

## ABSTRACT

Title of Document: Acculturation and BMI among Chinese, Korean and Vietnamese Adults in Maryland

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Objective: To examine the relationship between acculturation and BMI among Asian Americans. Methods: Data of 847 Chinese, Korean and Vietnamese recruited for a health education program in Maryland were included. Acculturation was measured by the short version of Suinn-Lew Asian Self-Identity Acculturation Scale (SL-ASIA) and its individual components. Height and weight were measured by trained staff. Multiple linear regression was used to estimate the parameters of acculturation variables. Results: After adjusting for confounders, SL-ASIA ( $\beta=0.71$ , 95% CI: 0.15, 1.26), having education in the U.S ( $\beta=0.56$ , 95% CI: 0.01, 1.11), younger age of arrival (0-5 years:  $\beta=3.32$ , 95% CI: 1.84, 4.80, 6-10 years:  $\beta=1.55$ , 95% CI: 0.02, 3.07) and equal preference of Asian/American food in restaurants ( $\beta=0.92$ , 95% CI 0.38, 1.46) were associated with BMI. The association between acculturation and BMI was stronger among men than women, and weakest among Vietnamese. Conclusion: Acculturation is moderately associated with BMI among Asian Americans.

ACCULTURATION AND BMI AMONG CHINESE, KOREAN AND  
VIETNAMESE ADULTS IN MARYLAND

By

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## Chapter 1: Introduction

### **Theoretical background of acculturation**

The concept of acculturation has been employed in various academic disciplines (e.g., anthropology, psychology, sociology, and public health) with a slightly different focus in definition and measurements.<sup>4</sup> Research on acculturation and health has been steadily increasing in the past few decades: articles indexed for “acculturation” in Medline increased by almost 6 fold in 1997-2000 compared to the period 1967 - 1971.<sup>5</sup> Despite the proliferating research on this topic in public health, the concept of acculturation has been criticized for its vague definitions and inconsistent measures.<sup>6-9</sup>

The concept of acculturation could be traced back to anthropological studies on Native Americans as early as in 1880.<sup>10</sup> However, it was not until the 1960s that acculturation was introduced into the field of epidemiology, with milestone studies such as Henry and Cassel’s work on the association between modernization and blood pressure, pointing out that difficulties in adaptation might eventually lead to hypertension.<sup>5, 11</sup> When applied to predict or explain health disparities, the underlying assumption of acculturation is that knowledge, attitude, and beliefs specific to a certain culture would influence the choice of behaviors and lifestyles that affect health.<sup>12</sup>

Here are some definitions of acculturation that are used in the field:

*“Adoption and assimilation by a person or social group of the cultural customs, traditions, practices and behavior of what previously had been for them an alien culture”<sup>1</sup>*

*“Acculturation is an adaptation process occurring when individuals from one culture are in contact with a host culture. By this process, individuals adopt characteristics of the mainstream culture and retain or relinquish traits of their traditional background.”<sup>2</sup>*

*“...culture change that is initiated by the conjunction of two or more autonomous cultural systems. Its dynamics can be seen as the selective adaptation of value systems, the processes of integration and differentiation, the generation of developmental sequences, and the operation of role determinants and personality factors.”<sup>3</sup>*

Hunt et al., summarized the common elements in various definitions: (1) involving at least two cultures (i.e., the ethnic versus the mainstream); (2) individuals placed into identifiable groups; (3) two distinct cultures coming into contact; and (4) cultural changes having occurred.<sup>5</sup> However, each of these elements is subsequently criticized by Hunt et al., for its problematic assumptions. For example, the conceptualization of acculturation as a uni-directional linear process is criticized to be over-simplified, for acculturation is multidirectional in nature.<sup>5</sup> As have been pointed out by other researchers,<sup>4</sup> broadly categorizing individuals into some vaguely defined groups such as “Hispanic” relies on the assumption that the group is homogeneous, however Hispanics vary in many characteristics such as race, geographic origin, and socioeconomic position.<sup>5</sup> These concerns can be readily applied to acculturation studies among Asians since considerable diversity exists by Asian subgroup in migration history,



socioeconomic position, religiosity, language use, and a one-size measure of acculturation may not fit.<sup>8</sup>

In addition to the critiques on the definition of acculturation, some studies have been questioned for overlooking the importance of the role of socioeconomic position (SEP) in examining the association between health disparities and acculturation.<sup>4, 8, 13-15</sup> Quite a few studies reported an association between acculturation and a certain health outcome without controlling for SEP factors.<sup>5</sup> The potential confounding effect of SEP has often not been taken into account in acculturation studies among Asian immigrants. In other cases SEP indicators (e.g., education or income) were used as proxy measures of acculturation.<sup>8</sup>

