and Islam have dietary restrictions such as avoidance of beef/all meat and pork, respectively (Eliasi and Dwyer, 2002). In addition

to these foods, Muslims in India also eat "halal" foods, which translates as "permissible for consumption by a muslim"(Eliasi and Dwyer, 2002). Furthermore, abstinence of certain foods such as animal products is practiced on religious designated days. Classifying a food as halal depends on how the food is obtained and processed in addition to several other determining factors (Eliasi and Dwyer, 2002). This was clearly evident by the participant who only selected restaurants that served halal foods.

Bharmal et al (2013) analyzed information from telephone interviews with 3228 Asian Indians in California from the 2004 California Asian Indian Tobacco Survey. Half of the Asian Indian participants in this study were classified as highly religious. Religiosity was associated with an increased likelihood of being overweight or obese for Hindus but not for Muslims. The authors discussed that the different religious practices within these religions (Muslims practice fasting and abstain from alcohol while Hindus consume foods high in saturated fat and refined sugars) could serve as a possible explanation for this difference (Bharmal et al., 2013).

Social network influences for consuming non-Indian foods

Social network appeared to be very influential in participant food selection in our sample. Participants tried and explored new foods for family members at home and when eating outside and accommodated preferences of family members, which was especially true in households with young children. It was evident from our sample that more than their parents, Asian Indian children under 18 years had a strong preference for other ethnic foods. These findings were consistent with a study conducted with Arabs in Canada. This study showed that Arab children who were raised in Canada preferred other ethnic foods to traditional Arabic foods (Abou El

Hassan and Hekmat, 2012). The same was apparent in a qualitative study with Pakistani women in Norway, which documented increased consumption of Norwegian vs. traditional foods by young children (Mellin-Olsen and Wandel, 2005).

Households with seniors or visitors from India were more likely to practice traditional dietary behaviors and were hence less exposed to host country foods in the home. In contrast parents in households with children under 18 years, were not as rigid in imposing their religious rules on children's dietary habits. Although parents did not consume or prepare prohibited foods at home, children were allowed to select those foods at school or when they dined elsewhere. On the other hand, parents with children above 18 years and who lived away from the family regularly provided traditional home cooked foods during their visits. Those children who were all of second generation had limited ability to cook traditional foods and hence relied mostly on other ethnic food choices that were widely available. Thus, for families with children, age of the children appeared to be an important determinant of the dietary habits of the entire family.

Dietary acculturation has been shown to be greater among children and adolescents (vs. adults) and those of second/third generation (vs. first generation) (Smith and Franzen-Castle, 2012, Tam et al., 2010, Wutso et al., 1995). In a study of Mexican American adolescents (12-19 years) in the NHANES 1999-2004 data set, second and third generation children and adolescents had poorer diet quality than first generation children. This was documented by significantly lower overall HEI 2005 scores as well as the individual HEI components - total fruit, whole fruit, total vegetables, dark green, orange vegetables and legumes, and meat and beans. On the other hand, whole grains, saturated fat, and sodium, intake was significantly higher for second and third

generation children and adolescents. In addition, energy from SoFAAS and intake of sweetened beverages was higher for third generation (Liu et al., 2012). Therefore, adaptation to host country's dietary practices may have a greater impact on children's food choices and subsequently may impact their diet quality.

In a qualitative study among Hispanic adults in South Carolina, family members were influential in participant food choices (Chavez-Martinez et al., 2010). Second generation Asian Indians or those who were born in India but relocated to the U.S. as children tend to choose foods that are both traditional as well as those that are available in the host country, which they were exposed to while growing up as adults (Koenig et al., 2012). Therefore, it is important to be aware that they are more likely to have a dietary pattern that is different from the first generation Asian Indians. Likewise, intake of energy dense foods increased during social gatherings in our study. Koenig et al. argues that the guest-host relationship is a social factor in Asian Indian families wherein the host encourages the guest to eat heartily to show affection and to facilitate rapport (Koenig et al., 2012). This might also result in less "healthful" eating from the traditional food perspective.

Increased health awareness

In our study, it emerged that during the initial years, first generation Asian Indians experienced social independence, which when coupled with a new food environment facilitated intake of less healthy foods and weight gain. However, over a period of several years, they gained nutrition knowledge through various resources and subsequently increased their health awareness, which may result in selection and substitution of healthy foods. In our sample, age (older vs. younger)

and having a family member with a medical condition or in the health care field also led to selection of what was perceived as healthy foods. These were not necessarily foods of Asian Indian origin. A medical/ health condition could therefore be a major determinant for the adoption of healthy dietary habits, regardless of preference for traditional or non-traditional foods (Chavez-Martinez et al., 2010).

The majority of our study participants mentioned that they gained health awareness in the U.S., which was reflected in their diet and eating habits. This notion was also conceived by Arabs of the Greater Toronto Area, and such a change was believed to occur mainly through increased awareness of health and nutrition (Abou El Hassan and Hekmat, 2012). However, contradicting results have also been documented in various cultures where poor dietary habits were adopted by individuals who relocated (Pan et al., 1999). Therefore, it appears that dietary acculturation could vary depending on the ethnic group chosen for investigation, or there may be other participant characteristics such as income, educational level or nutrition knowledge that may explain this difference between and within cultures. Similarly media was also perceived as a resource for the exposure to new foods as well as to learn about food and nutrition. Television was perceived as an important source of nutrition education/information that promoted healthy food consumption by our study participants as well as in another study conducted among Hispanics (Chavez-Martinez et al., 2010).

Sub-standard taste and increased cost of Asian Indian snacks/ restaurant foods

It was perceived that some of the foods sold at the Asian Indian specialty stores were expensive and lacked product/ nutritional information compared to the ones sold in the regular grocery

stores. Hence, they were concerned about the shelf life and taste of some of the products that might have been in the shelves beyond the expiration date. This was particularly mentioned for Asian Indian readymade snacks, which led to selection of non-Indian foods for snacks.

Distance and availability of ethnic products in local specialty ethnic stores could be a limiting factor for the consumption of traditional foods. In our study, participants who had a vehicle were able to go farther to a bigger city to purchase fresh or locally unavailable Asian Indian ingredients and foods. Therefore, as mentioned by some participants, alternative non-traditional foods were selected. Similarly, Hispanics in South Carolina perceived unavailability of specific ethnic foods as a barrier to traditional eating behaviors in the U.S. (Chavez-Martinez et al., 2010).

When dining out, some Asian Indians said they preferred to try new foods that were not commonly found in India. Restaurants were also chosen based on special offers, reviews and recommendations. Indian restaurants were not frequently sought after by many because participants had a tendency to compare the authenticity of the taste to that of the food offered in India or at home and were hence not completely satisfied. Asian Indians who were vegetarians mentioned that they had limited non-Indian dining options (salads, vegetarian sandwiches or cheese pizza most of the time), which resulted in initiation of meat consumption by some.

Traditional foods were considered to be expensive by some participants in our study. In a study among Hispanics, fresh fruits and vegetables were deemed expensive in the U.S. The same study also showed that it was a common practice during food purchasing to compare the prices of such

foods in the U.S. with that of their home country, however, comparing prices of foods decreased over a period of stay in the U.S. (Chavez-Martinez et al., 2010). Therefore, food purchasing based on cost may not necessarily be a barrier for non-native individuals who have the financial means and who have a longer duration of stay in the U.S.

Ability to cook Asian Indian foods, time constraints and convenience

Selection of non-Indian foods was more prevalent among those who did not have the time to cook at home or had limited ability to cook any kind of food. This was especially true for second generation Asian Indians who perceived that Indian foods take longer to cook. Similar to our study, cooking traditional foods was perceived to be time consuming, and hence a barrier for the frequent consumption of such foods by the Arab populations as well (Abou El Hassan and Hekmat, 2012). Moreover, many individuals who moved to the U.S. may not be aware of traditional cooking methods and hence lack the skills to prepare traditional foods (Chavez-Martinez et al., 2010).

Consistent with other studies, breakfast items had drastically changed from what participants typically consumed in India, while dinner consisted of predominantly Asian Indian foods (Mellin-Olsen and Wandel, 2005). The typical weekday and weekend dietary recall data showed an increased inclusion of non-Indian foods for breakfast, which were deemed convenient by most participants. Lunch and snacks included both Asian Indian and non-Indian items. It was evident that consumption of alcohol, meat, fish, soda, milk, fruits, and non-Indian foods increased in the U.S. while rice, spicy foods, sweets, and potato chips gradually decreased over time. In summary, according to the conceptual model of dietary acculturation, various factors within the

three domains (religious and cultural beliefs, psychosocial changes and changes in taste preferences, and environmental changes) influenced the dietary behavior of Asian Indians.

Strengths and limitations

Recruitment of subjects for the focus groups was facilitated by providing incentives for participation and through advertising via Asian Indian organizations. Two researchers coded qualitative focus group data independently and coding consensus was obtained to minimize bias. For the focus group discussions, the primary and the assistant moderators belonged to the same ethnicity and therefore participants were more comfortable and willing to disclose dietary and survey information. The fact that the primary and assistant moderators were Asian Indians also facilitated rapport with the participants during focus group discussions (Vatrapu and Perez-Quinones, 2006). Since the focus group participants were located in metropolitan/ suburban areas in Michigan, our sample was limited to one geographical region and hence may not be representative of the dietary behaviors of Asian Indians in the other regions in the U.S. However, a few participants had lived in the other states in the U.S. and recollected and compared their experiences to that of the current location. This provided some insight into potential regional variations.

Our sample consisted of a large proportion of individuals who were highly educated and had high annual household incomes, which could be attributed to the fact that most of the first generation Asian Indians were in the U.S. primarily for education or job opportunities. Hence, our sample may be reflective of the characteristics of a large proportion Asian Indians in the U.S (Whatley and Batalova, 2013). This is also evident in the U.S. census data, which depicts Asian

Indians to have high education and median incomes (U.S. Census Bureau, 2004) as well as a previous study, which included in-depth interviews with Asian Indian adults with type 2 diabetes in Michigan (Venkatesh et al., 2013, Venkatesh and Weatherspoon, 2013). In our study, only 5 participants were either second generation or relocated to the U.S. before age 3. Therefore, more participants in this category would have allowed us to better capture the perceptions of second generation Asian Indians in the U.S. and can be viewed a limitation.

Conclusion

This study documented the factors influencing dietary changes of Asian Indians in the U.S. The key facilitators that emerged from our data relative to dietary acculturation were: social independence, social network influences, increased health awareness, sub-standard taste and increased cost of Asian Indian snacks/ restaurant foods, and time constraints and convenience. Our study adds to the evidence that multiple factors may influence an individual's food choices, and that dietary acculturation can lead to both healthful and unhealthy eating patterns (Sobal and Bisogni, 2009).

II. Manuscript 2 (specific aim 2)

Reliability and validity of An Asian Indian Dietary Acculturation Measure (AIDAM)

Abstract

Background: Dietary acculturation (adopting the eating patterns/ practices of the host environment) of individuals who relocate to another country could be a risk factor for diet-related chronic diseases. A reliable and validated measure for the assessment of dietary acculturation may facilitate understanding if and how dietary acculturation is related to diet-related chronic diseases in various non-native populations.

Objective: Our objective was to determine the reliability and validity of an Asian Indian Dietary Acculturation Measure (AIDAM) for Asian Indian adults living in the U.S.

Methods: A cross-sectional web-survey was administered nationwide to 191 Asian Indian adults in the U.S. that consisted of the AIDAM, a food frequency consisting of Asian Indian (AI-FFQ) and non-Indian foods (NI-FFQ), and participant sociodemographic questions. Construct validity and reliability were examined through a polytomous Rasch model. The relationship between AIDAM and the AI-FFQ and the NI-FFQ scores were examined using correlations and linear regression analysis.

Results: Except for one item that was excluded due to misfit, 50 items were stable. The root mean square error was 0.08 for all the items and the item and person reliabilities were 0.98 and 0.88, respectively. AIDAM was positively related to NI-FFQ ($r=.265$) and negatively related to AI-FFQ ($r=.432$) based on correlations and linear regressions ($p<.001$).

Conclusion: Our analysis showed the AIDAM to be a reliable and valid measure of dietary acculturation when tested with Asian Indians in the U.S. This tool can be used by health

professionals to determine the level of dietary acculturation as well as diet quality implications and enhance the investigation of the potential association with risk for diet-related diseases.

Introduction

Asian Indians are the second largest Asian group in the U.S. and constitute nearly 1% (3.2 million) of the U.S. population (U.S. Census Bureau, 2012). Asian Indians in the U.S. are concentrated in California, New Jersey, Texas, New York, and Illinois, which are also areas with high concentrations of other immigrant/ non-native populations (Camarota, 2012, Whatley and Batalova, 2013). Dietary behaviors in such areas may be diverse with foods from different cultures. In addition, exposure to a new environment in general could also be associated with changes in types of foods that nonnative populations consume in a different environment when compared to their home country.

Dietary acculturation (the adaptation of the eating patterns/ practices to the host environment by individuals who move to a new cultural milieu) is hence highly likely (Satia-Abouta et al., 2002). However, the extent to which these changes may be beneficial or harmful from a health perspective is not conclusive. For example refined grains, high-fat dairy, and red meat increases the risk for type 2 diabetes and cardiovascular risk factors while whole grains, nuts/seeds, fruits and vegetables all have a protective effect (Nettleton et al., 2008, Stricker et al., 2013). Dietary acculturation of Asian Indians in the U.S. has been characterized by consumption of a diet high in fat, animal and saturated fat, cholesterol, convenience foods, alcohol, whole grain foods, fish, poultry, meat, salty snacks, and sugar/ sweets/desserts, while a diet low in saturated fat and fiber

was documented by another study (Balasubramanyam et al., 2008, Jonnalagadda and Diwan, 2002, Kulkarni, 2004).

Asian Indians are genetically prone to several diet-related diseases regardless of location of residence, which was also evident in the studies conducted with this target group in the U.S. (Bainey and Jugdutt, 2009, Enas et al., 2007). However, it is important not to disregard environmental risk factors, including dietary behaviors. Dietary risk factors for chronic diseases are low consumption of fruits, vegetables, nuts and seeds, foods high in omega 3 fatty acids, whole grains, foods rich in fiber, and consuming a diet high in sodium and processed meat (Lim et al., 2012).

A high prevalence of diet-related chronic diseases have been documented among Asian Indians in the U.S. such as type 2 diabetes (17.4% to 29%) and metabolic syndrome (26.9 to38.2%), which are risk factors for cardiovascular diseases (Kanaya et al., 2010, Misra et al., 2010b, Simmons et al., 1992, Venkataraman et al., 2004). Studies conducted in the U.S. have shown Asian Indians to be more likely to be affected with CVD and diabetes (odds ratio >2.0 vs. whites) than the general population (Enas et al., 1996, Kanaya et al., 2010, Lee et al., 2011, Mohanty et al., 2005, Oza-Frank et al., 2009, Rajpathak et al., 2010).

Diet related chronic diseases can increase medical expenditure and may result in poor quality of life, while consuming a diet consisting of healthy foods can prevent or delay the occurrence of such complications (Frazao, 1999).When investigating diet-related disease risk factors of non-native populations, dietary acculturation could therefore be an important avenue of interest to

many researchers. A culture specific measure for the assessment of dietary acculturation may be useful in explaining the extent to which dietary changes have occurred in non-native populations, as well as the quality. Research studies on dietary risk factors of migrants have not exclusively focused on dietary acculturation per se but included several other indicators of acculturation along with only one or two items on dietary behaviors.

More specifically, dietary acculturation measures referred to in the literature for Asian Indians were not comprehensive and the likely gap noted was the lack in attitudinal scales (Raj et al., 1999, Uusitalo et al., 2005, Varghese and Moore-Orr, 2002). In addition, the dietary acculturation scales developed for other cultures such as the Chinese, Japanese, and Koreans have culture specific foods, which were not deemed appropriate for Asian Indians (Bojanic and Xu, 2006, Kim et al., 2007, Lv and Cason, 2003, Pierce et al., 2007, Satia-Abouta et al., 2001, Sukalakamala and Brittin, 2006, Yang and Fox, 1979).

Therefore, we developed a culture specific tool called the "Asian Indian Dietary Acculturation Measure" (AIDAM) to assess the level of dietary acculturation of Asian Indians by conducting focus group discussions, soliciting experts input, and by reviewing relevant literature. The validity and reliability of any tool is critical to be able to accurately measure the underlying concept and for reproducibility. The objective of this study was to determine the reliability and validity of an Asian Indian Dietary Acculturation Measure (AIDAM) for use with Asian Indian adults in the U.S.

Methods

AIDAM was developed by conducting eight focus group discussions soliciting input from experts (Asian Indian registered dietitians and/or researchers in nutrition/acculturation and specialists in survey research and Rasch data analysis) and reviewing relevant literature (refer to chapter 4 - manuscript 1). In order to conduct reliability and validity testing of the AIDAM instrument, it was important to include a nationwide cross sectional sample of Asian Indian adults in the U.S. This was accomplished by conducting a web-based survey, administered through an independent organization with access to a variety of national databases of survey participants that can be prespecified to ensure appropriateness for study purposes.

The sample size for the web-survey was calculated for Rasch polytomous models that are employed for attitudinal rating scales. As for any other statistical analysis, a small sample size in Rasch analysis would yield less precise estimates, less powerful fit analysis, and less robust estimates. A sample size between 108 and 243 is recommended to have item calibrations that are stable with ±½ logit interval with a two tailed 99% confidence interval. For most purposes, the optimum sample size recommended to achieve this is 150 (Linacre, 1994). Anticipating missing responses, we targeted a sample of >200 to be able to have meaningful data from a larger sample. Therefore, we collected data from 225 Asian Indian adults in the U.S. Participants who did not complete all the items of the AIDAM were excluded resulting in a final sample consisted of 191 participants.

Recruitment of participants and administration of the web-survey was contracted through the Office of Survey Research (OSR) at Michigan State University via Qualtrics Research Suite, a

program designed to conduct web-based survey research (Qualtrics, 2009, Provo, Utah, USA. Version. 12,018). Qualtrics Research Suite used Research Now group, Inc (formerly known as E-Rewards, Inc, headquartered in Plano, Texas) for recruiting Asian Indians. Research Now is a recognized market research company that rewards participants for time spent taking market research surveys. A response rate of 16% was achieved (1408 emails sent and 225 participants completed the survey), and participants who completed the survey were allowed to redeem gift cards, program points, and partner products or services.

Interested and eligible participants (Asian Indians $\geq$ 18 years) were provided with a link, which provided access to an informed consent form for participation as well as the survey items, which were: (i) the AIDAM, (ii) a food frequency questionnaire that included Asian Indian and non-Indian foods, and (iii) sociodemographic questions such as information on participant age, gender, education level, employment status, duration of stay in the U.S., religion, marital status, annual household income from all sources, language mostly spoken at home, and residency in the U.S.

Asian Indian Dietary Acculturation Measure (AIDAM)

Instrument Development: The AIDAM was developed to measure the level of dietary acculturation of Asian Indian immigrants/ non-natives in conjunction with the influence of various underlying cultural, psychosocial and environmental factors on participant food choices. We explored the dietary patterns/practices of Asian Indians in the U.S. to be able to construct an instrument that specifically applies to this ethnicity by utilizing the following methods: (i) a thorough review of the literature on measures of Asian Indian dietary acculturation behaviors,

(ii) applying the conceptual model of dietary acculturation proposed by Satia-Abouta (Satia-Abouta et al., 2002) to define the domains of the dietary acculturation instrument, (iii) utilizing the themes generated from 8 focus group discussions with 30 Asian Indian adults, (iv) including recommendations from experts in nutrition/ dietetics of Asian Indian origin and experts in qualitative research, survey research and Rasch analytical approach, and (v) encompassing feedback from the target population by pilot testing the dietary acculturation items with 14 Asian Indian adults in Lansing, Michigan. This rigorous procedure resulted in 51 items on dietary acculturation.

(i) Literature review: The literature on dietary acculturation measures for Asian Indians showed that there was a gap in the literature related to attitudinal scales. Along with studies on Asian Indians as well as studies on other ethnic groups, data collection procedures, and the type of questionnaires used were examined to facilitate the process (Bojanic and Xu, 2006, Kim et al., 2007, Lv and Cason, 2003, Pierce et al., 2007, Raj et al., 1999, Satia-Abouta et al., 2001, Sukalakamala and Brittin, 2006, Uusitalo et al., 2005, Varghese and Moore-Orr, 2002, Yang and Fox, 1979).

(ii) Theoretical model: Based on the theoretical model on dietary acculturation, when exposed to a host culture, the socio-demographic and cultural factors along with psychosocial changes and changes in the taste preferences, food procurement and preparation may result in differing patterns of dietary intake (Satia-Abouta et al., 2002). Predetermined themes within these domains (psychosocial factors and taste preferences, environmental factors, and cultural factors)

were identified based on this model. Therefore, the themes included these domains, which were deemed crucial for comprehensive assessment.

(iii) Focus group discussions with Asian Indians: We conducted eight audio-taped focus group discussions (2-5 participants per group) with thirty Asian Indian adults in a Midwestern state in the US. The transcripts were independently analyzed by two researchers of Asian Indian origin to generate themes within the perceived factors influencing dietary acculturation based on the model proposed by Satia-Abouta (Satia-Abouta et al., 2002). The items represented the three domains (psychosocial factors and taste preferences, environmental factors, and cultural factors) and the eight underlying themes that were postulated as the influential factors of dietary acculturation behaviors: social network (9 items); health and nutrition (8 items); media (2 items); taste preferences (13 items); restaurants (3 items); food preparation (10 items); food purchasing (3 items); and religious and cultural beliefs (4 items) (details provided in chapter 4 - manuscript 2).

(iv) Expert reviews: Content validity, was established through expert reviews and pilot testing of the instrument. Ten professionals revised the instrument for comprehensiveness; appropriateness of the language used in the items, relevance to Asian Indians, and provided suggestions for instrument improvement. The experts were eight Asian Indians who are either registered dietitians and/or researchers in nutrition/acculturation and who were knowledgeable in Asian Indian food choices and dietary practices; a specialist in survey research who provided suggestions for question formulation and improvement of the readability of the instrument; and a professor with expertise in Rasch data analysis who reviewed the instrument items for data

analysis efficacy. Initially, there were 35 items in the AIDAM that was sent to the experts for reviewing, 16 items suggested by the experts were then added resulting in a total of 51 items.

(v) Pilot testing: The revised instrument was approved by the Michigan State University Institutional Review Board (MSU IRB) and was pilot tested with 12 Asian Indian adult participants (mean age: 34.42±9.9 years) who participated in the focus group study that we had previously conducted. The pilot survey was administered through Michigan State University Office for Survey Research who used Qualtrics Research Suite (Qualtrics, 2009, Provo, Utah, USA. Version. 12,018). Participants were contacted by email. A brief summary of the results of the focus group discussion in which they had participated was provided along with a link to the web-survey. Participation in the pilot test was entirely voluntary.

The pilot test results allowed the items that were frequently skipped or which appeared to be incorrectly interpreted to be examined or modified. Feedback on the length of the survey was also provided. Thus, the pilot test determined feasibility, the appropriateness of the language used in the items and the respondent burden. The only change that was made to the web-survey after the pilot testing was modification of the response categories of the food frequency questionnaire. The NHANES food frequency assessment categories were used to consolidate the food frequency response into five categories.

This rigorous instrument development procedure for the AIDAM resulted in 51 items on dietary acculturation. The items were in the form of statements and participants evaluated each statement and provided their level of agreement or disagreement on a five point Likert scale. The Flesh-

Kincaid readability score was 5.9 for the AIDAM and 8.3 for the entire web-survey, which indicates that the instrument was constructed with fifth to sixth U.S. grade reading level. The instrument measured the extent of dietary acculturation with traditional Asian Indian dietary practices to western/ non-Indian practices. Five Likert ordered response levels were used with the following format: (1) strongly agree; (2) agree; (3) neither agree nor disagree; (4) disagree; and (5) strongly disagree. Twenty three items that represented non-Indian dietary practices were reverse coded. Since dietary acculturation is not unidimensional, these items were included to represent non-Indian dietary practices; however, they were reverse coded to obtain a single dietary acculturation score. For the items with reverse coding, scores were assigned as strongly agree=5 to strongly disagree=1. The responses for all the items were added and divided by the number of items. The final scores also ranged from 1 to 5 with 1 indicating an Asian dietary pattern and 5, a western/non-Indian dietary pattern.

Food frequency questionnaire

A food frequency questionnaire was developed by the primary researcher consisting of Asian Indian and non-Indian foods (table 4). A food list was compiled based on the literature and from two 24 hour typical weekday and weekend dietary recall data that we collected from the focus group participants. The frequency of consumption of foods given in the food list was determined using a scale ranging from never =0, 1-11 times a year = 1, 1-3 times a month = 2, 1-6 times a week = 3, and every day = 4. Asian Indian (25 items) and non-Indian (25 items) foods in the food frequency questionnaire were identified and separated to compute Asian Indian (AI-FFQ) and non-Indian (NI-FFQ) scores that ranged from 0-100 (see table 4 for the list of Asian Indian and non-Indian items).

Table 4. List of Asian Indian and non-Indian foods in the Food Frequency Questionnaire

	Asian Indian	**Non-Indian**
1.	White rice	1. Brown rice
2.	Idly	2. Cous cous
3.	Vermicelli	3. Quinoa
4.	Dhokla	4. Pizza
5.	Handvo	5. Pasta/ spaghetti
6.	Dosa	6. Macaroni
7.	Sambar/ Dal	7. Chinese noodles
8.	Sabji	8. Tortillas/ tacos
9.	Paneer dishes	9. Non-Indian sandwiches
10.	Ethnic vegetables (e.g. drumstick, raw/ green banana, bitter gourd, etc.)	10. Non-Indian Salad
11.	Indian tea	11. Bacon
12.	Papad/ fryums	12. Roast beef
13.	Indian chutney	13. Hot dogs
14.	Indian pickles	14. Greek yogurt
15.	Indian mixed rice dishes (e.g. biryani, lemon rice, etc)	15. Flavored yogurt
16.	Indian rice and lentil dishes (e.g. Khichdi, pongal, bisibelabath, etc.)	16. Green tea
17.	Ready to eat Indian meals (e.g. swad, deep brands)	17. Cold breakfast cereals
18.	Indian bread (e.g. chapatti, naan, paratas, etc.)	18. Hot cereals (e.g. oatmeal)
19.	Indian style simple meat or vegetable curry	19. Pancakes/ waffles/ bagels
20.	Indian style stir fried vegetables	20. Breakfast cereal bar
21.	Indian style party foods (cream based/oily curries or foods)	21. Ready to eat non-Indian meals (e.g. lean cuisine, banquet, etc.)
22.	Indian fried foods (e.g. puri, vada, samosa, pakora, etc.)	22. Non-Indian bread (e.g. multigrain, rye, pita, rolls, crescents, corn bread, etc.)
23.	Indian fast foods (e.g. bhel puri, pani puri, etc.)	23. Non-Indian fast foods (e.g. french fries, burger, etc.)
24.	Indian sweets/ desserts (e.g. burfi, gulab jamun, kheer, etc.)	24. Non-Indian sweets/ desserts (e.g. Donut, pie, brownie, cookies, tart, etc.)
25.	Indian ready made salty snacks (e.g. mixture, chakli/ murukku)	25. Non-Indian readymade salty snacks (e.g. pretzels, tortilla chips, Chex-mix, etc.)

Scale range: never =0, 1-11 times a year = 1, 1-3 times a month = 2, 1-6 times a week = 3, and everyday = 4.

Scores were assigned for each category of the food frequency questions as follows: Everyday = 4, 1-6 times a week = 3, 1-3 times a month = 2, 1-11 times a year = 1, and never = 0. The scores were calculated based on participant responses by adding the number corresponding to each response category for each item in the food list. Thus, a higher score in the AI-FFQ or NI-FFQ categories indicated frequent selection of corresponding foods by the participants. The AI-FFQ or NI-FFQ scores were also used for external validation of the AIDAM by correlating with the AIDAM.

Data analysis

Responses to the items were examined for any missing information. Only responses with complete information for all the items of the AIDAM were included in the analysis. The distribution of all the variables was examined for normality. Construct validity and reliability was examined through a polytomous Rasch model using Winsteps software (Rasch measurement software version 3.74 Beaverton, Oregon). The Rasch model is based on item response theory and commonly used in psychometric analysis of survey data. The Rasch model was used to determine model fit because it postulates that several items are indirect measures of a single underlying attitude or trait (dietary acculturation behavior) that cannot be observed directly. This approach therefore provided information on how well the items on the instrument work to measure dietary acculturation. Based on this model, the probability of the response to a certain item on the instrument depends on the degree to which the person possesses the trait and the degree to which the test item measured the underlying trait, both on a linear continuum.

The Rasch model is based on the assumption that the data is unidimensional, the response of an individual for one item does not affect the responses to other items (local independence), monotonicity of the latent trait, and non-intersecting Item response functions (Iramaneerat et al., 2007). The rationale for using the Rasch model for this particular study is to create interval scores from the ordinal Likert scales, to eliminate items that do not fit the unidimensional construct, and to be able to calculate the total score even when some items are incomplete (however, in order to conduct and interpret regression analysis we eliminated missing responses for our study). These advantages of the Rasch model enable improved scoring and interpretation of the dietary acculturation measure.

The infit (inlier-sensitive fit) and outfit (outlier-sensitive fit) are fit statistics in the Rasch model, which are indicative of how accurately the data fits this model. The infit and outfit are examined using the mean square (MNSQ) and standardized fit statistics (z scores) (Linacre, 2002). A MNSQ value of 1.0 is considered ideal since values below 1.0 or above 1.0 are considered as either too predictable or unpredictable, respectively. An optimum MNSQ range of 0.5 – 1.5 is suggested by Linacre for Rasch measurement models (Linacre, 2002). Similarly, standardized fit statistics (z scores) are *t*-tests to confirm model fit. A negative value indicates that the data is too predictable while a positive value is indicative of a lack of predictability (Linacre, 2002).

Besides using multiple indicators of the same construct (dietary acculturation) in one survey, validity was also determined by using external survey data. Correlations between the dietary acculturation (AIDAM) score, the AI-FFQ and the NI-FFQ scores were examined to determine if there was an association between the two measures. Additionally, we conducted linear regression

analysis with the Rasch person score (an estimated dietary acculturation score for each person produced by the Rasch analysis) as the outcome and the AI-FFQ and NI-FFQ scores as predictors after controlling for sociodemographic variables.

Results

Sample Characteristics

Table 5 shows the sample characteristics. Of the 191 participants, about one-third of the participants were from California, New Jersey, Texas, and Illinois. Participants' age ranged from 21-89 with a mean and standard deviation of 43.46 and 14.7, respectively. The mean duration of stay in the U.S. was 19 years (standard deviation 13.8, range 2-62 years). There were nearly equal numbers of males and females. Three-fourths of the participants were Hindus with the remaining participants comprised of Muslims, Christians, Sikhs, Jains, Zoroastrians and atheists. About 60% of the sample had a master's degree or higher and 60% worked in a fulltime job.

More than two-thirds of the sample had an annual household income equal to or above $75,000 from all sources. Eighty percent of the participants were currently married and 40% spoke an Asian Indian language most of the time at home. About three fourths of the sample were either U.S. citizens or had acquired permanent residency. The AIDAM score of participants ranged from 1.52 – 4.18 (possible score range 1.0-5.0) with a mean score of 2.8 and standard deviation of 0.37. We did not see a significant difference in the AIDAM scores between males (mean: AIDAM 2.76$\pm$0.39) and females (mean: AIDAM 2.84$\pm$0.35). Out of a possible score between 0-100, participants had scored a mean of 50.12 (standard deviation 14.98) for the Indian FFQ and 37.91 (standard deviation 13.75) for the non-Indian FFQ items.

Table 5. Sample characteristics (n=191)

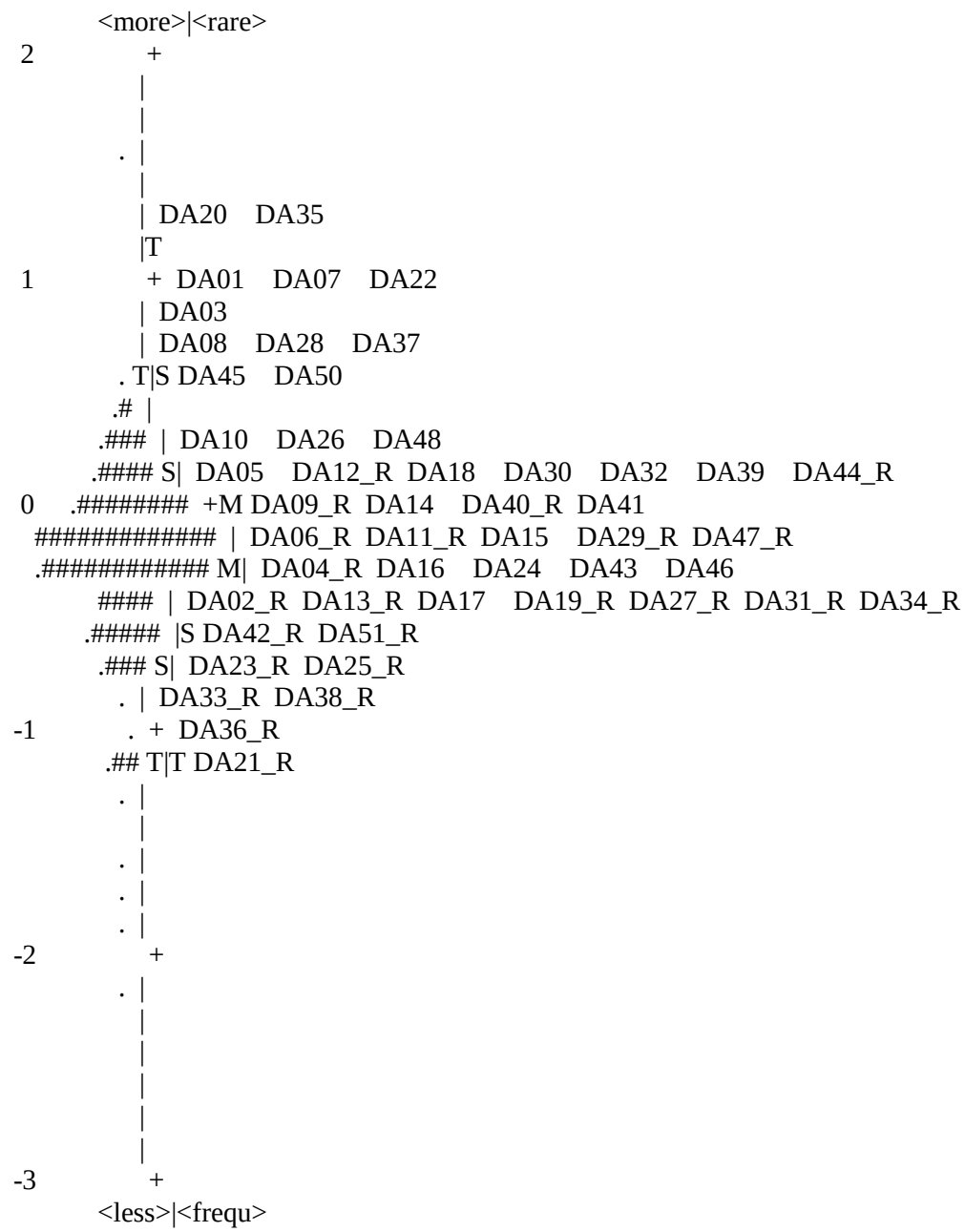
		Mean±SD; range
Age (years)		43.46±14.7 (21-89)
Duration of stay in the US		19.06±13.8 (2-62)
Rasch person measure of dietary acculturation trait		-0.27±0.45 (-2.08 – 1.51)
AIDAM score (50 items – possible score 1-5)		2.8±0.37 (1.52 – 4.18)
AI-FFQ score (25 items – possible score: 0-100)		50.12±14.98 (0-82)
NI-FFQ score (25 items – possible score: 0-100)		37.91±13.75 (0-75)
		n (%)
Gender	Male	92 (48.2)
	Female	99 (51.8)
Religion	Hindu	148 (77.5)
	Other (Muslim, Christian, Sikh, Jain, Zorastrian, Aethist)	43 (22.5)
Educational level	High school or bachelor's degree	78 (40.8)
	≥Masters	113 (59.2)
Employment	Employed full time	116 (60.7)
	Other (employed part time, home maker/ unemployed/ self-employed, retired, student)	75 (39.3)
Annual household income	<$75,000	61 (31.9)
	≥$75,000	127 (66.5)
Marital status	Currently married	153 (80.1)
	Other (single, divorced, widowed, dating, partnered)	38 (19.9)
Language spoken at home	Mostly Indian	78 (40.8)
	Indian and English equally	77 (40.3)
	Mostly English	36 (18.8)
Residency	US Citizens and permanent residents	145 (75.9)
	Work/student/ dependent visa	46 (24.1)

* 3 participants did not disclose income

AIDAM: Model fit, reliability and validity

The Rasch analysis determined the spread of item difficulty and person ability estimates for the AIDAM. In figure 3, the left side of the map shows participant data. Each # is equal to 3 participants and '.' is equal to 1 participant. Participants with a lower tendency to acculturate are located on the bottom of the map while those with an increased tendency are situated at the top.

Figure 3. Person/item map for the 50 item Asian Indian Dietary Acculturation Measure (AIDAM)



Items are denoted by DA followed by the item number on the right side. On the left the # denotes subjects, each # represents 3 subjects and '.' represents one subject. The items are placed based on their degree of difficulty to measure dietary acculturation and the persons are placed on their degree of ability to acculturate. Participants with lower tendency to acculturate are on the bottom of the map. Items with more difficulty are placed on the top and those that are easy are on the bottom. The scale is in logit units 2 to -3.

Similarly, the AIDAM items are depicted on the right side of the map with increasing order of difficulty from the bottom to top. Items at the bottom are easier to achieve while those at the top are difficult to achieve in terms of dietary acculturation. The scale is in logit units 2 to -3.

Tables 6 shows all the 50 items that comprise the AIDAM and the Rasch fit statistics for the individual items. The root mean square error over all the items is 0.08 and the item reliability is 0.98 (item separation=7.35) indicating stability of the item estimate. Person reliability is 0.88 (person separation=2.76). Where value of 2 is recommended for person separation; our sample showed a value greater than 2 indicating good reliability (Gothwal et al., 2009). The root mean square error over all the persons is 0.15.

Four items are out of the 5 – 1.5 MNSQ range. However, three of those items are within MNSQ 1.6, and hence considered as important for the instrument to be comprehensive. We excluded one item since the infit and outfit MNSQ are extremely out of range (*I strictly do not eat certain foods because they are not allowed in my religion* – infit MNSQ 1.82 and ZSTD 7.5; outfit MNSQ 1.93 and ZSTD 8.3). We repeated the analysis after excluding this item. The infit and outfit MNSQ of the other three items (items 39, 43, and 46 in table 6) are now within 1.61. Thus, a MNSQ range of 0.58 – 1.61 was used to finalize the AIDAM items.

Table 6: Descriptives and Rasch fit statistics of the Asian Indian Dietary Acculturation Measure (AIDAM) (n=191)

#	Items	Mean±sd	MNSQ infit (ZSTD)	MNSQ outfit (ZSTD)	Item Measure (SE)
1	I/or the people who I live with eat Indian foods often	1.91±0.92	0.89 (-1.1)	0.85 (-1.5)	1.06 (0.09)
2	I or the people who I live with eat non-Indian foods often	3.18±1.13	1.01 (0.1)	1.01 (0.1)	-0.42 (.08)
3	I present Indian foods to social gatherings or when I invite people	2.07±0.87	0.74 (-2.9)	0.72 (-3.1)	0.84 (.08)
4	I present non-Indian foods to social gatherings or when I invite people	3.02±0.97	0.74 (-3.1)	0.74 (-3.1)	-0.25(.08)
5	I prefer to eat Indian foods at my school/ workplace	2.66±1.09	0.90 (-1.2)	0.89 (-1.2)	0.14 (.08)
6	I prefer to eat non-Indian foods at my school/ workplace	2.98±1.06	0.83 (-1.9)	0.84 (-1.8)	-0.21 (.08)
7	I often eat Indian foods when I am with Indians	1.92±0.86	0.86 (-1.4)	0.86 (-1.4)	1.05 (.09)
8	I like to introduce Indian foods to non-Indians	2.17±0.92	1.08 (0.8)	1.45 (4.1)	0.71 (.08)
9	I changed my eating habits in the U.S. to eat like everyone else in the U.S.	2.83±1.07	0.92 (-0.9)	0.94 (-0.6)	-0.04 (.08)
10	I consider most of the Indian foods as healthy	2.49±0.99	0.96 (-0.5)	0.98 (-0.2)	0.33 (.08)
11	I consider most of the non-Indian foods as healthy	2.87±0.85	0.81 (-2.2)	0.85 (-1.8)	-0.08 (.08)
12	I do not eat the Indian type of diet on most of the days	2.63±1.02	0.82 (-2.1)	0.82 (-2.1)	0.17 (.08)
13	I eat healthier foods in the U.S. compared to the foods I would eat if I were in India	3.16±1.01	1.25 (2.6)	1.29 (2.8)	-0.40 (.08)
14	I eat the same size portions of food in the U.S. as I would typically eat if I were in India	2.80±1.02	1.10 (1.2)	1.27 (2.8)	0.00 (.08)
15	I eat the same amount of starchy foods in the U.S. as I would typically eat if I were in India	2.87±0.95	0.93 (-0.7)	1.08 (0.9)	-0.08 (.08)
16	I eat the same amount of sweet foods in the U.S. as I would typically eat if I were in India	3.11±0.96	1.16 (1.7)	1.27 (2.8)	-0.34 (.08)
17	I eat the same amount of oily/ fried foods in the U.S. as I would typically eat if I were in India	3.23±0.93	1.11 (1.2)	1.18 (1.9)	-0.48 (.08)
18	I try Indian foods that I see on the television and Internet	2.66±1.01	1.09 (1.0)	1.15 (1.6)	0.14 (.08)

Table 6 (cont'd).

#	Items	Mean±sd	MNSQ infit (ZSTD)	MNSQ outfit (ZSTD)	Item Measure
19	I try non-Indian foods that I see on the television and Internet	3.23±0.99	1.04 (0.5)	1.07 (0.8)	-0.48 (.08)
20	I enjoy eating Indian foods	1.78±0.74	0.78 (-2.2)	0.75 (-2.5)	1.26 (.09)
21	I enjoy eating non-Indian foods	3.80±0.92	0.96 (-0.4)	0.94 (-0.6)	-1.16 (.08)
22	I find Indian foods to be very filling and satisfying	1.92±0.76	0.72 (-3.0)	0.71 (-3.1)	1.04 (.09)
23	I find non-Indian foods to be very filling and satisfying	3.42±0.90	0.73 (-3.2)	0.73 (-3.2)	-0.69 (.08)
24	I prefer Indian foods for breakfast most of the time	3.01±1.19	1.19 (2.0)	1.20 (2.1)	-0.24 (.08)
25	I prefer non-Indian foods for breakfast most of the time	3.42±1.00	0.96 (-0.4)	0.96 (-0.4)	-0.69 (.08)
26	I prefer Indian foods for lunch most of the time	2.57±1.04	0.82 (-2.1)	0.82 (-2.0)	0.25 (.08)
27	I prefer non-Indian foods for lunch most of the time	3.14±0.86	0.58 (-5.5)	0.58 (-5.4)	-0.38 (.08)
28	I prefer Indian foods for dinner most of the time	2.22±0.94	0.74 (-3.1)	0.73 (-3.0)	0.65 (.08)
29	I prefer non-Indian foods for dinner most of the time	2.96±0.90	0.64 (-4.7)	0.64 (-4.6)	-0.18 (.08)
30	I prefer Indian foods for a snack most of the time	2.67±0.94	0.71 (-4.3)	0.74 (-3.2)	0.13 (.08)
31	I prefer non-Indian foods for a snack most of the time	3.19±0.83	0.66 (-3.9)	0.66 (-4.2)	-0.44 (.08)
32	I like to eat at Indian restaurants in the place where I live	2.62±1.04	1.03 (0.4)	1.04 (0.4)	0.19 (.07)
33	I like to eat at non-Indian restaurants in the place where I live	3.58±0.88	0.75 (-2.8)	0.73 (-3.0)	-0.89 (.08)
34	I eat out more often in the U.S. when compared to how I would eat in India	3.23±1.09	1.23 (2.4)	1.26 (2.6)	-0.47 (.08)
35	I/ or the people who I live with know how to cook Indian foods	1.81±0.85	0.93 (-0.6)	0.88 (-1.2)	1.22 (.09)
36	I/ or the people who I live with know how to cook non-Indian foods	3.69±0.96	0.99 (-0.1)	0.97 (-0.2)	-1.02(.08)
37	I/ or the people who I live with often find it easy to prepare Indian foods at home	2.13±1.00	0.97 (-0.2)	0.96 (-0.4)	0.76 (.08)
38	I/ or the people who I live with often find it easy to prepare non-Indian foods at home	3.57±0.94	0.92 (-0.9)	0.90 (-1.1)	-0.87 (.08)

Table 6 (cont'd).

#	Items	Mean±sd	MNSQ infit (ZSTD)	MNSQ outfit (ZSTD)	Item Measure
39	I/ or the people who I live with make Indian foods in large quantities and store them for later use	2.69±1.20	1.50 (4.9)	1.61 (5.8)	0.11 (.08)
40	I/ or the people who I live with make non-Indian foods in large quantities and store them for later use	2.76±1.08	1.26 (2.7)	1.29 (3.0)	0.03 (.08)
41	I often pick up Indian foods from stores/ restaurants when I/or the people who I live with do not have time to cook	2.84±1.15	1.31 (3.2)	1.33 (3.4)	-0.05 (.08)
42	I often pick up non-Indian foods from stores/ restaurants when I/or the people who I live with do not have time to cook	3.28±1.02	1.01 (0.2)	1.03 (0.3)	-0.54 (.08)
43	I have people who can make Indian foods for me when I/or the people who I live with do not have time to cook	3.10±1.21	1.61 (5.7)	1.61 (5.7)	-0.33 (.08)
44	I have people who can make non-Indian foods for me when I/or the people who I live with do not have time to cook	2.62±1.10	1.13 (1.4)	1.12 (1.3)	0.19 (.08)
45	I am able to get all the varieties of Indian foods/ produce in the store where I shop	2.32±1.07	1.17 (1.8)	1.17 (1.8)	0.53 (.08)
46	I often buy packaged and ready to make Indian foods	3.10±1.14	1.52 (5.0)	1.59 (5.5)	-0.33 (.08)
47	I often buy packaged and ready to make non-Indian foods	2.86±1.10	1.18 (1.9)	1.18 (2.0)	-0.08 (.08)
48	I practice all the food-related beliefs of my religion in the US	2.53±1.20	1.36 (3.7)	1.36 (3.6)	0.29 (.08)
49	I celebrate Indian festivals by eating specialty foods for the occasion	2.29±1.09	1.14 (1.5)	1.17 (1.7)	0.56 (.08)
50	I celebrate non-Indian festivals by eating specialty foods for the occasion	3.27±1.03	1.01 (0.1)	1.02 (0.2)	-0.52 (.08)

Correlation between AIDAM and AI-FFQ and NI-FFQ scores

AI-FFQ and NI-FFQ scores were correlated with the AIDAM scores. The dietary acculturation score was negatively correlated with the AI-FFQ food score ($r=-.432$, $p<.001$) and positively ($r=.265$, $p<.001$) associated with the NI-FFQ food score. Although the strength of the correlations was mediocre, since AIDAM measured Asian Indian food practices at the lower end and non-Indian food practices at the higher end, a negative correlation with AI-FFQ and a positive correlation with the NI-FFQ scores provide promising evidence for the validity of the dietary acculturation instrument.

Relationship of AIDAM with participant sociodemographic characteristics and AI-FFQ and NI-FFQ scores

Linear regression analysis was first conducted to examine the sociodemographic predictors of dietary acculturation in our sample with the Rasch person score as the outcome (table 7). The predictor variables were participant age, male gender (vs. females), duration in the U.S., English language spoken at home (vs. Asian Indian and bilingual), Hinduism (vs. other religions), currently married (vs. single, partnered, divorced, separated, and widowed), having a master's degree or higher (vs. high school or bachelor's degree), employed fulltime (vs. part-time, retired, student, and homemaker), annual household income from all sources $\geq$\$75,000 (vs. <\$75,000), and U.S. citizens or permanent residents. (vs. those with work, student or dependent visas).