### **Measures of acculturation**

Measures of acculturation can be roughly divided into two types: scale based and non-scale based.<sup>8</sup> Non-scale based measures typically consist of language preference, time since immigration, birthplace, generation, and etc. While evidence suggests these proxy measures of acculturation can serve as strong predictors of health,<sup>15</sup> caution is needed when applying them to study immigrant populations.<sup>8</sup> For example, duration of residence may not necessarily reflect the social interaction that might have occurred between the individual and the host culture for Chinese immigrants who live in a Chinatown.<sup>16</sup>

Developed based on the Acculturation Rating Scale for Mexican Americans,<sup>17</sup> the Suinn-Lew Asian Self-Identity Acculturation Scale (SL-ASIA) consists of 21 multiple choice questions covering 7 domains: language (4

questions), identity (4 questions) , friendship choice (4 questions), behavior (5 questions), generation/geographic history (3 questions), and attitude (1 question).<sup>18</sup> Specifically designed to assess acculturation in Asian immigrants, SL-ASIA has often been constructed as a summary score summing up the items, placing individuals on a continuum with Asian culture at one end and Western culture at the other.<sup>8, 19</sup>

SL-ASIA has been compared against measures of generation, length of residence, self identification (from very Asian to very Anglicized), years of schooling in US, years of living in non-Asian neighborhoods, English language ability, age when arrived in US, and country of residence with satisfying results that the summary score of the scale varied significantly among people of the above different characteristics.<sup>18, 20-23</sup> SL-ASIA has been tested among various Asian American subgroups including Chinese, Korean and Vietnamese with satisfactory internal consistency.<sup>23-25</sup> This scale has been used to link acculturation with a series of health outcomes including obesity,<sup>26</sup> and have been applied to Chinese, Korean and Vietnamese population respectively.<sup>27-29</sup>

The questionnaire used in this study was adapted from the SL-ASIA by Hoffstetter et al.<sup>30</sup> It had language (3 questions), friendship choice (3 questions), behavior (3 questions), and five open-ended questions: years of education in home country and in US, years of residence in US and in the country of origin, and country of birth. The five open-ended questions enter the scale as 3 items: generation, proportion of life in the U.S., and proportion of education in the U.S. Thus the revised version has 12 items in total. This revised version of SL-ASIA

has been tested among Korean Americans in California and was found to have as good internal consistency as the original scale (Cronbach's  $\alpha = 0.88 \sim 0.90$ ).<sup>30-32</sup>

### **Acculturation and weight status**

Despite all the criticism on its theoretical construction and measures, acculturation has been identified to have significant impact on access to health care, interaction with health professionals, and adoption of health behaviors, which in turn might affect general health status.<sup>9, 33</sup> Acculturation is associated with a number of health outcomes, including cancer, low birth weight, unhealthy lifestyles (e.g., smoking, alcohol use), physical activity, use of cancer screening service, and etc. Higher level of acculturation serve as a risk factor for some health behaviors or problems as listed above (i.e., smoking) but a beneficial factor for others (i.e., use of cancer screening).<sup>34-37</sup> With respect to obesity, results from previous studies are fairly consistent that a higher level of acculturation, examined by age at arrival, or duration of residence, language preference, birthplace, or certain acculturation scales, is associated with increased BMI and higher likelihoods to become overweight or obese.<sup>38-43</sup>

To the best of my knowledge, there is not much quantitative research that investigated the association between acculturation and weight status among Asian Americans adults. Previous studies includes three studies with a mix of Asian Americans, one of Chinese Americans, three of Korean American and none of Vietnamese, all of which suggest a positive relationship between acculturation and weight status.<sup>41, 44-48</sup> As seen in Table 1, studies varied in the measures of acculturation and very few controlled for socioeconomic factors.<sup>41, 44-48</sup>

Though all of the studies were cross-sectional and thus difficult to assess the mechanism, dietary intake might partly explain the observed association. Park et al., compared dietary intake and body mass index (BMI) between Korean American women born in the U.S. and in Korea with a total sample size of 492 participants. They found that US-born Korean Americans had a significantly higher proportion of overweight/obese individuals accompanied with higher total fat intake but less consumption of vegetables and fruit.<sup>46</sup> Gender difference on acculturation and weight status is also noted in this population. A study that compared the weight status of Korean Americans in California of different degree of acculturation assessed by SL-ASIA (i.e., traditional, bicultural, and acculturated) using Koreans in Seoul as a reference group confirmed the gender difference: while there was a gradient of increasing BMI of acculturation among men, no similar trend was found among women.<sup>48</sup> However, a small body of literature also pointed out that acculturation was positively associated with physical activity among Asian Americans. Further research is needed to clarify the contributing factors in the association of acculturation and BMI.<sup>48, 49</sup>