Table 7. Sociodemographic predictors of dietary acculturation as measured by Asian Indian Dietary Acculturation Measure (AIDAM)

	Model 1 Sociodemographic predictors of dietary acculturation (n=188)			**Model 2 Sociodemographic predictors of dietary acculturation with Asian Indian and non-Indian FFQ scores (n=161)**			**Model 3 Sociodemographic predictors of dietary acculturation with NI-FFQ scores (n=168)**			**Model 4 Sociodemographic predictors of dietary acculturation with AI-FFQ scores (n=179)**		
	B	**SE**	**p**	**B**	**SE**	**p**	**B**	**SE**	**p**	**B**	**SE**	**p**
Constant	-.027	.146	.855	.058	.140	.681	-.319	.151	.036	.386	.168	.023
Age (years)	-.008	.003	.010	-.007	.003	.008	-.007	.003	.011	-.007	.003	.029
Males (vs. females)	-.044	.069	.523	-.015	.053	.770	-.009	.060	.879	-.062	.067	.361
Duration in the U.S. (years)	.009	.003	.011	.005	.003	.070	.009	.003	.003	.004	.004	.262
Mostly English or Indian and English equally spoken at home (vs. mostly Indian language)	.226	.065	.001	.124	.050	.015	.183	.057	.002	.205	.063	.001
Hindus (vs. others)	-.212	.076	.006	-.097	.059	.105	-.187	.066	.005	-.179	.076	.019
Currently married (vs. not married)	-.198	.080	.014	-.066	.062	.288	-.141	.070	.046	-.130	.078	.097
Education ≥Master's (vs. <master's degree)	-.010	.064	.878	-.032	.050	.514	.007	.057	.907	-.180	.062	.769
Employed fulltime (vs. others)	.023	.073	.753	-.004	.056	.938	.021	.064	.738	.007	.071	.924
Annual household income ≥$75,000 (vs. <$75,000)	.104	.071	.142	.143	.055	.010	.112	.063	.078	.108	.069	.118
U.S. citizens and permanent residents (vs. those with work, student, and dependent visas)	.107	.087	.220	.047	.068	.486	.026	.078	.736	.130	.084	.123
NI-FFQ score				.014	.002	<.001	.007	.002	<.001			
AI-FFQ score				-.014	.002	<.001				-.009	.002	<.001
Linear regression adjusted R^2		.19 (p =<.001)			.45 (p =<.001)			.23 (p =<.001)			.28 (p =<.001)	

Outcome: Rasch person measure, scale range: -0.27±0.45 (-2.08 – 1.51)
AI-FFQ (Asian Indian food frequency questions) and NI-FFQ (Non-Indian food frequency questions) scale range: 0-100

Model 1 with only the sociodemographic variables explained 19% of the variance in dietary acculturation ($p<.001$). The dietary acculturation score decreased as age of the participants increased ($b=-.008$, $p=.010$), if participants were Hindus compared to other religions ($b=-.212$, $p=.006$) or if participants were currently married compared to those who were not married (single, partnered, widowed or divorced) ($b=-.198$, $p=.014$). On the other hand dietary acculturation increased with increasing duration in the U.S. ($b=.009$, $p=.011$) or if participants spoke mostly English/an Asian Indian language and English equally compared to those who mostly spoke an Asian Indian language at home ($b=.226$, $p=.001$).

Controlling for the sociodemographic predictors, we added the AI-FFQ and the NI-FFQ scores in the model in an effort to perform additional external validation of the AIDAM. This model (model 2) explained 45% of the variance in the dietary acculturation score ($p<.001$). However since the AI-FFQ and NI-FFQ scores were significantly correlated ($r=0.470$, $p<.001$), we included NI-FFQ and AI-FFQ scores separately in models 3 and 4, respectively to omit collinearity. Model 3 with the NI-FFQ score alone explained 23% of variance in the Rasch person scores. Participant age ($b=-.007$, $p=.011$), duration in the U.S. ($b=.009$, $p=.003$), language spoken at home ($b=.183$, $p=.002$), religion ($b=-.187$, $p=.005$), and marital status ($b=-.141$, $p=.046$) remained significant predictors of dietary acculturation in model 2. In addition, the NI-FFQ score was positively associated ($.007$, $p<.001$) with the participant dietary acculturation score. Those who frequently consumed non-Indian foods were more likely to have higher dietary acculturation, which is what we would expect. These findings validate both the AIDAM as well as the food frequency measures that were used in this study.

Model 4 with the AI-FFQ score explained 28% of variance in the dietary acculturation score. Younger age (b=-.007, p=.029), speaking mostly English/an Asian Indian language and English equally compared to those who mostly spoke an Asian Indian language at home (b=.205, p=.001), and participants following other religions compared to Hindus (b=-.179, p=.019) were more likely to have higher dietary acculturation scores. AI-FFQ scores were negatively associated with higher acculturation (b=-.009, p=<.001), indicating reduced consumption of Asian Indian foods by those with higher acculturation, once again as we would expect.

Discussion

This study was conducted to validate the 50 item AIDAM, which was generated to assess the dietary acculturation of Asian Indians. Our analysis showed that the AIDAM is a reliable and valid measure of dietary acculturation when tested with a national sample of Asian Indians in the U.S. In addition, the Rasch model used to determine construct validity and person reliability of the instrument showed a good model fit with infit and outfit MNSQ statistics within the range of 0.58-0.61. We found the item estimates to be stable as indicated by the item statistics with a person reliability of 0.88.

As one would expect, the AIDAM score was positively correlated with the non-Indian FFQ score and negatively correlated with the Asian Indian FFQ score. The AI-FFQ and NI-FFQ scores were significantly associated with the Rasch person measure in the linear regression analysis, after controlling for sociodemographic variables. In a previous study on Korean Americans, low acculturation has been shown to be associated with traditional food consumption, while participants with high acculturation consumed foods available in the host country (Kim and

Chan, 2004). Therefore, correlating the AIDAM scores with the AI-FFQ and NI-FFQ and conducting linear regression analysis provided additional evidence to support the validity of the AIDAM in accurately capturing dietary acculturation behaviors.

Before we added the AI-FFQ and the NI-FFQ, the sociodemographic predictors that were significantly associated with dietary acculturation were participants' age, marital status, religion, duration of stay in the U.S., and language primarily spoken at home. Age, duration of stay in the host country, fluency in the host language, family composition have all been shown to influence dietary acculturation in the conceptual model of dietary acculturation (Satia-Abouta et al., 2002).

Some studies that focused specifically on dietary acculturation of Asian Indians support the notion of sociodemographic characteristics as important variables that contribute to dietary choices. For example, in a study among Punjabi Sikhs in Canada, older participants preferred Asian Indian foods while younger participants who were born in Canada preferred locally available foods that were common in the host environment (Chapman et al., 2011). One possible explanation is that most of the young people are second or third generation Asian Indians who were either born in the host country or relocated at a very young age. Therefore increased exposure to and consumption of non-Indian foods through peers and social networks might have been major influencing factors.

Similarly, the primary language spoken by non-native individuals is also a good indicator of acculturation in general as well as dietary acculturation as shown in several studies. One such study on Peurto Rican adults utilized a language based acculturation scale, by evaluating the use

of English in activities such as watching television, reading newspapers/books, listening to the radio, communicating with neighbors, friends, family and at work (Van Rompay et al., 2012). The study showed that those with lower language acculturation were more likely to consume traditional foods such as rice, beans, and starchy vegetables, which is consistent with our study findings (Van Rompay et al., 2012).

Married individuals in our study were less likely to have higher dietary acculturation than those who were single, partnered, separated or widowed. Married individuals with Asian Indian spouses might be more likely to consume traditional foods. Out of the 38 participants in the "other" category for marital status, 21 reported that they were single and had never been married (mean age: 30.95$\pm$7.3 years). Therefore, it is likely that part of their meals could be consumed outside home consisting of non-Indian foods. Married respondents were also more likely to follow a vegetarian diet in a national study among Asian Indians in the U.S. (Misra et al., 2010a). A study conducted in Canada showed that the consumption pattern was the same between men and women in Asian Indian households; however the types of foods consumed were different for parents and children (Varghese and Moore-Orr, 2002). This is likely the reason why marital status was no longer a significant predictor when AI-FFQ and NI-FFQ were added to the model. Therefore, family composition could be an additional determinant of the types of foods selected in versus outside the home.

The fact that longer duration in the U.S. was associated with greater dietary acculturation could have been linked to greater health awareness of non-native individuals resulting in the perception that traditional Asian Indian cuisine is not healthful as shown in a previous study (Venkatesh et

al., 2013). In a study among South Asians (from Bangladesh, India, Nepal, Pakistan and Sri Lanka) in Canada, improved health awareness through media, increased effort to purchase nutritious foods, and greater reading and understanding of nutritional labels was evident in 60% of the participants (Lesser et al., 2014). Longer duration in Canada was associated with increased stir fry/BBQ, baking/grilling, and microwaving by South Asian participants, which are not commonly practiced food preparation techniques in their home country and perceived as healthier (Lesser et al., 2014). More specifically, from a healthier food choice perspective, in a study among 73 Asian Indians in New York City Washington, a significant reduction in the consumption of ghee (clarified butter), yogurt, butter, and milk was observed among participants who had been in the U.S. for more than ten years when compared to ten years or less (Raj et al., 1999).

In our sample those who were Hindus were less likely to obtain a higher score for dietary acculturation. A study among Asian Indians in Canada showed the prevalence of vegetarianism to be significantly higher among Hindus than others (Varghese and Moore-Orr, 2002). In Hinduism, avoidance of beef/ all meat products is practiced with varying degrees of strictness (Eliasi and Dwyer, 2002, Prashantham, 2008). In our study nearly 92% of vegetarians were Hindus. Therefore more than half (52%) of the participants who were Hindus followed vegetarianism. The Asian Indian vegetarian diet predominantly consists of cereals, legumes, fruits, vegetables, and dairy (Koenig et al., 2012) and therefore they may have a tendency to select foods that fall within these categories.

Furthermore, from our qualitative focus group discussions with Asian Indians in a mid-western state, a few participants who were vegetarians expressed the limited availability of vegetarian foods outside their home, being a limitation to the frequency of dining out (refer to chapter 4 - manuscript 1). However, the practice of vegetarianism may be subject to change over a period of time. A study showed that as duration in Canada increased Asian Indian participants exhibited a shift from their traditional practice of vegetarianism (Varghese and Moore-Orr, 2002). Furthermore, among Asian Indians in the U.S. higher acculturation has been shown to be associated with a reduction in religiosity (Bharmal et al., 2013).

In the model with both the Ai-FFQ and NI-FFQ (model 2) higher income was a significant predictor of higher dietary acculturation. Higher income was interestingly associated with greater dietary acculturation scores in our sample. Higher income can increase the frequency of eating out due to a reduced cost constraint. A study among Asian (born in China, Taiwan, Hong Kong, Japan or Korea) adults who had stayed in the U.S. for at least three months, showed that when dining out, participants often selected foods that were not traditional items, commonly consumed in their home country (Pan et al., 1999). Thus higher income may have increased the likelihood of exposure and experimentation with new foods.

In our study, sociodemographic variables such as participant age, marital status, religion, duration in the U.S., and language primarily spoken at home were significant predictors of dietary acculturation, all of which have been postulated to influence the dietary acculturation process (Satia-Abouta et al., 2002). Moreover, our AIDAM tool, which measured traditional behaviors at the lower end and non-Indian dietary behaviors at the higher end was positively

associated with the NI-FFQ. These findings provide additional evidence for the validity exhibited in our Rasch analysis.

Strengths and limitations

Administration of the proposed instrument via a web-based platform allowed for a national sample and hence generalizability of the findings is enhanced. Since it was a web-based, it was cost efficient with ease of electronic transfer of data minimizing data entry. The survey was constructed in such a manner that the participants were prompted for missing information hence reducing missing data. The entire web-survey was constructed at eighth to ninth grade reading level (AIDAM constructed at fifth to sixth grade level) in the U.S. to minimize readability issues. The dietary acculturation instrument was designed with clear instructions, the scores of which can be calculated using simple software or even manually.

Respondents had to have access to a computer and basic computer knowledge in order to complete the survey, potentially excluding an important segment of the population. An alternative for future studies using this instrument could be a paper-based version for individuals who are not comfortable with computers. Screen readers can be provided if needed or a scribe may also be able to assist individuals with disabilities. Options for translation of the instrument for individuals who have difficulty in reading or interpreting the items in English would therefore also widen the scope of potential participants. There is also much diversity in the commonly spoken major Asian Indian languages, and for some with the least amount of acculturation, language could be a barrier.

Conclusion

This study was conducted to validate a tool for the assessment of dietary acculturation, which was shown to be a reliable and valid measure when tested with Asian Indian adults. The instrument has been designed such that it is practical with a low respondent burden. The instrument has value as a tool for use by nutrition researchers and/or health professionals interested in ascertaining if and how dietary changes could be linked to a health problem, especially, where there is a role for diet.

III. Manuscript 3 (specific aim 3)

The relationship between dietary acculturation and type 2 diabetes risk in a sample of Asian Indians in the U.S.

Abstract

Background: Type 2 diabetes one of several diet-related diseases that are higher in Asian Indians (17.4% - 29%) than the general population (8.4%) in the U.S. One potential risk factor is poor dietary quality, which may be associated with dietary acculturation.

Objective: To examine the relationship between dietary acculturation of Asian Indians in the U.S. and their future risk for type 2 diabetes.

Methods: A validated Asian Indian Dietary Acculturation Measure (AIDAM) and the Finnish Diabetes Risk Score (FINDRISC) were completed by 153 Asian Indians in the U.S. via a cross-sectional web-survey. The AIDAM score was dichotomized as Asian Indian-oriented (AIO) (AIDAM$\leq$2.8) and Non-Indian oriented (NIO) (AIDAM>2.8) using the AIDAM sample mean. Correlations and relative risk ratios were used to examine the association between AIDAM and FINDRISC.

Results: The mean and median AIDAM score for the sample was 2.8. AIO participants indulged in at least 30 minutes of physical activity per day (76.5% vs. 56.5% in NIO) and reported daily consumption of vegetables and fruits/berries (95.6% vs. 81.2% in NIO) compared to NIO participants. A significantly larger proportion of NIO participants (44.7%) had higher FINDRISC scores (scores 7-26) compared to the AIO group (27.9%) (p=.024), and also had increased relative predictive risk for type 2 diabetes (relative risk ratio=1.6).

Conclusion: Our study showed a positive association between dietary acculturation and diabetes risk among Asian Indians in the U.S. These findings highlight the importance of including dietary behaviors as well as dietary acculturation in non-native groups especially Asian Indians when investigating type 2 diabetes risk factors and treatment.

Introduction

Asian Indians constitute about 1% of the U.S. population with growing numbers (U.S. Census Bureau, 2012). Asian Indians in the U.S. have a high prevalence of diet-related disease in general, but especially type 2 diabetes (Balasubramanyam et al., 2008, Kanaya et al., 2010, Misra et al., 2010b, Rajpathak et al., 2010, Venkataraman et al., 2004, Wu et al., 2012). The rate (17.4% - 29%) was alarmingly higher than Native American adults (14.9%) (Harjo et al., 2011) and non-Hispanic blacks (13.1%), Mexican Americans (8.7%), and non-Hispanic whites (7.4%) based on data from the National Health and Nutrition Examination Survey (NHANES) 2005-2010 (Selvin et al., 2014).

Recent studies have shown the prevalence of diabetes among Asian Indians in the U.S. to range from 17.4% to as high as 29% (Balasubramanyam et al., 2008, Kanaya et al., 2010, Misra et al., 2010b, Rajpathak et al., 2010, Venkataraman et al., 2004, Wu et al., 2012). In addition 35% fall in the prediabetes stage (Kanaya et al., 2010, Misra et al., 2010b). Globally India has the highest number of individuals with diabetes (31.7 million in 2000), which is projected to more than double by 2030 (79.4 million by 2030) (Wild et al., 2004). Therefore risk for this disease in this vulnerable population is especially high.

Furthermore, in studies conducted in the U.S., Asian Indians had the highest odds of type 2 diabetes than the other ethnic groups compared. Asian Indians/ South Asians were two to six time more likely to have type 2 diabetes than whites, thrice as likely as Latinos, twice as likely as African Americans, and two to three times more likely than Chinese (Kanaya et al., 2010, Lee et al., 2011, Mohanty et al., 2005, Oza-Frank et al., 2009, Rajpathak et al., 2010).

Similar to the trends in U.S., a higher prevalence of type 2 diabetes than the host population has been documented among Asian Indians/ South Asians (individuals from India, Pakistan, Bangladesh, and Sri Lanka) in other countries such as the United Kingdom (11.0% in South Asians 11.0% vs. 8.0% in blacks and 3.5% in whites), Canada (6.2% in South Asians vs. 2.2% in Caucasians), Singapore (12.8% in Asian Indians vs. 6.0% in Chinese and 9.0% in Malays), Mauritius (12.8% in Asian Indians vs. 11.5% in Creoles), Fiji (11.9% in Asian Indians vs. 5.3% in Melanesians), Norway (20.9% in South Asians vs. 4.4% in Westerners), Trinidad (20.5% in Asian Indians vs. 12.5% in Africans), and South Africa (10.4% in Asian Indians vs. 3.6% in Africans) (Anand et al., 2000, Beckles et al., 1986, Dowse et al., 1990, Dreyer et al., 2009, Marine et al., 1969, Yeo et al., 2006, Zimmet et al., 1983). Furthermore, the prevalence of type 2 diabetes among Asian Indians who relocated to these countries is also higher than the diabetes prevalence in India (7.3% urban and 3.1% rural) (Mohan et al., 2008).

According to the American Diabetes Association, the following are deemed established risk factors for type 2 diabetes: obesity, sedentary lifestyle, race ethnicity (African American, Latino, Native American, Asian Americans and Pacific Islanders), first-degree relatives with diabetes, hypertension, impaired glucose tolerance/fasting glucose, abnormal lipid profiles, history of

gestational diabetes or delivery of macrosomic baby, polycystic ovary syndrome, hemoglobin A1c level>5.7, and other clinical conditions associated with insulin resistance such as acanthosis nigricans (American Diabetes Association, 2014). It is a widely accepted fact that lifestyle changes due to urbanization and westernization are important potentially influential factors for the rising prevalence of type 2 diabetes and other noncommunicable diseases among ethnic groups who also have increased genetic susceptibility to type 2 diabetes, such as Asian Indians (Misra and Khurana, 2011).

Similarly, adaptation to the host country's practices (acculturation) can also negatively influence lifestyle behaviors and subsequently increase the risk factors for diet related diseases (Huang et al., 1996, Kandula et al., 2008). However, this notion may not be applicable to individuals of all ethnic groups as retaining one's cultural practices has been also shown to be associated with greater risk for type 2 diabetes in studies among Arabs and Hispanics (Jaber et al., 2003, Mainous et al., 2006).

Most of these studies did not focus specifically on dietary acculturation (adaptation to host countries dietary practices). An important lifestyle factor that contributes to the development of type 2 diabetes is dietary behaviors (Hu, 2011). Social and economic factors could lead to shifts in dietary behaviors such as increased consumption of animal products, increased consumption of refined foods, and increased accessibility and affordability to high calorie foods not often previously consumed (Hu, 2011). In a study among 143 Asian Indian participants in Texas, more than half of the participants consumed a diet high in fat, saturated fat, cholesterol, and sugar/ sweets (Balasubramanyam et al., 2008). A diet rich in red meat, processed meat, French fries,

high-fat dairy products, refined grains, and sweets and desserts has been shown to be associated with type 2 diabetes risk, while increased consumption of vegetables, fruit, fish, poultry and whole grains tends to have a preventative effect (van Dam et al., 2002).

In the Finnish Diabetes Prevention Study, 522 overweight individuals with impaired glucose tolerance were randomly assigned into either an intervention group that received individualized counseling to reduce body weight, total fat, saturated fat, and to increase fiber and physical activity, or a control group that received general oral and written information about diet and physical activity at every visit. The intervention group achieved greater weight loss at the end of the first year, the average of which was four times more than the control group (intervention 4.2 kg vs control 0.8 kg). The cumulative incidence of diabetes after 4 years was 11% and 23% in the intervention and the control groups, respectively, which is a 58 percent reduced risk of diabetes due to the intervention (Lindström et al., 2003, Tuomilehto et al., 2001).

Type 2 diabetes also increases the cost burden since it has been shown to triple the medical cost compared to those without diabetes (Trogdon and Hylands, 2008). Screening and early detection is therefore imperative to capture high risk individuals and those with undiagnosed diabetes (Pratley, 2013). The National Institute for Health and Clinical Excellence (NICE) based in the United Kingdom, recommends diabetes risk scores as the first stage for diabetes risk identification, followed by the second stage, which is the clinical laboratory assessment (Chatterton et al., 2012). Diabetes risk scores may not provide a perfect estimate of the future risk for diabetes, however, they can serve as a good cost-effective prediction tool to take preventive measures (Noble et al., 2011).

The Finnish Diabetes Risk Score (FINDRISC) is a diabetes screening tool that predicts the risk of developing diabetes in 10 years (Lindström and Tuomilehto, 2003). The FINDRISC is based on anthropometric and lifestyle behaviors in addition to the symptoms exhibited and medical/family history of subjects (Lindström and Tuomilehto, 2003). The FINDRISC is a cost-effective and a globally used screener in community based studies used not only to predict the risk for diabetes but also for insulin resistance (Lindström and Tuomilehto, 2003, Schwarz et al., 2009b). This tool has especially been shown to be useful for those who can benefit from intensive lifestyle interventions for type 2 diabetes (Lindström et al., 2008). The screener has a sensitivity of 78-81% and specificity of 76-77% in the baseline and the validation cohorts (Lindström and Tuomilehto, 2003). Sensitivity and specificity of a screening tool are critical for the identification of true and false positives, respectively. A review of the available diabetes risk scores conducted by Schwarz et al. concluded that the FINDRISC is the most accurate diabetes risk prediction tool, which is widely used in primary prevention programs (Schwarz et al., 2009a).

The high prevalence of type 2 diabetes among Asian Indians in the U.S. and the likelihood of a possible shift in the dietary pattern upon relocation warrant investigation of the relation between the level of dietary acculturation and future diabetes risk in this target group. Therefore, we conducted a web-survey to collect data from a nationally representative sample of Asian Indians in the U.S. to examine the relationship between dietary acculturation and the future risk for type 2 diabetes in this target group. The majority of the studies conducted on Asian Indians in the U.S. is either confined to a specific region in the U.S. or are targeted to individuals who are from a

specific region in India. Our study targeted a nationally representative population in the U.S. who were from various regions in India.

Methods

Prior to study commencement Institutional Review Board approval was obtained from Michigan State University. A cross-sectional web survey was administered to a national sample of 225 Asian Indian adults in the U.S. through Michigan State University Office for Survey Research who used Qualtrics research suite, a program designed to conduct web-based survey research (Qualtrics, 2009, Provo, Utah, USA. Version. 12,018). Qualtrics Research Suite used Research Now group, Inc, a recognized market research company to recruit participants. A response rate of 16% was achieved (1408 emails sent and 225 participants completed the survey). Out of the 225 who completed the web-survey, 162 participants had all the information required to calculate a predictive diabetes risk score as well as a dietary acculturation score. Because we were interested in future risk for diabetes, information about known diagnosed diabetes was solicited. Those who indicated that they had the disease (n=9) were excluded. Therefore, we limited our analysis to a final sample of 153 participants. The web-survey consisted of an informed consent, participant sociodemographic information, the items of the Asian Indian Dietary Acculturation Measure (AIDAM), and the FINDRISC predictive diabetes risk score items.

Asian Indian Dietary Acculturation Measure (AIDAM)

The 50 item AIDAM used in this study is a tool that was specifically developed for the assessment of dietary acculturation of Asian Indians (refer to chapter 4 - manuscript 2). The AIDAM was based on the conceptual model of dietary acculturation proposed by Satia-About a

(Satia-Abouta et al., 2002) and was developed from the themes generated using eight focus group discussions with Asian Indian adults in a Midwestern state in the U.S. and a thorough review of literature on measures of acculturation/ dietary acculturation.

The AIDAM was revised by ten registered dietitians/experts in nutrition or survey research, pretested with 14 participants of Asian Indian origin, and validated with a national sample of 191 Asian Indian adults in the U.S. The item and person reliabilities obtained using the Rasch rating scale model were 0.98 and 0.88, respectively. The items measured eight underlying themes that may influence dietary acculturation behaviors, which are: social network (9 items); health and nutrition (8 items); media (2 item); taste preferences (12 items); restaurants (3 items); food preparation (10 items); food purchasing (3 items); and religious and cultural beliefs (3 items).

The AIDAM items are in the form of statements for which participants provided their level of agreement on a five point Likert scale (1=strongly agree…5=strongly disagree). Dietary acculturation is measured with traditional Asian Indian dietary practices at one end and western/ non-Indian practices on the other. The responses for all the items are added and divided by the number of items to get a final score ranging from 1 to 5, where 1 indicates Asian Indian dietary practices and 5 is indicative of non-Indian dietary practices.

The Finnish Diabetes Risk Score (FINDRISC)

The web-based survey requested information required to calculate total diabetes risk score of the participants. Information included participants' age, self-reported weight and height to calculate Body Mass Index, self-reported waist circumference, physical activity, consumption of fruits and

vegetables, history of antihypertensive medications, history of hyperglycemia, and presence of family members with type 1 or type 2 diabetes. The eight items of the screener have different scores contributing to the total risk score. The total diabetes risk scores could range from 0 to 26. Scores are broadly categorized into the following five categories: lower than 7 (low risk – 1 in 100 will develop the disease), 7-11 (slightly elevated risk – 1 in 25 will develop the disease), 12-14 (moderate risk – 1 in 6 will develop the disease), 15-20 (high risk – 1 in 3 will develop the disease), and higher than 20 (very high risk – 1 in 2 will develop the disease).

Data analysis

All statistical analysis was conducted using the Statistical Package for Social Sciences (SPSS) software (version 20.0, 2011, Chicago, Illinois, SPSS Inc.). After examining the descriptives, all the variables were deemed normal. AIDAM and FINDRISC scores, which are continuous variables, were correlated to examine the relationship in our sample. We dichotomized the AIDAM score as Asian Indian-oriented (AIO) (AIDAM$\leq$2.8) and Non-Indian oriented (NIO) (AIDAM>2.8). A cut point of 2.8 was chosen since it was both the mean and the median value for the 153 participants. Similarly FINDRISC scores were dichotomized as low risk (scores 0-6) and some risk (scores 7-26 - includes slightly elevated risk, moderate risk, high risk, and very high risk). Chi square analysis was used to compare participants' socio-demographic information and their predictive diabetes risk score between AIO and NIO participants. Relative risk ratio was used to examine the association between AIDAM and FINDRISC scores of participants.

Results

Table 8. Participant characteristics (n=153)

		AIO (n=68)	NIO (n=85)	p
Mean±SD				
Age (years)		41.82±12.9	41.89±14.9	.08
No. members in the household		2.91±1.3	2.79±1.3	.96
Duration in the U.S. (years)		15.21±12.4	20.94±14.0	.08
FINDRISC score		5.51±4.5	7.11±4.8	.04
N(%)				
Gender	Male	35 (51.5)	37 (43.5)	.21
	Female	33 (48.5)	48 (56.5)	
Language spoken at home	Mostly English	5 (7.4)	21 (24.7)	.004
	Indian and English Equally	28 (41.2)	38 (44.7)	
	Mostly Indian	35 (51.5)	26 (30.6)	
Religion	Hindu	59 (86.8)	62 (72.9)	.03
	[a]Other	9 (13.2)	23 (27.1)	
Marital status	Currently married	59 (86.8)	64 (75.3)	.06
	Currently not married	9 (13.2)	21 (24.7)	
Employment	Employed full time	43 (63.2)	52 (61.2)	.46
	[b]Other	25 (36.8)	33 (38.8)	
[c]Annual household income	<$75,000	18 (26.5)	28 (33.3)	.23
	≥$75,000	50 (73.5)	56 (66.7)	
Residency	Citizens and permanent residents	43 (63.2)	70 (82.4)	
	[d]Other	25 (36.8)	15 (17.6)	.01

AIO: Asian Indian Oriented (AIDAM≤2.8), NIO: Non-Indian Oriented (AIDAM>2.8)
[a]Other = Christian, Muslim, Jain, and Sikh
[b]Other=employed part time, homemaker, unemployed, retired, student, and self-employed
[c]One participant did not disclose income
[a]Other = work visa, student visa, and dependent visa

Sample characteristics

The sample characteristics of the 153 studied subjects are presented in Table 8. The sample included 72 men and 81 women between 21 and 80 years. The mean dietary acculturation score was 2.8±0.38 (range: 1.52 – 4.18). There were 68 and 85 participants in the AIO and NIO groups, respectively. Mean age of the participants was 42 in both the groups. The mean duration

in the U.S. was 15 years and 21 years in the AIO and NIO groups, respectively. Participants in the AIO group were more likely to speak an Indian Language at home most of the time (p=.004). The majority (n=123) of the participants were currently married of which fifty five participants had one or more children under 18 years. A significantly larger proportion of AIO participants were Hindus (86.8% vs. 72.9% in the NIO group) (p=.03). About two-thirds of the participants were employed full time and had an annual household income $\geq$\$75,000 from all sources. A significantly larger proportion (82.4%) of NIO individuals were U.S. citizens or had acquired permanent residency in the U.S. (p=.01). The mean FINDRISC scores were significantly lower for the AIO (mean 5.5±4.5) than the NIO group (mean 7.11$\pm$4.8) (p=.04).

Participants' FINDRISC scores

Table 9 shows the scores for the eight individual components of the FINDRISC that are compared between AIO and NIO participants. The FINDRISC scores ranged from 0-22 with a mean of 6.4±4.7 for the overall sample. More than one-third of the sample was overweight or obese. The prevalence of overweight/obesity was 48.6% in men and 34.5% in women. However, when taking into account the cut points for waist circumference, about two-thirds of participants in both the groups were in the lowest category (64.7% in AIO and 65.9% in NIO). Asian Indians in the AIO group were more likely to engage in at least 30 minutes of physical activity per day at work, and/or during leisure time than NIO group (56.5%) (p=.008). Similarly 95.6% of the AIO participants reported daily consumption of vegetables and fruits/berries compared to 81.2% in the NIO group (p=.006). However, the fact that there were only three participants in the AIO group who reported that they did not consume fruits and vegetables every day, is an important consideration when interpreting the findings.

Table 9. Finnish Diabetes Risk Score (FINDRISC) components by dietary acculturation level (n=153)

		AIO (n=68)	NIO (n=85)	Total (n=153)	p
Age	<45 years (0 point)	48 (70.6)	55 (64.7)	103 (67.3)	.81
	45-54 years (2 points)	7 (10.3)	12 (14.1)	19 (12.4)	
	55-64 years (3 points)	7 (10.3)	8 (9.4)	15 (9.8)	
	>64 years (4 points)	6 (8.8)	10 (11.8)	16 (10.5)	
Body Mass Index	<25 kg/m^2 (0 point)	43 (63.2)	47 (55.3)	90 (58.8)	.59
	25-30 kg/m^2 (1 point)	18 (26.5)	26 (30.6)	44 (28.8)	
	>30 kg/m^2 (3 points)	7 (10.3)	12 (14.1)	19 (12.4)	
Waist circumference	<94 cm (men); <80 cm (women) (0 point)	44 (64.7)	56 (65.9)	100 (65.4)	.72
	94-102 cm (men); 80-88 cm (women) (3 points)	14 (20.6)	20 (23.5)	34 (22.2)	
	>102 cm (men); >88 cm (women) (4 points)	10 (14.7)	9 (10.6)	19 (12.4)	
At least 30 minutes of physical activity/ day	Yes (0 point)	52 (76.5)	48 (56.5)	100 (65.4)	.008
	No (2 points)	16 (23.5)	37 (43.5)	53 (34.6)	
Frequency of consumption of vegetables, fruits or berries	Every day (0 point)	65 (95.6)	69 (81.2)	134 (87.6)	.006
	Not every day (1 point)	3 (4.4)	16 (18.8)	19 (12.4)	
Taken regular medications for high blood pressure	No (0 point)	58 (85.3)	70 (82.4)	128 (83.7)	.40
	Yes (2 points)	10 (14.7)	15 (17.6)	25 (16.3)	
Ever found to have high blood glucose	No (0 point)	64 (94.1)	74 (87.1)	138 (90.2)	.12
	Yes (5 points)	4 (5.9)	11 (12.9)	15 (9.8)	
Family/ relatives with diagnosed with diabetes	No (0 point)	38 (55.9)	42 (49.4)	80 (52.3)	.41
	Yes: grandparent, aunt, uncle or first cousin (3 points)	15 (22.1)	16 (18.8)	31 (20.3)	
	Yes: parent, brother, sister or own child (5 points)	15 (22.1)	27 (31.8)	42 (27.5)	
FINDRISC score	Low risk (scores 0-6)	49 (72.1)	47 (55.3)	96 (62.7)	.024
	Slightly elevated risk – very high risk (scores 7-26)	19 (27.9)	38 (44.7)	57 (37.3)	

Chi-square analysis

AIO: Asian Indian Oriented (AIDAM$\leq$2.8), NIO: Non-Indian Oriented (AIDAM>2.8)

Nearly 16% of the participants were taking medications for high blood pressure on a regular basis and about 10% denoted that they had a history of high blood glucose levels, either in a health examination, during an illness, or during pregnancy for females. About half of the sample had family members with diabetes, with 27.5% of the sample reporting an immediate family member such as a parent, sibling, or child. A significantly larger proportion of AIO participants (72% vs. 55% in NIO) had a low type 2 diabetes predictive risk score (p=.024). About one-fifth of the overall sample had slightly elevated risk and 16.3% had moderate to very high risk.

Relation between FINDRISC and AIDAM

We looked at the bivariate correlation between dietary acculturation score and FINDRISC diabetes risk score. Although a significant correlation was observed between the dietary acculturation score and the FINDRISC diabetes risk score, the strength of the correlation was not strong (r=.160; p=.048). However, on further analysis, the relative risk for type 2 diabetes was 1.6 times greater in the NIO group, which indicates a 60% increased disease risk in the NIO relative to AIO group (table 10).

Table 10. The association (relative risk) between Asian Indian Dietary Acculturation Measure (AIDAM) and Finnish Diabetes Risk Score (FINDRISC) (n = 153)

	RR	95% CI
NIO	1.600	1.021 to 2.507
AIO	0.767	0.603 to 0.977

AIO: Asian Indian Oriented (AIDAM≤2.8), NIO: Non-Indian Oriented (AIDAM>2.8)
FINDRISC scores: low risk 0-6, high risk 7-26
RR: relative risk, CI: confidence interval

Discussion

The goal was to examine the relationship between dietary acculturation of Asian Indians and their future risk for type 2 diabetes. A dietary acculturation tool (AIDAM) that was developed and validated using a national sample of Asian Indian adults was used (refer to chapter 4 - manuscript 2). In our sample, AIO individuals were more likely to be Hindu, speak in their native language at home, to engage in at least 30 minutes of physical activity daily, to consume vegetables and fruits/berries daily, and have lower FINDRISC scores. On the other hand, NIO participants were more likely to be U.S. Citizens or permanent residents. Our study showed that a larger proportion of NIO participants had an increased risk for type 2 diabetes. Furthermore, the relative risk for developing type 2 diabetes was greater for NIO than AIO participants. Therefore increased dietary acculturation appeared to be a risk factor for developing type 2 diabetes in the future.

Although our sample did not show a very high prevalence of hypertension and high blood glucose concentration, other studies have shown these risk factors to be high among Asian Indians in the U.S. (Baweja et al., 2004, Kanaya et al., 2010, Misra et al., 2010b, Venkataraman et al., 2004). In a study among patients with prediabetes, participants with hypertension were more likely to progress to type 2 diabetes in less than a year, which was associated with increased health care utilization and associated cost (Francis et al., 2011).

Similarly, family history of diabetes is a major risk factor in the Asian Indian ethnic group as it has been shown to be an independent predictor of type 2 diabetes. Among Asian Indians in the U.S., nearly one in two members with type 2 diabetes have a family member affected by the

disease (Venkataraman et al., 2004). This association was supported in our findings given that half of our sample had a family member with diagnosed type 2 diabetes. We also found that a larger proportion of participants who had a family member with diabetes were also in the high risk category for FINDRISC, which was significantly higher if it was an immediate family member (71.4% vs. 16.2% if none in the family had diabetes) ($p<.01$). Besides the genetic risk factors of Asian Indians for type 2 diabetes, the modifiable risk factors such as dietary intake and physical activity should not be ignored, and should definitely include dietary acculturation. Dietary behaviors have been shown to contribute to the development of type 2 diabetes, more specifically consuming a diet rich in red meat, processed meat, high-fat dairy products, refined grains, and sweets (van Dam et al., 2002).

The two components of the FINDRISC that were significantly different between AIO and NIO groups were physical activity and fruit and vegetable consumption on a daily basis. In our sample, consumption of fruit and vegetables on a daily basis was reported by 95% and 81% of the participants in the AIO and NIO groups, respectively. It is encouraging to note that the majority of participants in both the groups consumed fruits and vegetables every day. However, the prevalence of fruit and vegetable consumption was higher among AIO participants. One possible reason for this difference could be the presence of a significantly larger proportion of Hindus in the AIO group.

In some or many cases, Hindus practice vegetarianism, which includes consumption of a plant-based diet that predominantly consists of fruits, vegetables, legumes and dairy products (Koenig et al., 2012). In our study 79% of participants who were vegetarians were Hindus. The Asian

Indian vegetarian diet may include foods that are cereals, legumes, fruits, vegetables, and dairy (Gadgil et al., 2014). Consumption of a diet high in fruits and vegetables has been shown to be protective of type 2 diabetes, and therefore adequacy of fruit and vegetable intake should be a strong consideration for this target group (van Dam et al., 2002). Along with genetic susceptibility to type 2 diabetes, behavioral risk factors such as a poor diet and physical inactivity are equally important. Therefore positive dietary behavioral changes should be emphasized more in research and practice settings (Bhopal, 2013, Mozaffarian et al., 2008).

In addition to fruit and vegetable consumption, the physical activity component of the FINDRISC was also significantly different between the two AIDAM groups. The proportion of participants who engaged in regular physical activity for at least 30 minutes a day at work, and/or during leisure time was significantly higher among those in the AIO than NIO group. Our data was supported by the fact that it has been shown that acculturation to the mainstream culture could impact physical activity levels of individuals both positively and negatively (Chavez-Martinez et al., 2010, Daniel and Wilbur, 2011).

Although about two-thirds of our study sample reported at least 30 minutes of daily physical activity, a few studies conducted with Asian Indians in the U.S. have documented low levels of physical activity in this target group (Misra et al., 2005, Balasubramanyam et al., 2008). Furthermore, Asian Indians were less likely to engage in moderate/ vigorous physical activity compared to non-Hispanic whites in the California Men's Health Cohort Study (Ghai et al., 2012). In a study conducted among 56 Asian Indians in the Bay area, a higher prevalence of metabolic syndrome was documented among those with lower physical activity (Misra et al.,

2005). It is therefore suggested that Asian Indians should engage in physical activity as a preventive measure (Misra and Khurana, 2011).

Strengths and limitations

The indicators used in the FINDRISC tool have been shown to be a good predictor of type 2 diabetes among Asian Indians (Das et al., 2012). These indicators could also be used for the risk prediction of other conditions such as metabolic syndrome and cardiovascular disease because these conditions share similar risk factors such as age, gender, body mass index, waist circumference, hypertension, and high blood glucose concentration. Therefore administration of this single tool can be utilized for the risk prediction of a cluster of metabolic disorders. The high sensitivity and specificity of the FINDRISC screener demonstrates its ability to capture individuals who are truly at risk for diabetes and the exclusion of low-risk individuals.

For the calculation of FINDRISC scores, participants provided a self-report of their height, weight, and waist circumference. Self-reported measures may not be as accurate as measured by researchers trained in anthropometric measures. Moreover, estimates of Body Mass Index obtained through self-reported measures could potentially be lower than that calculated from measured height and weight. This could be due to participants underestimating or overestimating their weight and height, respectively (Gorber et al., 2007). Therefore, it could be possible that the participants' BMI may have been higher if measured heights and weights were used for the calculation. Our study also requested self-reported fruit and vegetable intake. It is possible that over-reporting could be a factor. In the California Men's Health Study Cohort, only one-third of the Asian Indian participants consumed five servings of fruits and vegetables per day (Ghai et

al., 2012). Therefore, these limitations should be a consideration when interpreting the findings of this study.

In our study a large proportion of the sample had lower predictive risk for type 2 diabetes. Although we calculated a predictive risk score, which is indicative of the risk for development of type 2 diabetes in ten years, we expected the risk estimates to be consistent with type 2 diabetes prevalence rates. A high prevalence of type 2 diabetes has been documented among Asian Indians in the U.S. (17-29%) (Misra et al., 2010b, Kanaya et al., 2010, Venkataraman et al., 2004). Asian Indians have strong genetic and other risk factors, not necessarily captured comprehensively in FINDRISC. We had a relatively young sample (mean age 40 years), which could have impacted our findings. The mean age of Asian Indians in most of the other studies that investigated type 2 diabetes prevalence in the U.S. was over 50 years, which is a relatively higher age group than our study (Balasubramanyam et al., 2008, Kanaya et al., 2010, Misra et al., 2010b, Rajpathak et al., 2010, Venkataraman et al., 2004, Wu et al., 2012). In addition, weighting of the risk factors in FINDRISC might be variable in different cultures. It is plausible that although FINDRISC has merit in large community based studies, our findings may have differed if used in conjunction with objective assessments in this vulnerable target group.

Conclusion

In our study higher dietary acculturation was associated with increased FINDRISC scores, which is indicative of increased risk for type 2 diabetes in ten years. Furthermore, participants with lower dietary acculturation were more likely to consume vegetables and fruits/berries and engage in at least thirty minutes of physical activity on a daily basis. Health professionals could use this

information to advise Asian Indian individuals on preventive measures based on their current risk factors and to educate them about healthy lifestyle behaviors.

CHAPTER 5 - SUMMARY

I. Main findings

One primary area by which health status of those who move to another country is impacted is nutrition. A major consideration is obtaining information about dietary changes, the quality of the research instrument and its fit for the target population. The goal of this project was to develop a culturally appropriate dietary change measurement instrument for use with Asian Indians in the U.S. and potentially other countries to which Asian Indians relocate. The qualitative findings from our focus group discussions provided important information relevant to dietary changes of Asian Indians who relocate to the U.S. These factors collectively influenced food selection and dining behaviors, and were linked to improved health awareness as well as determining if, why and how non-Indian foods were included in the diet. These findings were utilized for the development and validation of an Asian Indian dietary acculturation instrument.

The major outcome of this study was a quantitative measure of dietary acculturation that was tested and determined to be reliable and valid for use with Asian Indians. Acculturation is an underlying latent trait (unobservable) and hence attitudinal rating scales are appropriate measures that can be employed (Yates, 2005). The psychometric analysis of the instrument showed that the survey measure is practical to use, has the ability to produce reproducible results and accurately measure the underlying construct (validity) when administered to the target population (item and person reliabilities were 0.98 and 0.88, respectively).

Although cultural sensitivity of the instrument is the main focus, the instrument can also be a common standardized measurement tool that can be used for comparisons with Asian Indians in

India or adapted for other ethnic groups. Comparison of the dietary acculturation score with participants' diabetes risk score showed that adaptation of host country's dietary practices by Asian Indians may increase the likelihood of developing type 2 diabetes.

There are a limited number of reliable instruments for the evaluation of nutrition interventions, that measure dietary acculturation behaviors specific for this population (Varghese and Moore-Orr, 2002, Raj et al., 1999). This research was timely because such instruments are critically needed in order to adequately assess dietary habits by integrating cultural preferences and for developing and implementing strategies that promote the nutritional health of Asian Indians to decrease the risk of diet-related chronic diseases.

The dietary acculturation instrument developed and validated in this study can be used in many settings to improve the understanding of nutrition/health professionals about Asian Indian food choices and preferences. Specifically, the use of this measure will allow health care/ nutrition professionals to evaluate the dietary changes that Asian Indians may undergo in conjunction with a change in the living environment. This measure will aid in the creation of new or tailoring of existing intervention strategies to promote healthy dietary practices among Asian Indians and to identify potential trends in the dietary patterns that could be used in supporting the establishment of healthy dietary behaviors within Asian Indians.

Researchers should be aware of the regional differences in the dietary behaviors within India. A study conducted in India showed that the cardiovascular mortality rate in India was correlated with dietary intake in addition to the several genetic risk factors (Gupta et al., 2006). The overall

prevalence of overweight/ obesity (body mass index >25 kg/m^2) was 12.7% with the highest rates in Delhi and Punjab (>30%). This study showed huge variations in the types of foods consumed and the nutrient composition of the diet among individuals in different states in India (Gupta et al., 2006). Another study compared dietary intake of individuals from Delhi, Trivandrum, and Mumbai, three cities in the north, south, and western regions in India, respectively. The study showed that the primary and the secondary food patterns in Delhi were "fruit-dairy" and "vegetable-pulses"; in Trivandrum was "pulses-rice" and "sweets-snacks"; and in Mumbai was "fruit-vegetables" and "snacks-meat" (Daniel et al., 2011). Thus, this could be a built-in limitation for studies investigating dietary behaviors/ patterns of Asian Indians collectively from different regions.

Furthermore, it is important not to disregard the rapid westernization of the Asian Indian diet in India due to lifestyle changes. Hence some of the shift in the diet that is observed among Asian Indians in other countries could also happen among Asian Indians in India (Hu, 2011). Dietary acculturation patterns among non-native individuals could therefore be a temporal topic since the diets are constantly changing in both the native country as well as the host country. These facts are key considerations when designing, implementing, and interpreting dietary acculturation studies.

II. Future Directions

Collectively, the findings related to the specific aims of this research will make a significant contribution to the literature by adding a validated dietary acculturation assessment tool and by documenting factors associated with dietary acculturation from the perception of Asian Indians.

These findings will inform health professionals about Asian Indian food practices and will provide a measure of the degree of dietary acculturation of Asian Indians.

Based on this work, a culturally competent intervention program targeted to Asian Indians can be designed and tested to promote healthy nutrition in this population. When providing dietary counseling for Asian Indians, health professionals should be aware of the cultural complexities, dietary concerns, and trends in the Asian Indian diet and provide individualized care. Such awareness can be achieved by the information obtained through our focus group study and using a measure of dietary acculturation that is specific for Asian Indians. The dietary acculturation instrument developed through this research can be administered as a web-based tool, and used for large scale population-based studies and has the capacity to calculate scores using simple software or even manually. This measure will allow future studies to compare and contrast risk factors for chronic diseases based on degree of dietary acculturation of Asian Indians to host country's dietary practices, which would further clarify the role of dietary acculturation in the prevalence of diet-related chronic diseases among Asian Indians.

III. Innovation

Traditional approaches to dealing with diet-related chronic diseases have focused on examination of the association between the diet quality and the health outcome of interest. These methods have however failed to capture the changes in the dietary behavior that occur as a result of a change in the host environment. General acculturation measures that determine adaptation to a new environment are also not comprehensive enough to evaluate the dietary change effects, which might have health implications.

This project is innovative because it combined the extent of adaptation to the host country and the cultural, environmental, and psychosocial influences on dietary behaviors into a single quantitative measure for dietary assessment in the Asian Indian population. Determination of the initial psychometric properties of the instrument using the target population ensures reliable and valid results when administered by future studies on Asian Indian population. The instrument could be used in interventions aimed at reducing the severity and high prevalence of type 2 diabetes and other diet-related chronic diseases and subsequently improve the quality of life in this population, which could produce savings in the cost of medical expenses.

APPENDICES

Appendix 1 - IRB approval

MICHIGAN STATE UNIVERSITY

Initial IRB Application Determination *Exempt*

January 31, 2011

To: Lorraine Weatherspoon
334 Trout FSHN Bldg
MSU

Re: **IRB# x11-049** Category: EXEMPT 2
Approval Date: January 28, 2011

Title: Assessment of Dietary Acculturation of Asian Indians: Instrument Development and Validation

The Institutional Review Board has completed their review of your project. I am pleased to advise you that **your project has been deemed as exempt** in accordance with federal regulations.