**Table 1 Summary of studies on acculturation and weight status among Asian American adults**

<b>Author, Year</b>	<b>Measure of acculturation</b>	<b>Sample</b>	<b>Covariates</b>	<b>Major findings</b>
Novotny, 2009	Birthplace, length of residence in US, generations, language spoken at home, and a self-developed acculturation	4530 hotel works in Hawaii, consisting of 42% Filipino, 32% Other Asian, 13% Pacific Islander, 9% White, 1%	Adjusted for sex, age and ethnicity in all models and adjusted for food intake in one model	BMI is higher among US born than foreign born, adjusting for gender and ethnicity. Age at arrival in US is negatively associated with BMI.

	scale consisting of age of migration, English ability and education level.	Black/African American and 3% Other.		
Lauderdale & Rathouz, 2000	Birthplace, and years in US	254,153 Asian American participants (Chinese, Filipino, Asian Indian, Japanese, Korean, Vietnamese) aged 18-59 included in the 1992-1995 NHIS	Adjusted for age and ethnicity, and stratified by gender.	For both men and women, US born individuals are more likely to be overweight or obese. Among the foreign-born, longer residence in the US is associated with higher odds of being overweight or obese.
Lee, 2008	A self-developed acculturation scale based on the two-culture matrix model with 3 groups: acculturated, bicultural and traditional.	A total of 347 Korean Americans aged 17 or older randomly sampled from telephone books searching by Korean surnames nation-wide.	Adjusted for age, size of place of residence, income, education, working status, and marital status	Analysis was only carried out in men because the low prevalence of overweight/obese in women. Bicultural men were significantly more likely than traditional men to be overweight/obese, but the comparison between acculturation and traditional men was not significant.
Park, 2005	Birthplace	A total of 492 Korean American women residing in Hawaii and Los Angeles.	Adjusted for age and education.	The average BMI was significantly higher in US-born than in Korean-born. Total fat intake was higher and vegetables and fruit intake was

				significantly lower among US born than Korean-born.
Song, 2004	SL-ASIA (classified as unacculturated, bicultural, and acculturated).	500 Koreans in Seoul and 2830 Korean Americans residing in California.	Adjusted for age and stratified by gender.	All 3 groups of Korean American men had at least 2 times the odds of becoming overweight than Korean men in Seoul. For women, only the most acculturated had significantly higher odds of being overweight compared to women in Korean.
Yeh, 2009	Length of residence in US, language preference and media use	2,342 Chinese Americans living in New York City	Multi-variate analysis not used.	Length of residence is positively associated with weight status. English media preference was not associated with weight status.
Cho, 2006	Length of residence in US	492 Korean Americans who participated in 2003 California Health Interview Survey	Adjusted for age, sex, marital status, education, poverty, working hours per week, smoking and drinking status, health insurance	Those who have lived in US for 15 years or more, or were born in US were significantly more likely to be overweight/obese than those who have lived in US less than 5 years.

## Chapter 2: Research Questions

The overall goal of this thesis was to examine the relationship between acculturation, as assessed by SL-ASIA and other individual measures (e.g., age at arrival in the U.S., language preference, having education in the U.S. or not, food preference at home and in restaurants, self perception of acculturation), and BMI among Chinese, Korean and Vietnamese Americans in Maryland. Informed by the literature on acculturation studies summarized above, the current study aimed to answer following specific questions:

(1) Is there an association between acculturation and BMI, when acculturation is measured by SL-ASIA, age at arrival in the U.S., language preference, having education in the U.S. or not, food preference at home and in restaurants, perception of acculturation?

Since there is no standard measure of acculturation, it would be interesting to see if the association between BMI and acculturation would change when various measures are used. Based on previous studies, my hypothesis was that the association will be significant when acculturation was measured by SL-ASIA, and age at arrival in the U.S., but not for language preference.<sup>45, 48</sup> Compared to using length of residence in the U.S. as an acculturation predictor, age at arrival takes account for the age when entering the U.S., implying that acculturation effect might be different for those who have entered the U.S. as children versus as an adult.<sup>8</sup> Previous studies found that those who came to the U.S. before age 20 were found to be more likely to be overweight/obese than those who came after age 50.<sup>43</sup> To the best of my knowledge, food preference and perception of

acculturation have been seldom used in examining the association between acculturation and BMI. My hypothesis is that there will be an association between food preference, perception of acculturation and BMI.

(2) Is acculturation independently associated with increased BMI after controlling for potential confounders?

As mentioned above, few studies have taken socioeconomic factors into account when examining the association between acculturation and health. Available information on education, employment status, household income and access to health care from the data set and adjusting for them in the multivariate-adjusted models (more details on the data set will be provided in the methods section) would allow me to examine the independent association of acculturation on weight status. My hypothesis was that higher acculturation level was associated with increased BMI after controlling for SEP and other confounders.