The IRB has found that your research project meets the criteria for exempt status and the criteria for the protection of human subjects in exempt research. **Under our exempt policy the Principal Investigator assumes the responsibilities for the protection of human subjects** in this project as outlined in the assurance letter and exempt educational material. The IRB office has received your signed assurance for exempt research. A copy of this signed agreement is appended for your information and records.

Renewals: Exempt protocols do not need to be renewed. If the project is completed, please submit an ***Application for Permanent Closure***.

Revisions: Exempt protocols do not require revisions. However, if changes are made to a protocol that may no longer meet the exempt criteria, a new initial application will be required.

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 and change the category of review, notify the IRB office promptly. Any complaints from participants regarding the risk and benefits of the project must be reported to the IRB.

Follow-up: If your exempt project is not completed and closed after three years, the IRB office will contact you regarding the status of the project and to verify that no changes have occurred that may affect exempt status.

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

Ashir Kumar, M.D.
BIRB Chair

c: Sumathi Venkatesh

)ffice of Regulatory Affairs
Human Research Protection Programs

Biomedical & Health Institutional Review Board (BIRB)

Community Research Institutional Review Board (CRIRB)

Social Science Behavioral/Education Institutional Review Board (SIRB)

207 Olds Hall
East Lansing, MI 48824
(517) 355-2180
Fax: (517) 432-4503
Email: irb@msu.edu
ww.humanresearch.msu.edu

Appendix 2 - Research flyer

Figure 4. Research flyer for focus group recruitment

Appendix 3 - Research participant informed consent form (A)

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:	Assessment of Dietary Acculturation of Asian Indians: Instrument Development and Validation
Researchers and Titles:	Lorraine Weatherspoon PhD, RD Associate Professor in Human Nutrition and Director, Didactic Program in Dietetics Sumathi Venkatesh M.S. Doctoral Student in Human Nutrition
Department and Institution:	Department of Food Science and Human Nutrition Michigan State University
Contact Information for L. Weatherspoon:	334 GM Trout Food Science Building Michigan State University, East Lansing Michigan 48824-1224 Tel: 517-355-8474 ext 136 Email: weathe43@msu.edu

PURPOSE OF RESEARCH:
You are being asked to participate in a research study that will help us understand the dietary patterns, food procurement, and food preparation of Asian Indian immigrants to the United States. You have been selected as a possible participant in this study because you contacted the researcher and indicated interest in participation in this research project. The investigators hope to learn how living in the United States of America and other factors are related to the dietary patterns of Asian Indian adults. Your participation in this entire study will take about 2 to 2.5 hours.

WHAT YOU WILL DO:
This study consists of three parts. First, you will complete a few general survey questions. This part will take about 10 minutes. The second part will consist of an audio-recorded group discussion with 6 to 8 other Asian Indian participants, lasting about an hour. We will ask questions about how living in the United States of America has influenced your dietary intake, food purchasing and food preparation methods. This interview will include questions, which will help us to better understand how living in the United States has influenced your eating habits. Thirdly, we will also need to call you on a different occasion later in the week agreed upon with you, if you do not mind giving us your phone number, to ask you questions about the typical foods that you eat for a 24-hr period during the week and weekend. This will take another 20 minutes, which will 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 your dietary habits in the United States. It may also benefit you indirectly and Indians in the United States of America by enabling the health care professional to understand about the special considerations for helping Indians, especially those with diet-related chronic diseases 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 focus groups will be conducted in a convenient place for you and the other participants. All data will only have identification numbers with no personal identifiers. Log sheets and data will be kept in separate locked filing cabinets. However, complete confidentiality of the information that you provided cannot be guaranteed because participants in the group discussion with you may share what was said in the group with others outside the focus group discussion. 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 focus group section is very important. So, if you do not want the discussions 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 three steps listed above, you will not be eligible for the $20 gift card.

COSTS AND COMPENSATION FOR BEING IN THE STUDY:
There are no costs associated with participation in this study. Upon completion of the general survey questions, the focus group discussion and the two 24 hr food recalls, you will receive a $20 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 and
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

DOCUMENTATION OF INFORMED CONSENT
Your signature below means that you voluntarily agree to participate in this research study and agree to audio-tape the focus group discussion.

Printed name of the Participant: _____

_____ _____
Signature Date

Appendix 4 - Sociodemographic survey

Participant ID _____ Date of Interview_____

1) Age _____

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

6) 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) _____

7) Marital status
   - ☐ Single
   - ☐ Married
   - ☐ Widowed
   - ☐ Separated/Divorced
   - ☐ Other (specify)_____

8) With whom do you live? (check all that apply)
   - ☐ Alone
   - ☐ With friends
   - ☐ With spouse
   - ☐ With children
   - ☐ With parents
   - ☐ Other (specify) _____

9) No. of members in Household_____
   - ☐ Adults_____
   - ☐ Children (<18 years) _____

10) What language do you speak at home?
   - ☐ Mostly Indian
   - ☐ Mostly English
   - ☐ Indian and English equally
   - ☐ Other (specify) _____

11) How would you describe the place in India where you spent the majority of your time before relocating to the U.S.?
   - ☐ Big City
   - ☐ Small City
   - ☐ Small Town
   - ☐ Village

12) At which age did you move to the U.S.? _____

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

14) Have you lived in a country other than US? If yes, specify country _____for how many years? _____

Appendix 5 - Focus group questions

1. What are some of your favorite foods? *Probe: They could be Asian Indian, western, or other ethnic foods*. Why are they your favorites?

2. What are some new foods that you started eating after coming to the U.S.? *Probe: Why?*

3. After coming to the U.S., how have you made any changes to the types, amount and/or the number of times you eat meals?

4. How do you choose the foods that you want to eat on a certain day? *Probe: Who does the cooking at home? How do you think the internet, TV, radio, or magazines here affect what you buy or eat?*

5. What are some changes that you made in your eating habits to suit the needs of your family? *Probe: e.g. elderly with medical conditions, school going children, etc.*

6. How do you decide what places to go out and eat? What are the types of foods that you eat in restaurants?

7. What are some Indian foods that you wish you could get here in the U.S.? How do you make up for those items?

8. What are your preferences for snack foods that you buy?

9. When you go grocery shopping for foods, how do you decide what you want to buy?

10. What are some typical dishes that are cooked at home or purchased from the store when you invite your American friends? *Probe: How is this different when you invite your Indian friends?*

11. What do you typically contribute when you attend potluck social gatherings? *Probe: How does it vary between Indian and American social gatherings?*

12. How are the foods that you eat outside your home different from what you eat at home? *Probe: e.g. workplace, school, road trips, etc.?*

13. How do you think the types of foods in the U.S. has changed your health? *Probe: What are some things that you like or dislike about the Indian diet? What are some things that you like or dislike about other non-Indian foods in the U.S.?*

14. When you were in India, what would you typically eat during the week days and weekends?

15. How did your religion determine what you ate in India? How has this changed since you came to the U.S.?

16. Do you want to say anything else about your eating habits in the U.S.?

Appendix 6 - 24-hour dietary recall

ID: _____ **Date: _____** **Day of the week _____**

Time of the day	Foods / beverages	Method of preparation (baked, fried, boiled, canned, etc.)	Amount/portion

"Do you take vitamin or mineral supplements" yes or no If yes specify:

Appendix 7 – Expert review of focus group guide

Reviewers

Marsha Carolan, PhD
Associate Professor
Marriage and Family Therapy
Michigan State University, East Lansing, Michigan

Deepa Handu, PhD, RD, LDN
Director, Dietetic Internship
Edward Hines Jr. VA Hospital, Hines, Illinois

Shabnam Riyazali Momin, PhD
Dissertation on acculturation and dietary behaviors of Asian Indians in the U.S.
Michigan State University, East Lansing, Michigan

Revisions made to the focus group guide

There were 29 questions in the focus group guide before revision. The experts suggested reducing the number of questions. After incorporating the expert suggestions, the revised guide consisted of 16 questions. The questions were rearranged such that the least sensitive questions were asked at ask at the beginning while sensitive questions (e.g. religious beliefs and health) were asked at the end. Questions that were wordy were simplified. Probes were suggested for questions to facilitate participant responses. Directive questions were identified and reworded (for example: *what are some foods that you think are good for your health?* was modified to *how you think the type of foods in the U.S. has changed your health? Probe: What are some things that you like or dislike about the Indian diet? What are some things that you like or dislike about other non-Indian foods in the U.S.?*). To avoid redundancy, questions on the type of foods consumed for each meal occasion were removed since they were obtained using the 24 hour dietary recalls.

Appendix 8 - Codebook for focus group analysis

Table 11. Codebook for focus group analysis

Domain	Theme	Code	Definition	Rule for Application	Example
Psychosocial	Social Network	Family	Participant dietary behaviors and food choices influenced by family	Applied when reference to food choices made for or influenced by family members	"When parents come…like my mom prepares something like upma or something and then lunch and dinner. Then in between some snack like samosa or pakoda…so when parents come it's, it was different, so yeah, that's it."
Psychosocial	Social Network	Friends and Others	Participant dietary behaviors and food choices influenced by friends, neighbors, and others	Applied when reference to food choices made for or influenced by friends, neighbors, and others	"I have changed my habit because of my roommate. Yeah, he likes to eat lot of healthy things so I switched from white rice to brown rice…he drinks lots of fruit juice so I have reduced my soft drink consumption."
Psychosocial	Social Network	Social Events	Participant dietary behaviors and food choices influenced by social events and gatherings	Applied when reference to food choices made for or influenced by social events and gatherings	"Usually it would be the same kind of food with Indians and non-Indians. Like it'd just be milder for non-Indians I guess and usually if there are kids that are coming with non-Indians then we'd make like pasta or something like that so they can just eat that, order pizza or something yeah."
Psychosocial	Social Network	Work Place	Participant dietary behaviors and food choices influenced by colleagues and work environment	Applied when reference to food choices made for or influenced by colleagues and work environment	"I feel like you know at a work place like especially when you open your lunch box and then it gives that smell, I am not comfortable with you know that kind of a feeling. Like I just try to you know keep something like that is not going to like, strong in aromas and stuff like that."
Psychosocial	Health and Nutrition	Health and Nutrition	Food choices and dietary behaviors related to participants' health	Applied when reference to views and experiences about diet and food related to health	"food items which are fried in oil, they say that many times they reuse it and uh it gives rise to bad fats so which are very dangerous to heart health. But here they say the oil they don't reuse it…they follow the regulations…so we are bit confident in taking any items"

Table 11 (cont'd).

Domain	Theme	Code	Definition	Rule for Application	Example
Psychosocial	Media	Media	Food choices and dietary behaviors influenced by media	Applied when reference to the influence of internet, television, radio, magazines, etc. in their food choices and dietary behaviors	"I do browse a lot on food; I really love food and cooking too. So I do browse and then if I can understand the recipe, I wanted to try it. So then I actually go buy for the recipe."
Changes in taste preferences	Taste Preferences	Favorite foods	Participants' preferred foods and cuisines	Applied when reference to favorite foods, cuisines, and ingredients. Applied when reference to Asian Indian foods that participant miss in the U.S.	"…some of the things I miss would be, on a rainy day hot tea and samosa, or the vada from a road side stand. Something like that and um and the Chinese food in India is totally different from the Chinese food here. So that is something I would miss as prepared food. Um for ingredients or raw stuff I miss the varieties of bananas we used to get"
Changes in taste preferences	Taste Preferences	Diet in the U.S.	Food choices and dietary behaviors in the U.S.	Applied when reference to the types of foods consumed and typical dietary behaviors in the U.S.	"um the amount I think um probably kind of stayed the same but the quality of food uh deteriorated because it's not home cooked food with you know all the different ingredients. It's almost always easy to make food or easy to buy food like pizzas and burritos and stuff like that, which are probably not healthy options."
Changes in taste preferences	Taste Preferences	Diet in India	Food choices and dietary behaviors in India	Applied when reference to the types of foods consumed and typical dietary behaviors when participant lived in or visited India	"So weekdays mostly it's what she (mother) cooks and it's going to be like morning it will…any tiffin and a cup of coffee and afternoon it was the meal and evening she used to make those appam, karappam…night it will be either a tiffin or rice…um most of the weekends I went out with my friends for a movie. So we used to go to the food court."

Table 11 (cont'd).

Domain	Theme	Code	Definition	Rule for Application	Example
Environmental	Restaurants	Restaurants	Choice of restaurants and types of foods selected when dining out	Applied when reference to views/ experiences about eating out. Reasons that determine the places participants choose to dine and the type of foods selected at restaurants	"I eat out when um when I am really busy and don't have time to or also when nothing sounds good at my house so…I usually eat out with one of my roommates or just whoever I am with and um yeah I like Menna's too and I like jimmy johns because like if I am really busy and don't have time to go anywhere they deliver really fast and they're pretty cheap."
Environmental	Food Preparation	Food Preparation	Participant perceptions of meals cooked at home	Applied when reference to experiences pertaining to types of foods cooked at home, factors influencing meal preparation, and participants' cooking ability	"Well for me it's uh more what I think over the weekend because that's when I cook. I sit in the weekend and cook for the week. And uh…yeah, I cook it and box it so I don't spend time during the week to cook…I wasn't cooking in India, I was a pampered kid. Um so, so now it's that's what I do it gets really frustrating for me during the week to sit and cook. Um so that's one change."
Environmental	Food Purchasing	Food Purchasing	Purchasing behavior and the types of foods purchased in stores	Applied when reference to views and experiences related to food purchasing, which includes planning, preparation, selection of stores, and types of foods purchased	"I have been trying some packed (Indian) food also...if one or two people want to eat, there is this small quantity they pack…now they are available in regular grocery stores too. Indians of course sell it in Indian grocery stores…yeah but uh the thing is that normal American grocery stores are starting to store, keep them also so it's just becoming more universal food."
Cultural	Religious and Cultural Beliefs	Religious and Cultural Beliefs	Religious and cultural influences on participant food choices and dietary behaviors	Applied when participant references to religious and cultural factors that determines dietary restrictions and the types of foods selected/ avoided	"Yeah my parents don't eat (non-vegetarian foods). They don't even eat cake because it has eggs. Um so the next generation like me, my cousins, my brother we all, we all binge a lot on meat."

Appendix 9 – Expert review of Asian Indian Dietary Acculturation Measure (AIDAM) and food frequency questions

Reviewers

Sudha Raj, PhD, RD
Assistant Professor in Nutrition Science and Dietetics
Syracuse University, Syracuse, New York

Moushumi Mukherjee, MS, RD
Hospital and Health Care
Lansing, Michigan

Parul shah, RD/LD
Consultant Dietitian and Nutrition educator
Atlanta, Georgia

Rita Batheja,MS RD CDN
Private Practice
New York

Ranjita Misra, PhD, CHES, FASHA
Professor and Director, Public Health Practice Program
West Virginia University, Morgantown, West Virginia

Padmini Balagopal, MS, B.Ed, RD, CDE, IBCLC
Principal investigator, nutrition consultant, and adjunct faculty
Manor College, Jenkintown, PA

Marly Mathew, Ph.D
Psychology Post-Doctoral Fellow
Dissertation on acculturation of Asian Indians in the U.S.
Oklahoma City, Oklahoma

Karmeen kulkarni, MS, RD, BC-ADM, CDE
Vice President of Health Care and Education for the American Diabetes Association
Director, Scientific Affairs at Abbott Diabetes Care
Salt Lake City, Utah

Karen Clark
Senior Project Manager - Web Survey Unit
Office for Survey Research
Institute for Public Policy and Social Research
Michigan State University, East Lansing, Michigan

Ryan P. Bowles
Assistant Professor
Department of Human Development and Family Studies
Michigan State University, East Lansing, Michigan

Revisions made to the Asian Indian Dietary Acculturation Measure

Before revision, the Asian Indian Dietary Acculturation Measure and the food frequency questionnaire had 35 and 41 items, respectively. The five point Likert scale used in AIDAM that ranged from strongly agree to strongly agree was considered as appropriate for the instrument items. Some experts completed the questionnaires themselves to examine cultural appropriateness and attached the responses along with their suggestions. These responses were examined to study the interpretation of the items. The experts corrected typographical errors if any and provided suggestions to revise the tool. It was recommended by the experts that the focus of the dietary acculturation measure should be on the assessment of the level of dietary acculturation and not to identify the reasons for dietary acculturation. Another important suggestion was to include items that represented non-Indian dietary behaviors. Furthermore, the experts provided illustrations to reword the items and suggestions for new items. For example, based on expert suggestion, items on Asian Indian and non-Indian foods not made at home but ordered from outside were included. Similarly, foods cooked in bulk at home and frozen for later consumption was suggested as important to include in the instrument. For the food frequency questionnaire, inclusion of Asian Indian fasting foods such as kichidi, dhokla, and handvo, Asian Indian party appetizers and north Indian fatty gravies, frequency of consumption of sodas, alcohol, and energy drinks, and different varieties of yogurt such as Greek yogurt and flavored yogurt were added as suggested by the experts.

Appendix 10 – Asian Indian Dietary Acculturation Measure (AIDAM) pilot test results (n=12)

Table 12. Asian Indian Dietary Acculturation Measure (AIDAM) – pilot test results (n=12)

		Mean±SD (range)
Age (years)		34.42±9.9 (21-52)
Duration of stay in the US		11.88 (2.5-30)
		N (%)
Gender	Male	6 (50.0)
	Female	6 (50.0)
Religion	Hindu	11 (91.7)
	Muslim	1 (8.3)
Educational level	High school or bachelor's degree	4 (33.4)
	≥Masters	8 (66.6)
Employment	Employed full time	7 (58.3)
	Other (employed part time, home maker, student)	5 (41.7)
Annual household income	<$75,000	6 (50.0)
	≥$75,000	6 (50.0)
Marital status	Currently married	8 (66.7)
	Other (single, divorced, widowed, dating, partnered)	4 (33.3)
Language spoken at home	Mostly Indian	5 (41.7)
	Indian and English equally/ Mostly English	7 (58.4)
Residency	US Citizens and permanent residents	7 (58.3)
	Work/student/ dependent visa	5 (41.7)

Table 13: Mean scores for the Asian Indian Dietary Acculturation Measure (AIDAM) – pilot test results (n=12)

#	Items	Mean±sd
1	I/or the people who I live with eat Indian foods often	1.83±0.58
2	I or the people who I live with eat non-Indian foods often	3.33±0.65
3	I present Indian foods to social gatherings or when I invite people	2.08±0.90
4	I present non-Indian foods to social gatherings or when I invite people	3.18±0.87
5	I prefer to eat Indian foods at my school/ workplace	3.08±0.79
6	I prefer to eat non-Indian foods at my school/ workplace	3.33±0.89
7	I often eat Indian foods when I am with Indians	2.00±0.60
8	I like to introduce Indian foods to non-Indians	2.08±0.52
9	I changed my eating habits in the U.S. to eat like everyone else in the U.S.	2.73±1.01
10	I consider most of the Indian foods as healthy	2.17±0.84
11	I consider most of the non-Indian foods as healthy	2.92±0.79
12	I do not eat the Indian type of diet on most of the days	3.00±1.21
13	I eat healthier foods in the U.S. compared to the foods I would eat if I were in India	3.08±0.79
14	I eat the same size portions of food in the U.S. as I would typically eat if I were in India	2.75±0.97
15	I eat the same amount of starchy foods in the U.S. as I would typically eat if I were in India	2.92±1.00
16	I eat the same amount of sweet foods in the U.S. as I would typically eat if I were in India	3.17±0.94
17	I eat the same amount of oily/ fried foods in the U.S. as I would typically eat if I were in India	3.08±0.90
18	I try Indian foods that I see on the television and Internet	2.75±0.97
19	I try non-Indian foods that I see on the television and Internet	3.50±0.67
20	I enjoy eating Indian foods	1.75±0.62
21	I enjoy eating non-Indian foods	4.17±0.58
22	I find Indian foods to be very filling and satisfying	1.92±0.67
23	I find non-Indian foods to be very filling and satisfying	3.67±0.49
24	I prefer Indian foods for breakfast most of the time	3.17±0.94
25	I prefer non-Indian foods for breakfast most of the time	3.67±0.78
26	I prefer Indian foods for lunch most of the time	2.92±1.00
27	I prefer non-Indian foods for lunch most of the time	3.42±0.67
28	I prefer Indian foods for dinner most of the time	2.08±0.79
29	I prefer non-Indian foods for dinner most of the time	3.17±1.03
30	I prefer Indian foods for a snack most of the time	3.08±1.00
31	I prefer non-Indian foods for a snack most of the time	3.58±0.90
32	I like to eat at Indian restaurants in the place where I live	2.83±1.19
33	I like to eat at non-Indian restaurants in the place where I live	3.92±0.90

Table 13 (cont'd).

#	Items	Mean±sd
34	I eat out more often in the U.S. when compared to how I would eat in India	3.92±1.17
35	I/ or the people who I live with know how to cook Indian foods	1.67±0.49
36	I/ or the people who I live with know how to cook non-Indian foods	3.83±0.72
37	I/ or the people who I live with often find it easy to prepare Indian foods at home	2.50±0.91
38	I/ or the people who I live with often find it easy to prepare non-Indian foods at home	3.50±0.67
39	I/ or the people who I live with make Indian foods in large quantities and store them for later use	2.25±0.91
40	I/ or the people who I live with make non-Indian foods in large quantities and store them for later use	3.00±1.04
41	I often pick up Indian foods from stores/ restaurants when I/or the people who I live with do not have time to cook	3.33±1.16
42	I often pick up non-Indian foods from stores/ restaurants when I/or the people who I live with do not have time to cook	3.33±0.99
43	I have people who can make Indian foods for me when I/or the people who I live with do not have time to cook	3.08±1.17
44	I have people who can make non-Indian foods for me when I/or the people who I live with do not have time to cook	2.75±1.06
45	I am able to get all the varieties of Indian foods/ produce in the store where I shop	2.58±0.79
46	I often buy packaged and ready to make Indian foods	3.25±1.06
47	I often buy packaged and ready to make non-Indian foods	3.25±0.87
48	I practice all the food-related beliefs of my religion in the US	3.00±1.04
49	I strictly do not eat certain foods because they are not allowed in my religion	3.17±1.59
50	I celebrate Indian festivals by eating specialty foods for the occasion	2.17±0.84
51	I celebrate non-Indian festivals by eating specialty foods for the occasion	3.33±0.78

Appendix 11 – Location of residence of web-survey participants (n=225)

Table 14. Location of residence of web-survey participants (n=225)

	No. Participants from each state	Total participants
California	30 (13.3)	30 (13.3)
New Jersey	23 (10.2)	23 (10.2)
Texas	14 (6.2)	14 (6.2)
Illinois	13 (5.8)	13 (5.8)
Georgia, Ohio	12 (5.3)	24 (10.6)
New York, North Carolina	11 (4.9)	22 (9.8)
Florida, Maryland	8 (3.6)	16 (7.2)
Massachusetts, Michigan, Minnesota	7 (3.1)	21 (9.3)
Pennsylvania	6 (2.7)	6 (2.7)
Washington	5 (2.2)	5 (2.2)
Tennessee, Virginia	4 (1.8)	8 (3.6)
Indiana, Wisconsin	3 (1.3)	6 (2.6)
Connecticut, Iowa, Louisiana, Missouri, Utah	2 (0.9)	10 (4.5)
Alabama, Arizona, Idaho, Kentucky, Mississippi, Nebraska, Oklahoma, Oregon, Rhode Island, South Carolina, Vermont, West Virginia	1 (0.4)	12 (4.8)
Total		210 (93.3)

15 participants did not report their location of residence

Appendix 12 – Comparison of demographic profile of Asian Indians participants and non-participants

Table 15. Comparison of demographic profile of participants with non-participants (n=1350)

		Participants (n=199)	Non-participants (n=1151)
Gender	Male	92 (46.2)	500 (43.4)
	Female	107 (53.8)	651 (56.6)
Education	Graduate school	131 (65.8)	749 (65.1)
	College or technical school graduate	47 (23.6)	294 (25.5)
	≤ Some college/ technical school	21 (10.5)	106 (9.2)
	Prefer not to answer	0 (0.0)	2 (0.2)
Income	≥$100,000	64 (32.2)	403 (35.0)
	$75,000 - $99,999	46 (23.1)	235 (20.4)
	$50,000 - $74,999	30 (15.1)	247 (21.5)
	<$50,000	33 (16.6)	163 (14.2)
	Prefer not to answer	26 (13.1)	103 (8.9)
Employment status	Full-time	41 (20.6)	264 (22.9)
	Other	41 (20.6)	152 (13.2)
	Not available	106 (53.3)	668 (58.0)
	Not applicable	11 (5.5)	67 (5.8)
Religion	Hindu	118 (59.3)	631 (54.8)
	Other	57 (28.6)	392 (34.1)
	Not available	6 (3.0)	26 (2.3)
	Prefer not to answer	18 (9.0)	102 (8.9)

The demographic profile comparison from Qualtrics Research Suite was available only for 1350 participants. A total of 1408 emails were sent to Asian Indians in the U.S., of which 289 individuals clicked on the entry link and 225 participants submitted their response.

Appendix 13 - Research participant informed consent form (B)

Asian Indian Dietary Acculturation Research Study

Thank you for participating in this survey. This study is in partial fulfillment for a PhD in Human Nutrition. The purpose of this research is to study the changes in dietary patterns of Asian Indians in the U.S. The investigators hope to learn how living in the United States of America and other factors are related to the dietary patterns of Asian Indian adults. Participation in this survey will require approximately 15-20 minutes of your time depending on your answers and the level of detail you wish to provide. The survey will include questions on your ethnic background, dietary habits, food frequency questions, questions on diabetes risk factors, and general survey questions. Your participation in this research is voluntary. You can discontinue this survey anytime without penalty. You do not have to answer any question that you do not wish to answer. The survey is anonymous and does not ask for any information that would identify you. Data collected from this survey will be kept confidential. Data will be grouped and your comments will not be individually identifiable. Filling out this survey indicates that you are an Asian Indian at least 18 years old and are giving your informed consent to be a participant in this study. Should you have any questions, please contact one of the Investigators:

Lorraine Weatherspoon, PhD, RD
Dept. Food Science and Human Nutrition
Michigan State University

Sumathi Venkatesh, MS, PhD Candidate
Dept. Food Science and Human Nutrition
Michigan State University

If you have any questions or concerns about your rights as a participant, you may contact the Michigan State University's Human Research Protection Program: phone 517-355-2180, fax 517-432-4503, email irb@msu.edu or regular mail 207 Olds Hall, MSU, East Lansing, MI48824.

By proceeding to the survey I acknowledge that I have read the above statements and voluntarily agree to participate in this research study.

- ❍ Agree
- ❍ Decline

Appendix 14 - Questions on demographic characteristics, diet, and general health

1) Age:

2) Gender:
   ☐ Male
   ☐ Female

3) How many years have you been in the U.S.? _____

4) Have you lived in a country other than US and India?
   ☐ No
   ☐ Yes (how many years?) _____

5) Please indicate in which country you, your parents, and your grandparents were born.

	U.S.	India	Other Country
You	☐	☐	☐
Father	☐	☐	☐
Mother	☐	☐	☐
Maternal grandfather	☐	☐	☐
Paternal grandfather	☐	☐	☐
Maternal grandmother	☐	☐	☐
Paternal grandmother	☐	☐	☐

Answer if you were born in India

6) At which age did you immigrate to the U.S.?

Answer if you were born in the U.S or other country

7) Have you ever lived in or visited India?
   ☐ No
   ☐ Yes

Answer if you marked yes to question 7

8) How many times have you visited India, and on average how long in months was your visit?
   ☐ Number of Times Visited: _____
   ☐ Average Length of Stay (please specify years or months): _____

9) When you lived in India or when you last visited India, was it a . . .
   ☐ Big city
   ☐ Small city
   ☐ Small town
   ☐ Village

10) What language do you speak at home?
- ☐ Mostly Indian
- ☐ Mostly English
- ☐ Indian and English equally
- ☐ Other- please specify _____

11) What is your religion?
- ☐ Hindu
- ☐ Christian
- ☐ Muslim
- ☐ Other - please specify _____

12) Are you currently . . .
- ☐ Single, never been married
- ☐ Married
- ☐ Divorced
- ☐ Widowed
- ☐ Separated
- ☐ Dating
- ☐ Member of an unmarried couple

13) With whom do you currently live? (check all that apply)
- ☐ Alone
- ☐ With friends
- ☐ With spouse
- ☐ With children
- ☐ With parents
- ☐ Other - please specify _____

14) Please indicate the number of members in your household including yourself that are:
- ☐ Adults >18 years _____
- ☐ Children _____

15) What is the highest level of education that you have achieved?
- ☐ Less than high school
- ☐ High school
- ☐ Bachelor's degree
- ☐ Master's degree
- ☐ PhD
- ☐ Other degree - please specify_____

16) What is your current employment status? (check all that apply)
- ☐ Employed full time
- ☐ Employed part time
- ☐ Homemaker
- ☐ Unemployed
- ☐ Disabled/ unable to work
- ☐ Retired
- ☐ Student
- ☐ Other - please specify _____

17) What is your approximate total annual household income from all sources?
- ☐ Under $20,000
- ☐ $20,000 to $49,999
- ☐ $50,000 to $74,999
- ☐ $75,000 to $99,999
- ☐ Over $100,000

18) What is your status in the U.S.?
- ☐ US Citizen
- ☐ Green card
- ☐ Work visa
- ☐ Student visa
- ☐ Other - please specify _____

19) In what state in the U.S. do you currently live? _____

20) If you do not eat Indian foods often (at home, work/school, social gatherings or restaurants) what are the reasons for not eating those type of foods? - Please list as many reasons as possible

_____

21) If you do not eat non-Indian foods often (at home, work/school, social gatherings or restaurants) what are the reasons for not eating those type of foods? - Please list as many reasons as possible

_____

22) Are you a vegetarian?
- ☐ Yes
- ☐ No

23) For each of the following foods, please indicate which ones you never eat or drink, then in the space below each that you never eat or drink, please indicate the main reason why you do not eat or drink that food.
- ☐ Milk _____
- ☐ Eggs _____
- ☐ Chicken _____
- ☐ Mutton / lamb _____
- ☐ Beef _____
- ☐ Pork _____
- ☐ Seafood _____
- ☐ Alcohol _____
- ☐ Other _____
- ☐ No dietary restrictions

24) Do you have any of the following medical problems?
- ☐ High blood pressure
- ☐ Heart disease
- ☐ Kidney problems
- ☐ Diabetes
- ☐ Overweight
- ☐ High cholesterol
- ☐ Other _____
- ☐ No medical problems

25) Please provide the following information:
- ☐ Your height in feet and inches: _____
- ☐ Your Weight in pounds: _____
- ☐ Your waist circumference in inches: _____

26) Thank you for taking the survey. Please provide any feedback you have about the survey or any comments about your food choices, your diet or your health.

_____

Appendix 15 - Food frequency assessment

Choose the option that best describes your typical meals.

	Every day	1-6 times/ week	1-3 times/ month	1-11 times/ year	Never
How often do you eat traditional Indian foods for breakfast?	☐	☐	☐	☐	☐
How often do you eat traditional Indian foods for lunch?	☐	☐	☐	☐	☐
How often do you eat traditional Indian foods for dinner?	☐	☐	☐	☐	☐
How often do you eat traditional Indian foods for snacks?	☐	☐	☐	☐	☐
How often do you eat non-Indian foods for breakfast?	☐	☐	☐	☐	☐
How often do you eat non-Indian foods for lunch?	☐	☐	☐	☐	☐
How often do you eat non-Indian foods for dinner?	☐	☐	☐	☐	☐
How often do you eat non-Indian foods for snacks?	☐	☐	☐	☐	☐

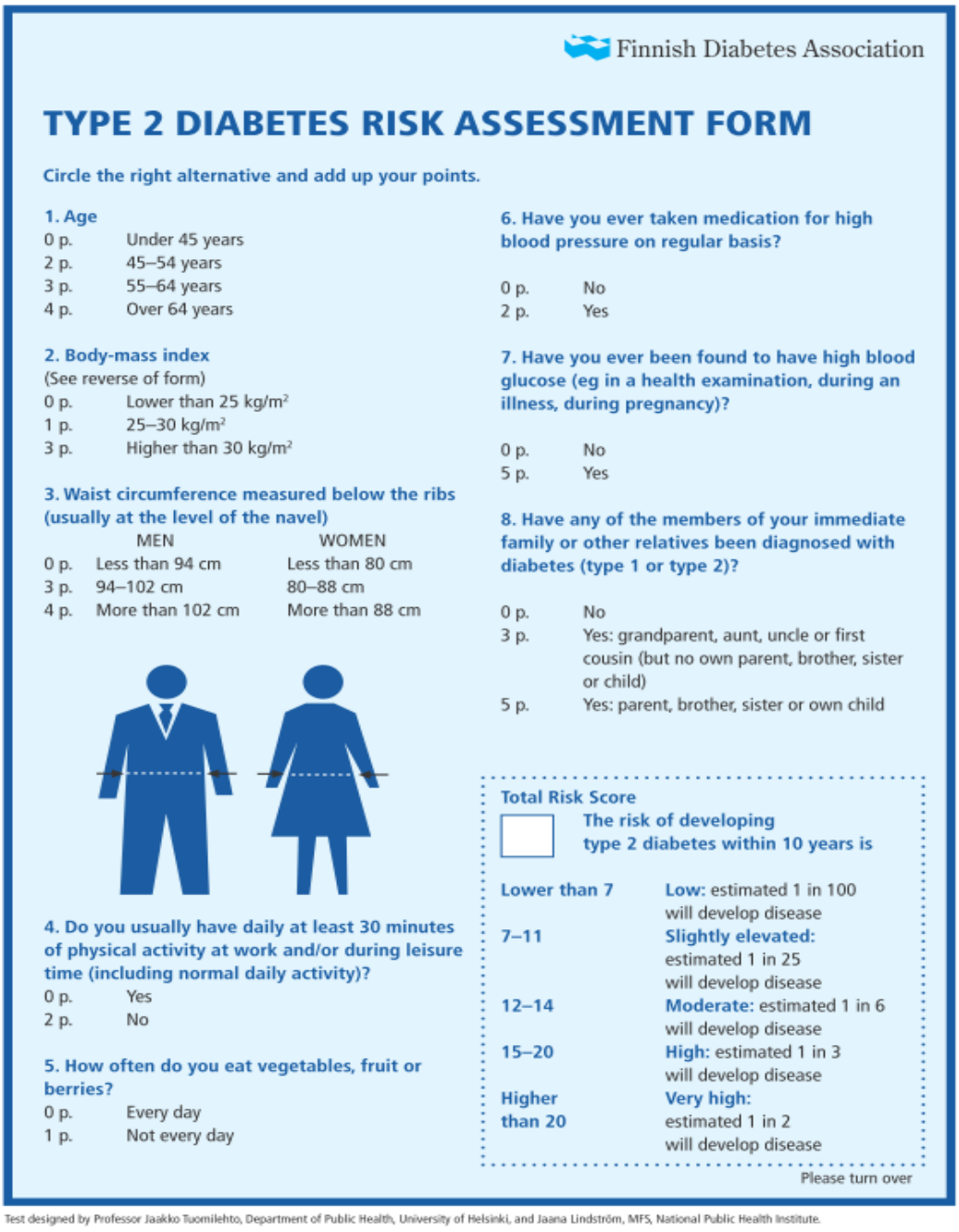
Choose the option that best describes your typical meals.
How often do you typically eat the following foods?

	Every day	1-6 times/ week	1-3 times/ month	1-11 times/ year	Never
1. White rice	☐	☐	☐	☐	☐
2. Brown rice	☐	☐	☐	☐	☐
3. Idly	☐	☐	☐	☐	☐
4. Vermicelli	☐	☐	☐	☐	☐
5. Cous cous	☐	☐	☐	☐	☐
6. Quinoa	☐	☐	☐	☐	☐
7. Dhokla	☐	☐	☐	☐	☐
8. Handvo	☐	☐	☐	☐	☐
9. Dosa	☐	☐	☐	☐	☐
10. Pizza	☐	☐	☐	☐	☐
11. Pasta/ spaghetti	☐	☐	☐	☐	☐
12. Macaroni	☐	☐	☐	☐	☐
13. Chinese noodles	☐	☐	☐	☐	☐
14. Tortillas/ tacos	☐	☐	☐	☐	☐
15. Non-Indian sandwiches	☐	☐	☐	☐	☐
16. Non-Indian Salad	☐	☐	☐	☐	☐
17. Bacon	☐	☐	☐	☐	☐
18. Roast beef	☐	☐	☐	☐	☐
19. Hot dogs	☐	☐	☐	☐	☐
20. Sambar/ Dal	☐	☐	☐	☐	☐
21. Sabji	☐	☐	☐	☐	☐
22. Paneer dishes	☐	☐	☐	☐	☐
23. Ethnic vegetables (e.g. drumstick, raw/ green banana, bitter gourd, etc.)	☐	☐	☐	☐	☐
24. Greek yogurt	☐	☐	☐	☐	☐
25. Flavored yogurt	☐	☐	☐	☐	☐
26. Green tea	☐	☐	☐	☐	☐
27. Indian tea	☐	☐	☐	☐	☐

	Every day	1-6 times/ week	1-3 times/ month	1-11 times/ year	Never
28. Cold breakfast cereals	☐	☐	☐	☐	☐
29. Hot cereals (e.g. oatmeal)	☐	☐	☐	☐	☐
30. Pancakes/ waffles/ bagels	☐	☐	☐	☐	☐
31. Breakfast cereal bar	☐	☐	☐	☐	☐
32. Biscuits commonly found in India (e.g. Marie, rusk, etc.)	☐	☐	☐	☐	☐
33. Papad/ fryums	☐	☐	☐	☐	☐
34. Indian chutney	☐	☐	☐	☐	☐
35. Indian pickles	☐	☐	☐	☐	☐
36. Alcohol	☐	☐	☐	☐	☐
37. Soda/ pop or cold drinks	☐	☐	☐	☐	☐
38. Indian mixed rice dishes (e.g. biryani, lemon rice, etc)	☐	☐	☐	☐	☐
39. Indian rice and lentil dishes (e.g. Khichdi, pongal, bisibelabath, etc.)	☐	☐	☐	☐	☐
40. Ready to eat Indian meals (e.g. swad, deep brands)	☐	☐	☐	☐	☐
41. Ready to eat non-Indian meals (e.g. lean cuisine, banquet, etc.)	☐	☐	☐	☐	☐
42. Indian bread (e.g. chapatti, naan, paratas, etc.)	☐	☐	☐	☐	☐
43. Non-Indian bread (e.g. multigrain, rye, pita, rolls, crescents, corn bread, etc.)	☐	☐	☐	☐	☐
44. Indian style simple meat or vegetable curry	☐	☐	☐	☐	☐
45. Indian style stir fried vegetables	☐	☐	☐	☐	☐
46. Indian style party foods (cream based/oily curries or foods)	☐	☐	☐	☐	☐
47. Indian fried foods (e.g. puri, vada, samosa, pakora, etc.)	☐	☐	☐	☐	☐
48. Indian fast foods (e.g. bhel puri, pani puri, etc.)	☐	☐	☐	☐	☐
49. Non-Indian fast foods (e.g. french fries, burger, etc.)	☐	☐	☐	☐	☐
50. Indian sweets/ desserts (e.g. burfi, gulab jamun, kheer, etc.)	☐	☐	☐	☐	☐
51. Non-Indian sweets/ desserts (e.g. Donut, pie, brownie, cookies, tart, etc.)	☐	☐	☐	☐	☐
52. Indian ready made salty snacks (e.g. mixture, chakli/ murukku)	☐	☐	☐	☐	☐
53. Non-Indian ready made salty snacks (e.g. pretzels, tortilla chips, Chex-mix, etc.)	☐	☐	☐	☐	☐

Appendix 16 - The Finnish Diabetes Risk Score (FINDRISC) assessment

Figure 5. The Finnish Diabetes Risk Score (FINDRISC) assessment



Finnish Diabetes Association

TYPE 2 DIABETES RISK ASSESSMENT FORM

Circle the right alternative and add up your points.

1. Age

0 p. Under 45 years
2 p. 45–54 years
3 p. 55–64 years
4 p. Over 64 years

2. Body-mass index

(See reverse of form)
0 p. Lower than 25 kg/m²
1 p. 25–30 kg/m²
3 p. Higher than 30 kg/m²

3. Waist circumference measured below the ribs (usually at the level of the navel)

	MEN	WOMEN
0 p.	Less than 94 cm	Less than 80 cm
3 p.	94–102 cm	80–88 cm
4 p.	More than 102 cm	More than 88 cm

4. Do you usually have daily at least 30 minutes of physical activity at work and/or during leisure time (including normal daily activity)?

0 p. Yes
2 p. No

5. How often do you eat vegetables, fruit or berries?

0 p. Every day
1 p. Not every day

6. Have you ever taken medication for high blood pressure on regular basis?

0 p. No
2 p. Yes

7. Have you ever been found to have high blood glucose (eg in a health examination, during an illness, during pregnancy)?

0 p. No
5 p. Yes

8. Have any of the members of your immediate family or other relatives been diagnosed with diabetes (type 1 or type 2)?

0 p. No
3 p. Yes: grandparent, aunt, uncle or first cousin (but no own parent, brother, sister or child)
5 p. Yes: parent, brother, sister or own child

Total Risk Score

The risk of developing type 2 diabetes within 10 years is

Lower than 7	**Low:** estimated 1 in 100 will develop disease
7–11	**Slightly elevated:** estimated 1 in 25 will develop disease
12–14	**Moderate:** estimated 1 in 6 will develop disease
15–20	**High:** estimated 1 in 3 will develop disease
Higher than 20	**Very high:** estimated 1 in 2 will develop disease

Please turn over

Test designed by Professor Jaakko Tuomilehto, Department of Public Health, University of Helsinki, and Jaana Lindström, MFS, National Public Health Institute.

Figure 5 (cont'd)

Finnish Diabetes Association

WHAT CAN YOU DO TO LOWER YOUR RISK OF DEVELOPING TYPE 2 DIABETES?

You can't do anything about your age or your genetic predisposition. On the other hand, the rest of the factors predisposing to diabetes, such as overweightness, abdominal obesity, sedentary lifestyle, eating habits and smoking, are up to you. Your lifestyle choices can completely prevent type 2 diabetes or at least delay its onset until a much greater age.

If there is diabetes in your family, you should be careful not to put on weight over the years. Growth of the waistline, in particular, increases the risk of diabetes, whereas regular moderate physical activity will lower the risk. You should also pay attention to your diet: take care to eat plenty of fibre-rich cereal products and vegetables every day. Omit excess hard fats from your diet and favour soft vegetable fats.

Early stages of type 2 diabetes seldom cause any symptoms. If you scored 12–14 points in the Risk Test, you would be well advised to seriously consider your physical activity and eating habits and pay attention to your weight, to prevent yourself from developing diabetes. Please contact a public-health nurse or your own doctor for further guidance and tests.

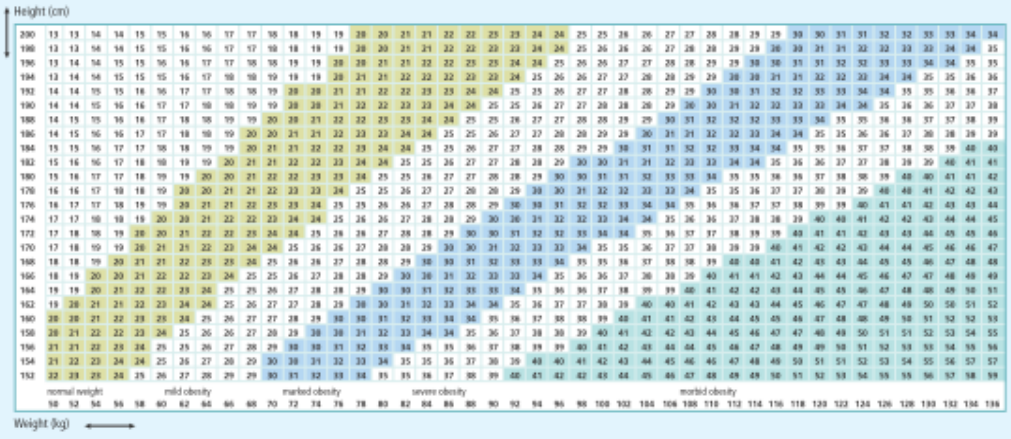
If you scored 15 points or more in the Risk Test, you should have your blood glucose measured (both fasting value and value after a dose of glucose or a meal) to determine if you have diabetes without symptoms.

BODY-MASS INDEX

The body-mass index is used to assess whether a person is normal weight or not. The index is calculated by dividing body weight (kg) by the square of body height (m). For example, if your height is 165 cm and your weight 70 kg, your body-mass index will be 70/(1.65 x 1.65), or 25.7.

If your body-mass index is 25–30, you will benefit from losing weight; at least you should take care that your weight doesn't increase beyond this. If your body-mass index is higher than 30, the adverse health effects of obesity will start to show, and it will be essential to lose weight.

BODY-MASS INDEX CHART



Appendix 17 – Validated Asian Indian Dietary Acculturation Measure (AIDAM)

The purpose of this instrument is to measure the level of dietary acculturation of Asian Indians through the assessment of the influence of various underlying cultural, psychosocial and environmental factors on participant food choices. We explored the dietary patterns/practices of Asian Indians to be able to construct an instrument that specifically applies to Asian Indians. The instrument items were finalized by (i) conducting a thorough review of literature on measures for Asian Indian dietary acculturation behaviors, (ii) utilizing the conceptual model of dietary to define the domains of the instrument, (iii) utilizing the themes generated from 8 focus group discussions with 30 Asian Indian adults in a mid-western state in the U.S., (iv) obtaining opinion from experts in nutrition/ dietetics of Asian Indian origin and experts in qualitative research, survey research, and Rasch analytical approach, and (v) obtaining feedback from the target population by conducting a pilot test of the dietary acculturation items with 12 Asian Indian adults. This rigorous procedure along with psychometric analysis of the tool resulted in 50 items on dietary acculturation.

The items are in the form of statements and participants will evaluate each statement and their level of agreement or disagreement is measured on a five point Likert scale. The items measure 8 underlying concepts that may influence dietary acculturation behaviors, which are given as follows: social network (9 items – item numbers 1-9); health and nutrition (8 items – item numbers 10-17); media (2 items – item numbers 18-19); taste preferences (13 items – item numbers 20-31); restaurants (3 items – item numbers 32-34); food preparation (10 items – item numbers 35-44); food purchasing (3 items – item numbers 45-47); and religious and cultural beliefs (3 items – item numbers 48-50)

The instrument measures dietary acculturation with traditional Asian Indian dietary practices at one-end and non-Indian practices at the other. Each item has five possible Likert responses, ranging from 1 – 5. Five ordered response levels were used, the format of which is: (1) strongly agree; (2) agree; (3) neither agree nor disagree; (4) disagree; and (5) strongly disagree. Items that represent non-Indian dietary practices are reverse coded with strongly agree as 5 to strongly disagree as 1 (refer to the table below for the specific items). The responses for all the items are added and divided by the number of items. The final scores also range from 1 to 5, where 1 indicates Asian Indian dietary practices and 5 is indicative of non-Indian dietary pattern.

Coding	Items	Scoring
Direct coded items (represents Asian Indian practices):	1, 3, 5, 7, 8, 10, 14, 15, 16, 17, 18, 20, 22, 24, 26, 28, 30, 32, 35, 37, 39, 41, 43, 45, 46, 48, 49	1 = Strongly agree 2 = agree 3 = neither agree nor disagree 4 = disagree 5 = strongly disagree
Reverse coded items (represents non-Indian practices):	2, 4, 6, 9, 11, 12, 13, 19, 21, 23, 25, 27, 29, 31, 33, 34, 36, 38, 40, 42, 44, 47, 50	5 = Strongly agree 4 = agree 3 = neither agree nor disagree 2 = disagree 1 = strongly disagree

ASIAN INDIAN DIETARY ACCULTURATION MEASURE

Since living in the U.S., you might have changed some of your cultural dietary habits. For each statement below please check the box on the right that best describes you.