(3) Is there an interaction between acculturation and potential confounders, such as ethnicity and sex?

Asian Americans are not a homogeneous group and Chinese, Korean and Vietnamese included in this study might differ significantly in migration history/patterns, socioeconomic positions, and even the features of their own culture of origin. Though the association is hypothesized to vary among three subgroups, there is no trend or pattern could be predicted given the scarcity of literature.

The studies mentioned previously have pointed out the necessity of stratified analysis by sex.<sup>47, 48</sup> Based on these findings, my hypothesis is that the



association between acculturation and weight status is stronger among men than that among women.

## Chapter 3: Methods

### **Study design**

This paper used data from a randomized community trial delivered by the Asian American Liver Cancer Program (AACP), an ongoing community-based participatory research collaboration between Johns Hopkins School of Public Health (JHSPH) and the University of Maryland School of Public Health (UMDPSH), and funded by the National Cancer Institute. From November 2009 to June 2010, the AACP conducted a randomized community trial on liver cancer prevention in Chinese, Korean and Vietnamese communities in Maryland. Considering it was a hard-to-reach population, a convenience sample was recruited through community-based or faith-based organizations (such as churches or language schools, Asian grocery markets/restaurants, nail salons and universities). Flyers were posted in these organizations/locations, recruitment advertisements were distributed on organizational list-serve and local news papers, and announcement were made during church service. Eligibility criteria included: (1) self-identified Chinese/Korean/Vietnamese Americans; (2) 18 years of age and over; (3) those who had never participated in other hepatitis B or liver cancer education program. Organizational membership was not required for participation, and potential participants were encouraged to bring their family members, friends and neighbors to the study.

For both the intervention and control arms, each participant was asked to fill out a 51-item questionnaire consisting of questions on demographics, general health, hepatitis B screening and vaccination experience, hepatitis B knowledge,

perceived norms, risk and efficacy on hepatitis B screening, access to health care, revised 12-item SL-ASIA, health behaviors, mental health, cultural views on cancer, and health literacy. When they completed the questionnaire, height and weight were measured by the research team at the study site, and BMI was calculated.

Information from the questionnaire (i.e., demographic information and acculturation scale) and BMI data were used in the analysis for this study, which was cross-sectional in nature.

### **Description of study sample and participants recruitment**

A total of 877 participants were recruited for the trial, consisting of 303 Chinese, 294 Koreans and 280 Vietnamese. For the purpose of this study, the sample was restricted to the subjects who had information on both height and weight, reducing the sample to 847 subjects. All 847 subjects had at least one acculturation variable: age at arrival in the U.S. (calculated by current age subtract the duration of residence in the U.S.), language preference, proportion of education in US, or completion of the SL-ASIA. Therefore, the analytic sample for testing each acculturation variable was slightly different due to missing subjects. Completion of SL-ASIA was defined as those who had up to 2 missing items out of 12 items in the scale, and the summary score was calculated by averaging the scores of non-missing items.

### **Human Subjects**

The parent study, Asian Liver Cancer Project, was approved by the Institutional Review Board of JHSPH, and JHSPH was the IRB of record. The

current thesis project used de-identified data that were collected by Asian Liver Cancer Project and approved by the Institutional Review Board, University of Maryland College Park.

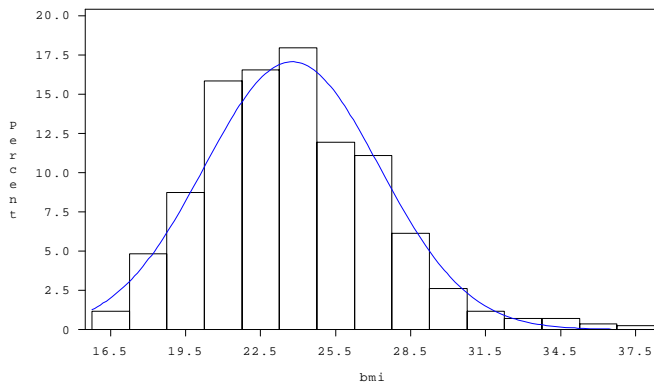
## **Description of variables**

### **(1) Outcome variable**

The outcome variable, BMI was calculated by weight in kilograms divided by the square of the height in meters ( $\text{kg}/\text{m}^2$ ). Height and weight was measured for each participant at study sites by research staff using a standard scale and height measuring rod.

The distribution of BMI as a continuous variable in the study sample was slightly skewed to the right, ranging from 15.9 to 37.8 with a mean of 23.8 and median of 23.5. (Figure 1)

**Figure 1 Distribution of BMI in the study sample**



### **(2) Exposure variables**

Acculturation was measured using the revised 12-item SL-ASIA and other non-scale based measures. The summary score of the revised SL-ASIA was the average of the standardized scores (i.e., z-score) of each item, including 9

multiple choice questions (original score ranging from 1 to 5), two continuous score (proportion of education in the U.S. and proportion of life in the U.S.), and one binary score for generation (i.e., first generation if the respondent was foreign born, second or more if he/she was born in the U.S.).