	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
1. I/or the people who I live with eat Indian foods often	☐	☐	☐	☐	☐
2. I or the people who I live with eat non-Indian foods often	☐	☐	☐	☐	☐
3. I present Indian foods to social gatherings or when I invite people	☐	☐	☐	☐	☐
4. I present non-Indian foods to social gatherings or when I invite people	☐	☐	☐	☐	☐
5. I prefer to eat Indian foods at my school/ workplace	☐	☐	☐	☐	☐
6. I prefer to eat non-Indian foods at my school/ workplace	☐	☐	☐	☐	☐
7. I often eat Indian foods when I am with Indians	☐	☐	☐	☐	☐
8. I like to introduce Indian foods to non-Indians	☐	☐	☐	☐	☐
9. I changed my eating habits in the U.S. to eat like everyone else in the U.S.	☐	☐	☐	☐	☐
10. I consider most of the Indian foods as healthy	☐	☐	☐	☐	☐
11. I consider most of the non-Indian foods as healthy	☐	☐	☐	☐	☐
12. I do not eat the Indian type of diet on most of the days	☐	☐	☐	☐	☐
13. I eat healthier foods in the U.S. compared to the foods I would eat if I were in India	☐	☐	☐	☐	☐
14. I eat the same size portions of food in the U.S. as I would typically eat if I were in India	☐	☐	☐	☐	☐
15. I eat the same amount of starchy foods in the U.S. as I would typically eat if I were in India	☐	☐	☐	☐	☐
16. I eat the same amount of sweet foods in the U.S. as I would typically eat if I were in India	☐	☐	☐	☐	☐
17. I eat the same amount of oily/ fried foods in the U.S. as I would typically eat if I were in India	☐	☐	☐	☐	☐
18. I try Indian foods that I see on the television and Internet	☐	☐	☐	☐	☐
19. I try non-Indian foods that I see on the television and Internet	☐	☐	☐	☐	☐
20. I enjoy eating Indian foods	☐	☐	☐	☐	☐
21. I enjoy eating non-Indian foods	☐	☐	☐	☐	☐
22. I find Indian foods to be very filling and satisfying	☐	☐	☐	☐	☐
23. I find non-Indian foods to be very filling and satisfying	☐	☐	☐	☐	☐
24. I prefer Indian foods for breakfast most of the time	☐	☐	☐	☐	☐
25. I prefer non-Indian foods for breakfast most of the time	☐	☐	☐	☐	☐
26. I prefer Indian foods for lunch most of the time	☐	☐	☐	☐	☐
27. I prefer non-Indian foods for lunch most of the time	☐	☐	☐	☐	☐
28. I prefer Indian foods for dinner most of the time	☐	☐	☐	☐	☐

	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
29. I prefer non-Indian foods for dinner most of the time	☐	☐	☐	☐	☐
30. I prefer Indian foods for a snack most of the time	☐	☐	☐	☐	☐
31. I prefer non-Indian foods for a snack most of the time	☐	☐	☐	☐	☐
32. I like to eat at Indian restaurants in the place where I live	☐	☐	☐	☐	☐
33. I like to eat at non-Indian restaurants in the place where I live	☐	☐	☐	☐	☐
34. I eat out more often in the U.S. when compared to how I would eat in India	☐	☐	☐	☐	☐
35. I/ or the people who I live with know how to cook Indian foods	☐	☐	☐	☐	☐
36. I/ or the people who I live with know how to cook non-Indian foods	☐	☐	☐	☐	☐
37. I/ or the people who I live with often find it easy to prepare Indian foods at home	☐	☐	☐	☐	☐
38. I/ or the people who I live with often find it easy to prepare non-Indian foods at home	☐	☐	☐	☐	☐
39. I/ or the people who I live with make Indian foods in large quantities and store them for later use	☐	☐	☐	☐	☐
40. I/ or the people who I live with make non-Indian foods in large quantities and store them for later use	☐	☐	☐	☐	☐
41. I often pick up Indian foods from stores/ restaurants when I/or the people who I live with do not have time to cook	☐	☐	☐	☐	☐
42. I often pick up non-Indian foods from stores/ restaurants when I/or the people who I live with do not have time to cook	☐	☐	☐	☐	☐
43. I have people who can make Indian foods for me when I/or the people who I live with do not have time to cook	☐	☐	☐	☐	☐
44. I have people who can make non-Indian foods for me when I/or the people who I live with do not have time to cook	☐	☐	☐	☐	☐
45. I am able to get all the varieties of Indian foods/ produce in the store where I shop	☐	☐	☐	☐	☐
46. I often buy packaged and ready to make Indian foods	☐	☐	☐	☐	☐
47. I often buy packaged and ready to make non-Indian foods	☐	☐	☐	☐	☐
48. I practice all the food-related beliefs of my religion in the US	☐	☐	☐	☐	☐
49. I celebrate Indian festivals by eating specialty foods for the occasion	☐	☐	☐	☐	☐
50. I celebrate non-Indian festivals by eating specialty foods for the occasion	☐	☐	☐	☐	☐

Appendix 18 – Participant responses to the food frequency questionnaire

Table 16. Participant responses for the food frequency questionnaire

#	Question	Never	1-11 times/ year	1-3 times/ month	1-6 times/ week	Everyday	n
1	White rice	6 (3.2)	10 (5.3)	43 (22.8)	88 (46.6)	42 (22.2)	189
2	Brown rice	56 (30.8)	29 (15.9)	56 (30.8)	34 (18.7)	7 (3.7)	182
3	Idly	21 (11.1)	59 (31.2)	79 (41.8)	27 (14.3)	3 (1.6)	189
4	Vermicelli	38 (20.0)	65 (34.2)	60 (31.6)	25 (13.2)	2 (1.1)	190
5	Cous cous	100 (52.9)	41 (21.7)	34 (18.0)	11 (5.8)	3 (1.6)	189
6	Quinoa	99 (52.1)	26 (13.7)	37 (19.5)	26 (13.7)	2 (1.1)	190
7	Dhokla	54 (28.6)	74 (39.2)	44 (23.0)	17 (8.9)	0 (0.0)	189
8	Handvo	102 (54.3)	37 (19.7)	37 (19.7)	11 (5.9)	1 (0.5)	188
9	Dosa	9 (4.7)	72 (37.9)	63 (33.2)	41 (21.5)	5 (2.6)	190
10	Pizza	4 (2.1)	53 (27.9)	106 (55.8)	26 (13.7)	1 (0.5)	190
11	Pasta/ spaghetti	13 (6.8)	50 (26.2)	94 (49.2)	33 (17.3)	1 (0.5)	191
12	Macaroni	50 (26.5)	57 (30.2)	65 (34.4)	17 (9.0)	0 (0.0)	189
13	Chinese noodles	35 (18.5)	66 (34.9)	72 (38.1)	15 (7.9)	1 (0.5)	189
14	Tortillas/ tacos	18 (9.6)	52 (27.7)	93 (49.5)	25 (13.3)	0 (0.0)	188
15	Non-Indian sandwiches	19 (10.0)	29 (15.3)	87 (45.8)	51 (26.8)	4 (2.1)	190
16	Non-Indian Salad	23 (12.1)	28 (14.7)	79 (41.6)	51 (26.8)	9 (4.7)	190
17	Bacon	124 (65.3)	23 (12.0)	31 (16.3)	10 (5.3)	2 (1.1)	190
18	Roast beef	126 (66.3)	30 (15.8)	26 (13.7)	8 (4.2)	0 (0.0)	190
19	Hot dogs	122 (64.6)	35 (18.5)	26 (13.8)	6 (3.2)	0 (0.0)	189
20	Sambar/ dal	7 (3.7)	38 (20.0)	49 (25.8)	70 (36.8)	26 (13.7)	191
21	Sabji	7 (3.7)	21 (11.1)	28 (14.7)	80 (42.1)	54 (28.4	190
22	Paneer dishes	18 (9.5)	57 (30.0)	76 (40.0)	37 (19.5)	2 (1.1)	190
23	Ethnic vegetables (e.g. drumstick, raw/green banana, bitter gourd, etc.)	13 (6.8)	33 (17.4)	55 (28.9)	73 (38.4)	16 (8.4)	190
24	Greek yogurt	45 (23.8)	44 (23.3)	40 (21.2)	44 (23.3)	16 (8.5)	191
25	Flavored yogurt	42 (22.3)	49 (26.1)	43 (22.9)	45 (23.9)	9 (4.8)	191

Table 16 (cont'd).

#	Question	Never	1-11 times/ year	1-3 times/ month	1-6 times/ week	Everyday	n
26	Green tea	55 (28.9)	38 (20.0)	40 (21.1)	38 (20.0)	19 (10.0)	191
27	Indian tea	13 (6.8)	26 (13.7)	27 (14.2)	35 (18.4)	89 (46.8)	190
28	Cold breakfast cereals	22 (11.6)	21 (11.1)	52 (27.5)	67 (35.4)	27 (14.3)	189
29	Hot cereals (e.g. oatmeal)	27 (14.2)	33 (17.4)	60 (31.6)	41 (21.6)	29 (15.3)	190
30	Pancakes/ waffles/ bagels	14 (7.4)	63 (33.2)	78 (41.1)	31 (16.3)	4 (2.1)	190
31	Breakfast cereal bar	43 (22.8)	51 (27.0)	59 (31.2)	26 (13.8)	10 (5.3)	189
32	Biscuits commonly found in India (e.g. Marie, rusk, etc.)	25 (13.2)	46 (24.2)	48 (25.3)	53 (27.9)	18 (9.5)	190
33	Papads/ fryums	17 (8.9)	46 (24.2)	78 (41.1)	42 (22.1)	7 (3.7)	190
34	Indian chutney	9 (4.7)	35 (18.4)	74 (38.9)	60 (31.6)	12 (6.3)	190
35	Indian pickles	13 (6.8)	32 (16.8)	57 (30.0)	69 (36.3)	19 (10.0)	190
36	Alcohol	73 (38.4)	44 (23.2)	44 (23.2)	23 (12.1)	6 (3.2)	190
37	Soda/ pop or cold drinks	24 (12.8)	59 (31.4)	54 (28.7)	39 (20.7)	12 (6.4)	188
38	Indian mixed rice dishes (e.g. biryani, lemon rice, etc.)	9 (4.7)	29 (15.2)	93 (48.9)	52 (27.4)	7 (3.7)	190
39	Indian rice and lentil dishes (e.g. khichdi, pongal, bisibelabath, etc.)	8 (4.2)	28 (14.7)	81 (42.6)	59 (31.1)	14 (7.4)	190
40	Ready to eat Indian meals (e.g. Swad, Deep brands)	47 (24.9)	49 (25.9)	62 (32.8)	26 (13.8)	5 (2.6)	189
41	Ready to eat non-Indian meals (e.g. Lean cuisine, Banquet, etc.)	78 (41.3)	42 (22.2)	50 (26.5)	18 (9.5)	1 (0.5)	189
42	Indian bread (e.g. chapatti, naan, paratas, etc.)	6 (3.2)	19 (10.0)	49 (25.8)	71 (37.4)	45 (23.7)	190
43	Non-Indian bread (e.g. multigrain, rye, pita, rolls, crescents, corn bread, etc.)	16 (8.4)	37 (19.5)	64 (33.7)	60 (31.6)	13 (6.8)	190
44	Indian style simple meat or vegetable curry	25 (13.2)	15 (7.9)	49 (25.8)	68 (35.8)	33 (17.4)	190
45	Indian style stir fried vegetables	13 (6.8)	23 (12.1)	49 (25.8)	76 (40.0)	29 (15.3)	190
46	Indian style party foods (cream based/ oily curries or foods)	14 (7.4)	56 (29.5)	85 (44.7)	31 (16.3)	4 (2.1)	190
47	Indian fried foods (e.g. puri, vada, samosa, pakora, etc.)	8 (4.2)	59 (31.2)	95 (50.3)	26 (13.8)	1 (0.5)	189

Table 16 (cont'd)

#	Question	Never	1-11 times/ year	1-3 times/ month	1-6 times/ week	Everyday	n
48	Indian fast foods (e.g. bhel puri, pani puri, etc.)	16 (8.4)	70 (36.8)	83 (43.7)	20 (10.5)	1 (0.5)	190
49	Non-Indian fast foods (e.g. French fries, burger, etc.)	18 (9.5)	59 (31.1)	86 (45.3)	27 (14.2)	0 (0.0)	190
50	Indian sweets/ desserts (e.g. burfi, gulab jamun, kheer, etc.)	9 (4.7)	72 (37.9)	83 (43.7)	25 (13.2)	1 (0.5)	190
51	Non-Indian sweets/ desserts (e.g. donut, pie, brownie, cookies, tart, etc.)	12 (6.4)	62 (33.0)	84 (44.7)	25 (13.3)	5 (2.7)	188
52	Indian readymade salty snacks (e.g. spice mixture, chakli/ murukku, etc.)	17 (9.0)	46 (24.3)	73 (38.6)	48 (25.4)	5 (2.6)	189
53	Non-Indian readymade salty snacks (e.g. pretzels, tortilla chips, Chex-mix, etc.)	12 (6.3)	42 (22.1)	91 (47.9)	38 (20.0)	7 (3.7)	190

BIBLIOGRAPHY

Abou El Hassan D. & Hekmat S. (2012) Dietary acculturation of Arab immigrants in the Greater Toronto Area. *Can J Diet Pract Res* **73,** 143-146.

Aldrich L. & Variyam J. (2000) Acculturation erodes the diet quality of US Hispanics. *Food Review-Washington DC* **23,** 51–56.

American Diabetes Association (2014) Standards of medical care in diabetes--2014. *Diabetes Care* **37 Suppl 1,** S14-80.

Anand S., Yusuf S., Vuksan V., Devanesen S., Teo K., Montague P., et al. (2000) Differences in risk factors, atherosclerosis, and cardiovascular disease between ethnic groups in Canada: the Study of Health Assessment and Risk in Ethnic groups (SHARE). *Lancet* **356,** 279-284.

Bainey K.R. & Jugdutt B.I. (2009) Increased burden of coronary artery disease in South-Asians living in North America. Need for an aggressive management algorithm. *Atherosclerosis* **204,** 1-10.

Bajaj M. & Banerji M. (2004) Type 2 diabetes in South Asians: a pathophysiologic focus on the Asian-Indian epidemic. *Curr Diab Rep* **4,** 213-218.

Balasubramanyam A., Rao S., Misra R., Sekhar R.V. & Ballantyne C.M. (2008) Prevalence of metabolic syndrome and associated risk factors in Asian Indians. *J Immigr Minor Health* **10,** 313-323.

Banerji M.A., Faridi N., Atluri R., Chaiken R.L. & Lebovitz H.E. (1999) Body composition, visceral fat, leptin, and insulin resistance in Asian Indian men. *Journal of Clinical Endocrinology and Metabolism* **84,** 137-144.

Baweja G., Nanda N.C., Parikh N., Bhatia V. & Venkataraman R. (2004) Prevalence of stroke and associated risk factors in Asian Indians living in the state of Georgia, United States of America. *Am J Cardiol* **93,** 267-269.

Beckles G.L.A., Kirkwood B.R., Carson D.C., Miller G.J., Alexis S.D. & Byam N.T.A. (1986) High total and cardiovascular-disease mortality in adults of Indian descent in Trinidad, unexplained by major coronary risk-factors. *Lancet* **1,** 1298-1301.

Berry J.W. (2005) Acculturation: living successfully in two cultures. *Int J Intercult Rel* **29,** 697-712.

Bharmal N., M Kaplan R., Shapiro M.F., Kagawa-Singer M., Wong M.D., Mangione C.M., et al. (2013) The association of religiosity with overweight/obese body mass index among Asian Indian immigrants in California. *Prev Med* **57,** 315-321.

Bhopal R.S. (2013) A four-stage model explaining the higher risk of Type 2 diabetes mellitus in South Asians compared with European populations. *Diabet Med* **30,** 35-42.

Bojanic D. & Xu Y. (2006) An investigation of acculturation and the dining-out behavior of Chinese living in the United States. *Int J Hosp Manag* **25,** 211-226.

Breitkopf C. & Berenson A. (2004) Correlates of weight loss behaviors among low-income African-American, Caucasian, and Latina women. *Obstet Gynecol***,** 231-239.

Bunce C. & Wormald R. (2006) Leading causes of certification for blindness and partial sight in England & Wales. *BMC Public Health* **6,** 58.

Camarota S.A. (2012) Immigrants in the United States, 2010: a profile of America's foreign-born population. Center for Immigration Studies.

Campbell M., Reynolds K., Havas S., Curry S., Bishop D., Nicklas T., et al. (1999) Stages of change for increasing fruit and vegetable consumption among adults and young adults participating in the national 5-a-Day for Better Health community studies. *Health Educ Behav* **26,** 513-534.

Chandalia M., Abate N., Garg A., Stray-Gundersen J. & Grundy S.M. (1999) Relationship between generalized and upper body obesity to insulin resistance in Asian Indian men. *Journal of Clinical Endocrinology and Metabolism* **84,** 2329-2335.

Chang M., Brown R., Nitzke S. & Baumann L. (2004) Development of an instrument to assess predisposing, enabling, and reinforcing constructs associated with fat intake behaviors of low-income mothers. *J Nutr Educ Behav* **36,** 27-34.

Chapman G.E., Ristovski-Slijepcevic S. & Beagan B.L. (2011) Meanings of food, eating and health in Punjabi families living in Vancouver, Canada. *Health Education Journal* **70,** 102-112.

Chatterton H., Younger T., Fischer A., Khunti K. & Group P.D. (2012) Risk identification and interventions to prevent type 2 diabetes in adults at high risk: summary of NICE guidance. *BMJ* **345,** e4624.

Chavez-Martinez A., Cason K.L., Mayo R., Nieto-Montenegro S., Williams J.E. & Haley-Zitin V. (2010) Assessment of predisposing, enabling, and reinforcing factors toward food choices and healthy eating among Hispanics in South Carolina. *Top Clin Nutr* **25,** 47-59.

Chung R.H., Kim B.S. & Abreu J.M. (2004) Asian American multidimensional acculturation scale: development, factor analysis, reliability, and validity. *Cultur Divers Ethnic Minor Psychol* **10,** 66-80.

Conway J., Ingwersen L. & Moshfegh A. (2004) Accuracy of dietary recall using the USDA five-step multiple-pass method in men: an observational validation study. *J Am Diet Assoc* **104,** 595-603.

Conway J.M., Ingwersen L.A., Vinyard B.T. & Moshfegh A.J. (2003) Effectiveness of the US Department of Agriculture 5-step multiple-pass method in assessing food intake in obese and nonobese women. *American Journal of Clinical Nutrition* **77,** 1171-1178.

Cowie C., Rust K., Ford E., Eberhardt M., Byrd-Holt D., Li C., et al. (2009) Full accounting of diabetes and pre-diabetes in the U.S. population in 1988-1994 and 2005-2006. *Diabetes Care* **32,** 287-294.

Cuellar I., Arnold B. & Maldonado R. (1995) Acculturation Rating-Scale for Mexican-Americans-II - A revision of the original ARSMA scale. *Hisp J Behav Sci* **17,** 275-304.

Cuellar I., Harris L. & Jasso R. (1980) An Acculturation Scale for Mexican-American normal and clinical populations. *Hisp J Behav Sci* **2,** 199-217.

Daniel C.R., Prabhakaran D., Kapur K., Graubard B.I., Devasenapathy N., Ramakrishnan L., et al. (2011) A cross-sectional investigation of regional patterns of diet and cardio-metabolic risk in India. *Nutr J* **10,** 12.

Daniel M. & Wilbur J. (2011) Physical activity among South Asian Indian immigrants: an integrative review. *Public Health Nurs* **28,** 389-401.

Das M., Pal S. & Ghosh A. (2012) Family history of type 2 diabetes and prevalence of metabolic syndrome in adult Asian Indians. *J Cardiovasc Dis Res* **3,** 104-108.

Devine C., Nelson J., Chin N., Dozier A. & Fernandez I. (2007) "Pizza is cheaper than salad": assessing workers' views for an environmental food intervention. *Obesity (Silver Spring)* **15 Suppl 1,** 57S-68S.

Dixon L., Sundquist J. & Winkleby M. (2000) Differences in energy, nutrient, and food intakes in a US sample of Mexican-American women and men: findings from the Third National Health and Nutrition Examination Survey, 1988-1994. *Am J Epidemiol* **152,** 548-557.

Dowse G., Gareeboo H., Zimmet P., Alberti K., Tuomilehto J., Fareed D., et al. (1990) High prevalence of NIDDM and impaired glucose tolerance in Indian, Creole, and Chinese Mauritians. Mauritius Noncommunicable Disease Study Group. *Diabetes* **39,** 390-396.

Dreyer G., Hull S., Aitken Z., Chesser A. & Yaqoob M.M. (2009) The effect of ethnicity on the prevalence of diabetes and associated chronic kidney disease. *QJM* **102,** 261-269.

Egan B.M., Zhao Y. & Axon R.N. (2010) US trends in prevalence, awareness, treatment, and control of hypertension, 1988-2008. *JAMA* **303,** 2043-2050.

Eliasi J.R. & Dwyer J.T. (2002) Kosher and Halal: religious observances affecting dietary intakes. *J Am Diet Assoc* **102,** 911-913.

Enas E.A., Garg A., Davidson M.A., Nair V.M., Huet B.A. & Yusuf S. (1996) Coronary heart disease and its risk factors in first-generation immigrant Asian Indians to the United States of America. *Indian Heart J* **48,** 343-353.

Enas E.A., Mohan V., Deepa M., Farooq S., Pazhoor S. & Chennikkara H. (2007) The metabolic syndrome and dyslipidemia among Asian Indians: a population with high rates of diabetes and premature coronary artery disease. *J Cardiometab Syndr* **2,** 267-275.

Eyler A., Haire-Joshu D., Brownson R. & Nanney M. (2004) Correlates of fat intake among urban, low income African Americans. *Am J Health Behav* **28,** 410-417.

Farver J., Narang S. & Bhadha B. (2002) East meets west: ethnic identity, acculturation, and conflict in Asian Indian families. *J Fam Psychol* **16,** 338-350.

Foley R.N. & Collins A.J. (2007) End-stage renal disease in the United States: an update from the United States Renal Data System. *J Am Soc Nephrol* **18,** 2644-2648.

Fox C., Pencina M., Meigs J., Vasan R., Levitzky Y. & D'Agostino R.S. (2006) Trends in the incidence of type 2 diabetes mellitus from the 1970s to the 1990s: the Framingham Heart Study. *Circulation* **113,** 2914-2918.

Francis B.H., Song X., Andrews L.M., Purkayastha D., Princic N., Sedgley R., et al. (2011) Progression to type 2 diabetes, healthcare utilization, and cost among pre-diabetic patients with or without comorbid hypertension. *Curr Med Res Opin* **27,** 809-819.

Frazao E. (1999) High costs of poor eating patterns in the United States In: Frazao E, ed. America's eating Habits: changes and consequences. U.S. Department of Agriculture, Economic Research Service, Washington, DC.

Gadgil M.D., Anderson C.A., Kandula N.R. & Kanaya A.M. (2014) Dietary patterns in Asian Indians in the United States: an analysis of the metabolic syndrome and atherosclerosis in South Asians Living in America study. *J Acad Nutr Diet* **114,** 238-243.

Ghai N.R., Jacobsen S.J., Van Den Eeden S.K., Ahmed A.T., Haque R., Rhoads G.G., et al. (2012) A comparison of lifestyle and behavioral cardiovascular disease risk factors between Asian Indian and White non-Hispanic men. *Ethn Dis* **22,** 168-174.

Gorber S.C., Tremblay M., Moher D. & Gorber B. (2007) A comparison of direct vs. self-report measures for assessing height, weight and body mass index: a systematic review. *Obes Rev* **8,** 307-326.

Gothwal V.K., Wright T.A., Lamoureux E.L. & Pesudovs K. (2009) Rasch analysis of visual function and quality of life questionnaires. *Optom Vis Sci* **86,** 1160-1168.

Green L. (1999) What can we generalize from research on patient education and clinical health promotion to physician counseling on diet? *Eur J Clin Nutr* **53 Suppl 2,** S9-18.

Griffith J. (1983) Relationship between acculturation and psychological impairment in adult Mexican-Americans. *Hisp J Behav Sci* **5,** 431-459.

Groeneveld Y., Petri H., Hermans J. & Springer M. (1999) Relationship between blood glucose level and mortality in type 2 diabetes mellitus: a systematic review. *Diabet Med* **16,** 2-13.

Gupta R., Misra A., Pais P., Rastogi P. & Gupta V.P. (2006) Correlation of regional cardiovascular disease mortality in India with lifestyle and nutritional factors. *Int J Cardiol* **108,** 291-300.

Gupta R. & Yick A. (2001) Preliminary validation of the acculturation scale on Chinese Americans. *Journal of Social Work Research and Evaluation* **12,** 43-56.

Hales C.N. & Barker D.J.P. (2001) The thrifty phenotype hypothesis. *British Medical Bulletin* **60,** 5-20.

Harjo T.C., Perez A., Lopez V. & Wong N.D. (2011) Prevalence of diabetes and cardiovascular risk factors among California Native American adults compared to other ethnicities: the 2005 California Health Interview Survey. *Metab Syndr Relat Disord* **9,** 49-54.

Hu F.B. (2011) Globalization of diabetes: the role of diet, lifestyle, and genes. *Diabetes Care* **34,** 1249-1257.

Huang B., Rodriguez B.L., Burchfiel C.M., Chyou P.H., Curb J.D. & Yano K. (1996) Acculturation and prevalence of diabetes among Japanese-American men in Hawaii. *Am J Epidemiol* **144,** 674-681.

Hubert H.B., Snider J. & Winkleby M.A. (2005) Health status, health behaviors, and acculturation factors associated with overweight and obesity in Latinos from a community and agricultural labor camp survey. *Prev Med* **40,** 642-651.

Iramaneerat C., Smith E. & Richard S. (2007) *An introduction to Rasch measurement.* Sage publications, Thousand Oaks.

Jaber L.A., Brown M.B., Hammad A., Zhu Q. & Herman W.H. (2003) Lack of acculturation is a risk factor for diabetes in Arab immigrants in the US. *Diabetes Care* **26,** 2010-2014.

Johannesson A., Larsson G., Ramstrand N., Turkiewicz A., Wiréhn A. & Atroshi I. (2009) Incidence of lower-limb amputation in the diabetic and nondiabetic general population: a 10-year population-based cohort study of initial unilateral and contralateral amputations and reamputations. *Diabetes Care* **32,** 275-280.

Jolly S., Vittinghoff E., Chattopadhyay A. & Bibbins-Domingo K. (2010) Higher cardiovascular disease prevalence and mortality among younger blacks compared to whites. *Am J Med* **123,** 811-818.

Jonnalagadda S.S. & Diwan S. (2002) Regional variations in dietary intake and body mass index of first-generation Asian-Indian immigrants in the United States. *J Am Diet Assoc* **102,** 1286-1289.

Kanaya A.M., Wassel C.L., Mathur D., Stewart A., Herrington D., Budoff M.J., et al. (2010) Prevalence and correlates of diabetes in South asian indians in the United States: findings from the metabolic syndrome and atherosclerosis in South asians living in america study and the multi-ethnic study of atherosclerosis. *Metab Syndr Relat Disord* **8,** 157-164.

Kandula N.R., Diez-Roux A.V., Chan C., Daviglus M.L., Jackson S.A., Ni H., et al. (2008) Association of acculturation levels and prevalence of diabetes in the multi-ethnic study of atherosclerosis (MESA). *Diabetes Care* **31,** 1621-1628.

Kaplan M., Chang C., Newsom J. & McFarland B. (2002) Acculturation status and hypertension among Asian immigrants in Canada. *J Epidemiol Community Health* **56,** 455-456.

Kayrooz K., Moy T., Yanek L. & Becker D. (1998) Dietary fat patterns in urban African American women. *J Community Health* **23,** 453-469.

Khairullah D.Z. & Khairullah Z.Y. (1999) Behavioural acculturation and demographic characteristics of Asian-Indian immigrants in the United States of America. *Int J Sociol Soc Policy* **19,** 57-80.

Kim B.S.K., Atkinson D.R. & Yang P.H. (1999) The Asian values scale: development, factor analysis, validation, and reliability. *J Couns Psychol* **46,** 342-352.

Kim J. & Chan M.M. (2004) Acculturation and dietary habits of Korean Americans. *Br J Nutr* **91,** 469-478.

Kim M.J., Lee S.J., Ahn Y.H., Bowen P. & Lee H. (2007) Dietary acculturation and diet quality of hypertensive Korean Americans. *J Adv Nurs* **58,** 436-445.

Klein R., Klein B.E. & Moss S.E. (1996) Relation of glycemic control to diabetic microvascular complications in diabetes mellitus. *Ann Intern Med* **124,** 90-96.

Koenig C.J., Dutta M.J., Kandula N. & Palaniappan L. (2012) "All of those things we don't eat": a culture-centered approach to dietary health meanings for Asian Indians living in the United States. *Health Commun* **27,** 818-828.

Krueger R.A. & Casey M.A. (2009) *Focus groups: a practical guide for applied research (4th edition).* Sage.

Kulkarni D.K. (2004) Food, culture, and diabetes in the United States. *Clinical Diabetes* **22,** 190-192.

Kumanyika S., Gary T., Lancaster K., Samuel-Hodge C., Banks-Wallace J., Beech B., et al. (2005) Achieving healthy weight in African-American communities: research perspectives and priorities. *Obes Res* **13,** 2037-2047.

Lee J.W., Brancati F.L. & Yeh H.C. (2011) Trends in the prevalence of type 2 diabetes in Asians versus whites: results from the United States National Health Interview Survey, 1997-2008. *Diabetes Care* **34,** 353-357.

Lee S., Sobal J. & Frongillo E.J. (1999) Acculturation and dietary practices among Korean Americans. *J Am Diet Assoc* **99,** 1084-1089.

Lehto S., Rönnemaa T., Pyörälä K. & Laakso M. (1996) Predictors of stroke in middle-aged patients with non-insulin-dependent diabetes. *Stroke* **27,** 63-68.

Lesser I.A., Gasevic D. & Lear S.A. (2014) The association between acculturation and dietary patterns of South Asian immigrants. *PLoS One* **9,** e88495.

Lim S.S., Vos T., Flaxman A.D., Danaei G., Shibuya K., Adair-Rohani H., et al. (2012) A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet* **380,** 2224-2260.

Linacre J.M. (1994) Sample Size and Item Calibration Stability. *Rasch Measurement Transactions* **7,** 328.

Linacre J.M. (2002) What do Infit and Outfit, Mean-square and Standardized mean? *Rasch Measurement Transactions* **16,** 878.

Lindström J., Louheranta A., Mannelin M., Rastas M., Salminen V., Eriksson J., et al. (2003) The Finnish Diabetes Prevention Study (DPS): lifestyle intervention and 3-year results on diet and physical activity. *Diabetes Care* **26,** 3230-3236.

Lindström J., Peltonen M., Eriksson J.G., Aunola S., Hämäläinen H., Ilanne-Parikka P., et al. (2008) Determinants for the effectiveness of lifestyle intervention in the Finnish Diabetes Prevention Study. *Diabetes Care* **31,** 857-862.

Lindström J. & Tuomilehto J. (2003) The diabetes risk score: a practical tool to predict type 2 diabetes risk. *Diabetes Care* **26,** 725-731.

Liu J.H., Chu Y.H., Frongillo E.A. & Probst J.C. (2012) Generation and acculturation status are associated with dietary intake and body weight in Mexican American adolescents. *J Nutr* **142,** 298-305.

Lv N. & Cason K.L. (2003) Current dietary pattern and acculturation of Chinese Americans in Pennsylvania. *Top Clin Nutr* **18,** 291-300.

Mainous A.G., Majeed A., Koopman R.J., Baker R., Everett C.J., Tilley B.C., et al. (2006) Acculturation and diabetes among Hispanics: evidence from the 1999-2002 National Health and Nutrition Examination Survey. *Public Health Rep* **121,** 60-66.

Malhotra S. (1970) Dietary factors causing hypertension in India. *Am J Clin Nutr* **23,** 1353-1363.

Marin G., Sabogal F., Marin B.V., Oterosabogal R. & Perezstable E.J. (1987) Development of a short acculturation scale for Hispanics. **9,** 183-205.

Marine N., Vinik A.I., Edelstei.I & Jackson W.P.U. (1969) Diabetes, Hyperglycemia and Glycosuria among Indians, Malays and Africans (Bantu) in cape Town, South Africa. *Diabetes* **18,** 840-&.

Marmot M.G. & Syme S.L. (1976) Acculturation and coronary heart disease in Japanese-Americans. *Am J Epidemiol* **104,** 225-247.

McClelland J., Demark-Wahnefried W., Mustian R., Cowan A. & Campbell M. (1998) Fruit and vegetable consumption of rural African Americans: baseline survey results of the Black Churches United for Better Health 5 A Day Project. *Nutr Cancer* **30,** 148-157.

Mealey B. & Oates T. (2006) Diabetes mellitus and periodontal diseases. *J Periodontol* **77,** 1289-1303.

Mellin-Olsen T. & Wandel M. (2005) Changes in food habits among Pakistani immigrant women in Oslo, Norway. *Ethn Health* **10,** 311-339.

Misra A. & Khurana L. (2011) Obesity-related non-communicable diseases: South Asians vs White Caucasians. *Int J Obes* **35,** 167-187.

Misra A. & Vikram N.K. (2004) Insulin resistance syndrome (Metabolic syndrome) and obesity in Asian Indians: Evidence and implications. *Nutrition* **20,** 482-491.

Misra K., Endemann S. & Ayer M. (2005) Leisure time physical activity and metabolic syndrome in Asian Indian immigrants residing in northern California. *Ethn Dis* **15,** 627-634.

Misra R., Balagopal P., Klatt M. & Geraghty M. (2010a) Complementary and alternative medicine use among Asian Indians in the United States: a national study. *J Altern Complement Med* **16,** 843-852.

Misra R., Patel T., Kotha P., Raji A., Ganda O., Banerji M., et al. (2010b) Prevalence of diabetes, metabolic syndrome, and cardiovascular risk factors in US Asian Indians: results from a national study. *J Diabetes Complications* **24,** 145-153.

Mohan V., Mathur P., Deepa R., Deepa M., Shukla D.K., Menon G.R., et al. (2008) Urban rural differences in prevalence of self-reported diabetes in India--the WHO-ICMR Indian NCD risk factor surveillance. *Diabetes Res Clin Pract* **80,** 159-168.

Mohanty S.A., Woolhandler S., Himmelstein D.U. & Bor D.H. (2005) Diabetes and cardiovascular disease among Asian Indians in the United States. *J Gen Intern Med* **20,** 474-478.

Mozaffarian D., Wilson P.W.F. & Kannel W.B. (2008) Beyond established and novel risk factors: lifestyle risk factors for cardiovascular disease. *Circulation* **117,** 3031-3038.

Neff J.A., Hoppe S.K. & Perea P. (1987) Acculturation and alcohol-use-drinking patterns and problems among Anglo and Mexican-American male drinkers. *Hisp J Behav Sci* **9,** 151-181.

Negy C. & Woods D.J. (1992) The importance of acculturation in understanding research with Hispanic-Americans. *Hisp J Behav Sci* **14,** 224-247.

Nettleton J.A., Steffen L.M., Ni H., Liu K. & Jacobs D.R. (2008) Dietary patterns and risk of incident type 2 diabetes in the Multi-Ethnic Study of Atherosclerosis (MESA). *Diabetes Care* **31,** 1777-1782.

Noble D., Mathur R., Dent T., Meads C. & Greenhalgh T. (2011) Risk models and scores for type 2 diabetes: systematic review. *BMJ* **343,** d7163.

Oza-Frank R., Ali M., Vaccarino V. & Narayan K. (2009) Asian Americans: diabetes prevalence across U.S. and World Health Organization weight classifications. *Diabetes Care* **32,** 1644-1646.

Pan Y.L., Dixon Z., Himburg S. & Huffman F. (1999) Asian students change their eating patterns after living in the United States. *J Am Diet Assoc* **99,** 54-57.

Patel J., Vyas A., Cruickshank J., Prabhakaran D., Hughes E., Reddy K., et al. (2006) Impact of migration on coronary heart disease risk factors: comparison of Gujaratis in Britain and their contemporaries in villages of origin in India. *Atherosclerosis* **185,** 297-306.

Perneger T.V., Brancati F.L., Whelton P.K. & Klag M.J. (1994) End-stage renal disease attributable to diabetes mellitus. *Ann Intern Med* **121,** 912-918.

Pettys G.L. & Balgopal P.R. (1998) Multigenerational conflicts and new immigrants: An Indo-American experience. *Families in Society-the Journal of Contemporary Human Services* **79,** 410-423.

Pierce B.L., Austin M.A., Crane P.K., Retzlaff B.M., Fish B., Hutter C.M., et al. (2007) Measuring dietary acculturation in Japanese Americans with the use of confirmatory factor analysis of food-frequency data. *Am J Clin Nutr* **86,** 496-503.

Prashantham B.J. (2008) *Cultural Considerations for Disaster Workers.* Springer: New York , USA.

Pratley R.E. (2013) The early treatment of type 2 diabetes. *Am J Med* **126,** S2-9.

Prentice A., Rayco-Solon P. & Moore S. (2005) Insights from the developing world: thrifty genotypes and thrifty phenotypes. *Proc Nutr Soc* **64,** 153-161.

Radhika G., Van Dam R., Sudha V., Ganesan A. & Mohan V. (2009) Refined grain consumption and the metabolic syndrome in urban Asian Indians (Chennai Urban Rural Epidemiology Study 57). *Metabolism* **58,** 675-681.

Raj S., Ganganna P. & Bowering J. (1999) Dietary habits of Asian Indians in relation to length of residence in the United States. *J Am Diet Assoc* **99,** 1106-1108.

Raji A., Seely E.W., Arky R.A. & Simonson D.C. (2001) Body fat distribution and insulin resistance in healthy Asian Indians and Caucasians. *Journal of Clinical Endocrinology and Metabolism* **86,** 5366-5371.

Rajpathak S.N., Gupta L.S., Waddell E.N., Upadhyay U.D., Wildman R.P., Kaplan R., et al. (2010) Elevated risk of type 2 diabetes and metabolic syndrome among Asians and South Asians: results from the 2004 New York City HANES. *Ethn Dis* **20,** 225-230.

Ramachandran A., Snehalatha C. & Vijay V. (2004) Low risk threshold for acquired diabetogenic factors in Asian Indians. *Diabetes Res Clin Pract* **65,** 189-195.

Ramsey S., Newton K., Blough D., McCulloch D., Sandhu N., Reiber G., et al. (1999) Incidence, outcomes, and cost of foot ulcers in patients with diabetes. *Diabetes Care* **22,** 382-387.

Ryder A.G., Alden L.E. & Paulhus D.L. (2000) Is acculturation unidimensional or bidimensional? A head-to-head comparison in the prediction of personality, self-identity, and adjustment. *J Pers Soc Psychol* **79,** 49-65.

Satia-Abouta J., Galanko J. & Neuhouser M. (2005) Food nutrition label use is associated with demographic, behavioral, and psychosocial factors and dietary intake among African Americans in North Carolina. *J Am Diet Assoc* **105,** 392-402; discussion 402-393.

Satia-Abouta J., Galanko J. & Siega-Riz A. (2004) Eating at fast-food restaurants is associated with dietary intake, demographic, psychosocial and behavioural factors among African Americans in North Carolina. *Public Health Nutr* **7,** 1089-1096.

Satia-Abouta J., Patterson R., Neuhouser M. & Elder J. (2002) Dietary acculturation: applications to nutrition research and dietetics. *J Am Diet Assoc***,** 1105-1118.

Satia-Abouta J., Patterson R.E., Kristal A.R., Hislop T.G., Yasui Y. & Taylor V.M. (2001) Development of scales to measure dietary acculturation among Chinese-Americans and Chinese-Canadians. *J Am Diet Assoc* **101,** 548-553.

Satia-Abouta J., Patterson R.E., Taylor V.M., Cheney C.L., Shiu-Thornton S., Chitnarong K., et al. (2000) Use of qualitative methods to study diet, acculturation, and health in Chinese-American women. *J Am Diet Assoc* **100,** 934-940.

Saydah S.H., Fradkin J. & Cowie C.C. (2004) Poor control of risk factors for vascular disease among adults with previously diagnosed diabetes. *JAMA* **291,** 335-342.

Schwarz P.E., Li J., Lindstrom J. & Tuomilehto J. (2009a) Tools for predicting the risk of type 2 diabetes in daily practice. *Horm Metab Res* **41,** 86-97.

Schwarz P.E., Li J., Reimann M., Schutte A.E., Bergmann A., Hanefeld M., et al. (2009b) The Finnish Diabetes Risk Score is associated with insulin resistance and progression towards type 2 diabetes. *J Clin Endocrinol Metab* **94,** 920-926.

Selvin E., Parrinello C.M., Sacks D.B. & Coresh J. (2014) Trends in prevalence and control of diabetes in the United States, 1988-1994 and 1999-2010. *Ann Intern Med* **160,** 517-525.

Simmons D., Williams D. & Powell M. (1992) Prevalence of diabetes in different regional and religious south Asian communities in Coventry. *Diabet Med* **9,** 428-431.

Smith C. & Franzen-Castle L. (2012) Dietary acculturation and body composition predict American Hmong children's blood pressure. *Am J Hum Biol* **24,** 666-674.

Sobal J. & Bisogni C.A. (2009) Constructing food choice decisions. *Ann Behav Med* **38 Suppl 1,** S37-46.

Stephenson M. (2000) Development and validation of the Stephenson Multigroup Acculturation Scale (SMAS). *Psychol Assess* **12,** 77-88.

Stricker M.D., Onland-Moret N.C., Boer J.M., van der Schouw Y.T., Verschuren W.M., May A.M., et al. (2013) Dietary patterns derived from principal component- and k-means cluster analysis: long-term association with coronary heart disease and stroke. *Nutr Metab Cardiovasc Dis* **23,** 250-256.

Suinn R.M. (2010) Reviewing acculturation and Asian Americans: how acculturation affects health, adjustment, school achievement, and counseling. *Asian American Journal of Psychology* **1,** 5-17.

Suinn R.M., Ahuna C. & Khoo G. (1992) The Suinn-Lew Asian Self-Identity Acculturation Scale: concurrent and factorial validation. *Educ Psychol Meas* **52,** 1041-1046.

Suinn R.M., Rickardfigueroa K., Lew S. & Vigil P. (1987) The Suinn-Lew Asian Self-Identity Acculturation Scale: an initial report. *Educ Psychol Meas* **47,** 401-407.

Sukalakamala S. & Brittin H.C. (2006) Food practices, changes, preferences, and acculturation of Thais in the United States. *J Am Diet Assoc* **106,** 103-108.

Szapocznik J., Scopetta M.A., Kurtines W. & Angelesaranalde M.D.L. (1978) Theory and measurement of acculturation. *Revista Interamericana De Psicologia* **12,** 113-130.

Tam C.F., Tzou O.S., Lee J., Syu K.L., Kim N., Iao M.L., et al. (2010) A comparison of dietary patterns and nutrient intakes between Korean American college students and their respective parents living in the same household. *College Student Journal* **44,** 979-993.

Thai A., Yeo P., Lun K., Hughes K., Wang K., Sothy S., et al. (1987) Changing prevalence of diabetes mellitus in Singapore over a ten year period. *J Med Assoc Thai* **70 Suppl 2,** 63-67.

Trogdon J.G. & Hylands T. (2008) Nationally representative medical costs of diabetes by time since diagnosis. *Diabetes Care* **31,** 2307-2311.

Tsai C., Hayes C. & Taylor G.W. (2002) Glycemic control of type 2 diabetes and severe periodontal disease in the US adult population. *Community Dent Oral Epidemiol* **30,** 182-192.

Tuomilehto J., Lindström J., Eriksson J.G., Valle T.T., Hämäläinen H., Ilanne-Parikka P., et al. (2001) Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. *N Engl J Med* **344,** 1343-1350.

U.S. Census Bureau (2004) Census 2000 Special Reports. We the People: Asians in the United States.

U.S. Census Bureau (2012) Census Bri*efs 2010. The Asian* Population: 2010.

Uusitalo U., Sobal J., Moothoosamy L., Chitson P., Shaw J., Zimmet P., et al. (2005) Dietary Westernisation: conceptualisation and measurement in Mauritius. *Public Health Nutr* **8,** 608-619.

van Dam R.M., Rimm E.B., Willett W.C., Stampfer M.J. & Hu F.B. (2002) Dietary patterns and risk for type 2 diabetes mellitus in U.S. men. *Ann Intern Med* **136,** 201-209.

Van Rompay M.I., McKeown N.M., Castaneda-Sceppa C., Falcon L.M., Ordovas J.M. & Tucker K.L. (2012) Acculturation and sociocultural influences on dietary intake and health status among Puerto Rican adults in Massachusetts. *J Acad Nutr Diet* **112,** 64-74.

Varghese S. & Moore-Orr R. (2002) Dietary acculturation and health-related issues of Indian immigrant families in Newfoundland. *Can J Diet Pract Res* **63,** 72-79.

Vatrapu R. & Perez-Quinones M. (2006) Culture and Usability Evaluation. The Effects of Culture in Structured Interviews. *Journal of Usability Studies* **1,** 156-170.

Venkataraman R., Nanda N.C., Baweja G., Parikh N. & Bhatia V. (2004) Prevalence of diabetes mellitus and related conditions in Asian Indians living in the United States. *Am J Cardiol* **94,** 977-980.

Venkatesh S. & Weatherspoon L. (2013) Social and health care provider support in diabetes self-management. *Am J Health Behav* **37,** 112-121.

Venkatesh S., Weatherspoon L.J., Kaplowitz S.A. & Song W.O. (2013) Acculturation and glycemic control of Asian Indian adults with type 2 diabetes. *J Community Health* **38,** 78-85.

Vitolins M., Quandt S., Bell R., Arcury T. & Case L. (2002) Quality of diets consumed by older rural adults. *J Rural Health* 49-56.

Watters J. & Satia J. (2009) Psychosocial correlates of dietary fat intake in African-American adults: a cross-sectional study. *Nutr J* **8,** 15.

Watters J., Satia J. & Galanko J. (2007) Associations of psychosocial factors with fruit and vegetable intake among African-Americans. *Public Health Nutr* **10,** 701-711.

Wenrich T. & Cason K. (2004) Consumption and perceptions of soy among low-income adults. *J Nutr Educ Behav* **36,** 140-143.

Whatley M. & Batalova J. (2013) Indian Immigrants in the United States. Migration Policy Institute.

Wild S., Roglic G., Green A., Sicree R. & King H. (2004) Global prevalence of diabetes - Estimates for the year 2000 and projections for 2030. *Diabetes Care* **27,** 1047-1053.

Wolfe M.M., Yang P.H., Wong E.C. & Atkinson D.R. (2001) Design and development of the European American values scale for Asian Americans. *Cultur Divers Ethnic Minor Psychol* **7,** 274-283.

Wong-Rieger D. & Quintana D. (1987) Comparative acculturation of Southeast-Asian and Hispanic immigrants and sojourners. *J Cross Cult Psychol* **18,** 345-362.

Wu T.-Y., Wang J. & Chung S. (2012) Cardiovascular disease risk factors and diabetes in Asian Indians residing in Michigan. *J Community Health* **37,** 395-402.

Wutso P., Yeh I.L. & Tam C.F. (1995) Comparisons of dietary intake in young and old Asian Americans - A two-generation study. *Nutrition Research* **15,** 1445-1462.

Yajnik C.S. (2004) Early life origins of insulin resistance and type 2 diabetes in India and other Asian countries. *J Nutr* **134,** 205-210.

Yajnik C.S., Lubree H.G., Rege S.S., Naik S.S., Deshpande J.A., Deshpande S.S., et al. (2002) Adiposity and hyperinsulinemia in Indians are present at birth. *J Clin Endocrinol Metab* **87,** 5575-5580.

Yang G.I. & Fox H.M. (1979) Food habit changes of Chinese persons living in Lincoln, Nebraska. *J Am Diet Assoc* **75,** 420-424.

Yates S.M. (2005) Rasch and attitude scales: explanatory style. Applied Rasch Measurement: A Book of Exemplars. Springer Netherlands.

Yeo K.K., Tai B.C., Heng D., Lee J.M.J., Ma S., Hughes K., et al. (2006) Ethnicity modifies the association between diabetes mellitus and ischaemic heart disease in Chinese, Malays and Asian Indians living in Singapore. *Diabetologia* **49,** 2866-2873.

Zimmet P., Taylor R., Ram P., King H., Sloman G., Raper L.R., et al. (1983) Prevalence of diabetes and impaired glucose-tolerance in the birachial (melanesian and Indian) population of Fiji - A rural-urban comparison. *Am J Epidemiol* **118,** 673-688.