Other non-scale based measures included age at arrival in the U.S., education in the U.S., self perception of acculturation, food preference at home and in restaurants, and language preference. The food and language preference questions were derived directly from the SL-ASIA scale, and they were measured on a 5-point likert scale varying from “Exclusively American” to “Exclusively Asian” at two ends. Age at arrival (calculated by subtracting years living in the U.S. from current age subtract) and education in the U.S. (dichotomized as having any education in the U.S. or not) were derived from the questions in the SL-ASIA. Proportion of life in the U.S. (calculated as years of living in the U.S. divided by current age) and proportion of education in the U.S. (calculated as years of education in the U.S. divided by the sum of years of education in the U.S. and home country) were correspondingly used in the SL-ASIA scale. Self perception of acculturation was measured by one single question “How do you rate your self” on a 5-point likert scale which is not included in the short version of SL-ASIA.

### **(3) Potential confounding variables**

Age, sex, ethnicity, income, marital status, and education were considered to be potential confounding variables based on previous studies on acculturation and body weight.<sup>40, 43, 44, 46-48</sup> Age, sex, marital status and socioeconomic position

(i.e., education, income) have been found to be related to weight status.<sup>50, 51</sup> Sex appears to moderate the association between acculturation and multiple health outcomes, though it is still under debate whether it is because men and women acculturate at a different pace or their health is affected differently by acculturation.<sup>8, 52, 53</sup> Similarly, the association between acculturation and BMI is also moderated by sex.<sup>54</sup>

Age was analyzed as a continuous variable.<sup>40, 47, 48</sup> Marital status was categorized as married (including married, single but living with a partner, and remarried), divorced/separated/widowed, and never married.<sup>40, 55</sup> Education level was categorized as less than high school, high school, some college (including vocational school and some college), and college graduate and above (including college graduate and attended graduate school).<sup>42</sup>

### **Statistical Analysis**

Descriptive analysis was conducted to assess the distribution of sociodemographic variables and acculturation variables, and check missing values for these variables. There were no or very few missing values in all exposure variables and covariates except household income (missing=32), for which a missing category was created. Mean BMI was compared among subgroups by sociodemographic characteristics and acculturation status using Anova (multi-group mean comparison) and T test (2 group mean comparison) as a first step to assess potential confounders in the study. SL-ASIA summary score was divided into quartiles based on the sample distribution.

Bivariate linear regression was performed to assess the unadjusted association between each acculturation measure and BMI. Covariates were added to the bivariate models one by one as a second step to assess confounding. Using SL-ASIA summary score as the exposure, all hypothesized confounders changed the crude parameter estimate by 10% and thus were confirmed as confounders. To further examine the confounding effect, covariates were grouped into two blocks: demographic block including age, sex and ethnicity, and SEP block including education, income and marital status, and added to the bivariate models block by block. Results show that the demographic block had a bigger confounding effect than the SES block for the former changed crude parameter estimate more than the latter. Based on the above steps and the previous literature, the final model was established which consisted of one acculturation variable plus covariates (age, sex, ethnicity, education, household income, and marital status) for each model. Multivariate linear analysis for the final model estimated the association between acculturation and BMI with one acculturation measure in each model, while accounting for potential confounders. Multicollinearity tests were performed using a variance inflation factor and tolerance test. In each multivariate model, the interaction between sex/ethnicity and the acculturation variable was tested. If the interaction term was significant, the parameter estimate was reported separately for men and women or for each ethnic group.

## Chapter 4: Results

Table 2 shows the socio-demographic characteristics and acculturation status of the study sample. Among 847 participants, approximately 58% were female and 42% were male, and each ethnicity accounted for about one-third of the sample. The mean age was 45 and ranged from 18 to 89 years and the majority was married. The study sample was generally highly educated with more than half having college education or more, but significant variation was found by ethnicity group: while college graduates predominated in the Chinese group (76%), they only accounted for one-third of Vietnamese. (Data not shown) More than half reported having an annual family income below \$50,000 per year.

The study sample was distributed towards the Asian end of the acculturation continuum as reflected by various acculturation measures. Ninety-seven percent of our participants were first generation immigrants. The mean age at arrival in the U.S. was 30 and the majority of them came after the age of 20. About 68% preferred Korean/Chinese/Vietnamese over English and 22% had no preference between Asian language and English. The vast majority liked Asian food better than American food both at home and in restaurants. More than half had some education in the U.S. and 77% perceived themselves as “Asians” rather than “Americans”.

The mean BMI was 23.75 for all participants and about one-third had BMI over 25. (Data not shown) As shown in Table 1, mean BMI differed by age group, sex, ethnicity, education level and marital status. Though the unadjusted mean BMI did not differ by most acculturation measures, it was significantly different



among people who came to the U.S. at different ages. Multicollinearity diagnostic tests were performed for each acculturation variable with potential confounders and all VIF values fell in a reasonable range. (Data not shown)

**Table 2 Mean BMI by Sociodemographic Characteristics and Acculturation variables (n=847)**

Characteristics	n	%	Mean BMI (SE)	P-value
<b>Age, y (mean= 45.00, SE=13.47)</b>				<0.0001
18-35	203	24.0%	23.17 (3.73)	
36-45	268	31.6%	23.48 (3.38)	
46-55	169	20.0%	23.77 (3.26)	
56 and above	207	24.4%	24.66 (3.49)	
<b>Sex</b>				<.0001
Female	493	58.2%	23.21 (3.50)	
Male	354	41.8%	24.51 (3.38)	
<b>Ethnicity</b>				0.003
Korean	282	33.3%	24.34 (3.59)	
Chinese	297	35.1%	23.52 (3.48)	
Vietnamese	268	31.6%	23.40 (3.39)	
<b>Education</b>				0.023
Less than high school	111	13.1%	24.59 (3.53)	
High school graduate	175	20.7%	23.67 (3.57)	
Some college	111	13.1%	24.05 (3.88)	
College graduate or higher	450	53.1%	23.50 (3.35)	
<b>Annual Family Income</b>				0.715
Less than \$20,000	204	24.1%	23.81 (3.76)	
\$20,000-49,999	254	30.0%	23.86 (3.65)	
\$50,000-74,999	107	12.6%	23.68 (3.16)	
\$75,000-99,999	94	11.1%	24.08 (3.16)	
More than \$100,000	156	18.4%	23.38 (3.43)	
Missing	32	3.8%	23.67 (3.54)	
<b>Marital Status</b>				0.015
Married/Partnered	647	76.4%	23.84 (3.42)	
Separated/ Divorced/ Widowed	71	8.4%	24.32 (3.89)	
Never been married	129	15.2%	22.99 (3.61)	
<b>SL-ASIA</b>				0.412
0-25%	211	24.9%	23.84 (3.42)	
26-50%	212	25.0%	24.04 (3.56)	
51-75%	212	25.0%	23.51 (3.93)	
76-100%	212	25.0%	23.63 (3.66)	
<b>Age at arrival in years (mean=30, SE=14.12)</b>				0.041

0-5	40	4.7%	24.93 (4.50)	
6-10	29	3.4%	23.68 (3.96)	
11-15	46	5.4%	23.31 (3.75)	
16-20	84	9.9%	23.38 (3.43)	
21-30	277	32.7%	23.36 (3.41)	
31-40	215	25.4%	23.95 (3.23)	
41 and above	155	18.3%	24.22 (3.58)	
<b>Language preference</b>				0.588
Asian language	578	68.2%	23.83 (3.48)	
Equal	190	22.4%	23.67 (3.30)	
English	79	9.3%	23.42 (4.17)	
<b>Education in the US</b>				0.703
Had any	448	52.9%	23.71 (3.69)	
None	393	46.4%	23.83 (3.31)	
<b>Food preference at home</b>				0.947
Asian	700	82.6%	23.75 (3.48)	
Equal	142	16.8%	23.79 (3.68)	
American	5	0.6%	23.68 (2.41)	
<b>Food preference in restaurant</b>				0.130
Asian	594	70.1%	23.61 (3.45)	
Equal	238	28.1%	24.13 (3.68)	
American	15	1.8%	23.24 (2.49)	
<b>Self perception of acculturation</b>				0.259
Asian	648	76.5%	23.69 (3.45)	
Equal	179	21.1%	23.84 (3.43)	
American	20	2.4%	24.96 (5.58)	

Though only age at arrival was significantly associated with BMI in bivariate analysis, this might be due to the confounding effect of age. For all acculturation measures except language preference and food preference at home, multivariate linear analysis shows that those who were more acculturated had higher BMI than those who were less acculturated after controlling for potential confounders, as indicated. (Table 3) Adjusting for age, sex, education, income, marital status and ethnicity, every unit increase in the SL-ASIA summary score (range:-1.37 to 1.41) resulted in 0.72 (95% CI: 0.19-1.25) unit increase in BMI, those who came to the U.S. between age 0-5 and 6-10 had 3.32 (95%CI: 1.84,

4.80) and 1.55 (95%CI: 0.02, 3.07) unit increase in BMI respectively compared to those who came at age 41 or over, those who had any education in the U.S. had 0.56 (95%CI: 0.01, 1.11) unit increase in BMI compared to those who did not have any education in this country, those who preferred Asian and American food equally in restaurants had 0.92 (95%CI: 0.38, 1.46) unit increase in BMI compared to those who preferred Asian food only, those who perceived themselves as “Americans” had 1.51 (95%CI: 0.002, 3.02) unit increase in BMI compared to those who rated themselves as “Asians”. Since the vast majority of our participants were first generation immigrants, the proportion of people who were most acculturated was relative small, i.e., only 1.8% of the total sample preferred American food in restaurants, which might explain some of the insignificant results (i.e., those who preferred American food in restaurants were not different in terms of BMI to those who preferred Asian food).

**Table 3 Parameter estimates for linear regression models of acculturation variables and BMI (n=847)**

Variable	Parameter Estimates	
	Unadjusted Beta Estimate (95% CI)	Adjusted Beta Estimate <sup>a</sup> (95% CI)
<b>SL-ASIA summary score</b>	-0.06 (-0.49, 0.38)	0.71 (0.15, 1.26)
<b>Age at arrival</b>		
0-5	0.70 (-0.51, 1.91)	3.32 (1.84, 4.80)
6-10	-0.54 (-1.92, 0.84)	1.55 (0.02, 3.07)
11-15	-0.91 (-2.06, 0.23)	1.06 (-0.27, 2.39)
16-20	-0.84 (-1.76, 0.09)	0.85 (-0.22, 1.91)
21-30	-0.86 (-1.55, -0.18)	0.53 (-0.32, 1.39)
31-40	-0.27 (-0.99, 0.45)	0.45 (-0.34, 1.24)
41 and above	REF	REF
<b>Language preference</b>		
Asian	REF	REF
Equal	-0.15 (-0.73, 0.42)	0.44 (-0.18, 1.07)
English	-0.41 (-1.23, 0.42)	0.44 (-0.44, 1.33)
<b>Education in the US</b>		
Had any	-0.11 (-0.59, 0.36)	0.56 (0.01, 1.12)
No	REF	REF
<b>Food preference at home</b>		
Asian	REF	REF
Equal	0.04 (-0.60, 0.67)	0.25 (-0.37, 0.88)
American	-0.48 (-3.57, 2.60)	0.01 (-2.97, 2.98)
<b>Food preference in restaurant</b>		
Asian	REF	REF
Equal	0.52 (-0.004, 1.05)	0.92 (0.38, 1.46)
American	-0.38 (-2.17, 1.42)	0.01 (-1.71, 1.73)
<b>Self Perception of acculturation</b>		
Asian	REF	REF
Equal	0.15 (-0.43, 0.73)	0.40 (-0.17, 0.97)
American	1.27 (-0.29, 2.83)	1.51 (0.002, 3.02)

CI: confidence interval

<sup>a</sup> Adjusted for age, sex, education, household income, marital status and ethnicity.

SL-ASIA summary score, self perception of acculturation and age at arrival had a significant interaction with sex, suggesting that acculturation has a stronger association in men than for women. One unit increase in SL-ASIA score

resulted in 1.35 units increase in BMI among men, but increasing SL-ASIA by one unit did not yield significant increase in BMI among women. Among men, those who perceived themselves as “Americans” had 3.88 unit increase in BMI (95%CI: 1.81, 5.96) compared to those who self perceived as “Asians.” However, this association was not significant among women. For both men and women, younger age at arrival was associated with increased BMI, but the significant increase was seen among those who came to U.S. between 0-5 years of age for men (4.65, 95%CI: 2.64, 6.67) and between 6-10 years of age for women (2.42, 95%CI: 0.31, 4.55) as compared to their counterparts who came to the U.S. at age 41 or over. (Table 4)

**Table 4 Parameter estimates for linear regression models of acculturation variables and BMI by sex**

Variables	Parameter Estimates (95% CI) <sup>a</sup>	
	Male	Female
<b>SL-ASIA</b>	1.35 (0.61, 2.11)	0.32 (-0.41, 1.05)
<b>Self perception</b>		
Asian	REF	REF
Equal	0.54 (-0.28, 1.37)	0.29 (-0.48, 1.06)
American	3.88 (1.81, 5.96)	-1.08 (-3.22, 1.06)
<b>Age at arrival in years</b>		
0-5	4.65 (2.64, 6.67)	1.65 (-0.56, 3.86)
6-10	1.32 (-0.84, 3.50)	2.42 (0.31, 4.55)
11-15	1.83 (-0.07, 3.74)	0.67 (-1.15, 2.50)
16-20	0.80 (-0.82, 2.41)	1.04 (-0.36, 2.44)
21-30	1.03 (-0.29, 2.37)	0.37 (-0.72, 1.46)
31-40	0.74 (0.62, -0.48)	0.23 (-0.79, 1.26)
41 and above	REF	REF

CI: confidence interval

<sup>a</sup> Adjusted for age, education, household income, marital status and ethnicity.

The association between acculturation and BMI also varies by three ethnic groups. As shown in Table 5, Korean Americans who came to the U.S. between

age 0-5 years and Chinese Americans who came to the U.S. between 0-5 years and 6-10 years had a significant increase in BMI compared to their counterparts who came at age 41 or over. No significant difference in BMI was found among Vietnamese who came to the U.S. at different age. Only among Chinese group those who perceived themselves as “Americans” had a significant increase in BMI (6.60, 95% CI: 3.33, 9.87). No association between self perceived acculturation and BMI was found for the other two ethnic groups.

**Table 5 Parameter estimates for linear regression models of acculturation variables and BMI by ethnicity**

	Parameter Estimates (95% CI) <sup>a</sup>		
	Korean	Chinese	Vietnamese
<b>Self perception</b>			
Asian	REF	REF	REF
Equal	0.82 (-0.32, 1.96)	0.55 (-0.35, 1.43)	-0.02 (-2.28, 2.22)
American	1.24 (-1.36, 3.84)	6.60 (3.33, 9.87)	-0.02 (-0.99, 0.93)
<b>Age at arrival in years</b>			
0-5	4.92 (2.00, 7.84)	9.34 (5.70, 12.97)	1.85 (-0.53, 4.24)
6-10	0.52 (-2.27, 3.31)	6.99 (3.20, 10.77)	0.87 (-1.59, 3.33)
11-15	0.89 (-1.43, 3.22)	2.31 (-0.40, 5.03)	0.97 (-1.29, 3.22)
16-20	0.07 (-1.76, 1.89)	2.16 (0.14, 4.17)	0.72 (-1.11, 2.56)
21-30	0.03 (-1.35, 1.40)	1.57 (-0.03, 3.16)	0.71 (-0.84, 2.25)
31-40	-0.18 (-1.46, 1.10)	1.60 (0.16, 3.03)	0.38 (-1.16, 1.91)
41 and above	REF	REF	REF

CI: confidence interval

<sup>a</sup> Adjusted for age, sex, education, household income, and marital status.

## Chapter 5: Discussion

This study found that more acculturated Asian Americans were more likely to have increased BMI, as indicated by various acculturation measures, including SL-ASIA, age at arrival in the U.S., education in the U.S., self perception of acculturation, and food preference in restaurants. The relationship between certain acculturation measures (i.e., SL-ASIA, age at arrival and self perception of acculturation) and BMI was modified by sex. Among Asian American men, those who were more acculturated consistently had significantly higher BMI across these three measures. For women, only significance in BMI was seen for those who came to U.S. at different age. We also found an ethnic-specific association between acculturation and BMI: the association was strongest among Chinese Americans and weakest among Vietnamese Americans.

Consistent with earlier studies among Asian Americans, acculturation was positively associated with weight status.<sup>45, 47, 48, 55</sup> This might be explained by the adaption of US lifestyles by immigrants, especially dietary patterns. We found that those who preferred American food in restaurants had higher BMI than those who preferred Asian food. Dietary change along with acculturation process, more specifically, more fats or sweets intake but less consumption of vegetables and fruits were reported among Asian immigrants by earlier studies.<sup>46, 48, 56-58</sup> However, some studies also suggest that more acculturated Korean Americans tended to exercise more frequently compared to less acculturated counterparts.<sup>48,</sup>

<sup>49</sup> As most of these studies are cross-sectional, further studies, preferably

prospective studies, are needed to disentangle the factors contribute to weight gain along with the acculturation process.

Gender difference on in the association between acculturation and BMI found in our results is consistent with previous observations that acculturation seemed to have stronger association with BMI among Asian American men than that among Asian American women.<sup>47, 48</sup> Yet, the direction of the gender effect of acculturation might depend on ethnicity of immigrants. Sanchez-Vaznaugh et al.'s study on length of residence and BMI with a California sample of immigrants of mixed ethnicity found an opposite relationship as the current study: the association was stronger among women rather than among men.<sup>54</sup> The mechanism of the gender effect of acculturation on health is still unclear, for which traditional gender roles (i.e., women being more restricted to domestic work, thus slower in acculturation process and more social isolated) were thought to be possible explanations.<sup>8</sup> Gender differences in the desired body size exist among Asians Americans, specifically more men preferred larger body size over same or smaller body size while more women preferred smaller body size.<sup>59</sup>

The observed difference in the relationship between acculturation and BMI in the current study is noteworthy. Though a small but growing body of literature have suggested the importance of region of origin in acculturation and BMI,<sup>2, 60</sup> very few have looked at the heterogeneity among Asian subgroups. Refugee background might distinguish Vietnamese Americans from Chinese and Korean Americans in our study. Compared to Chinese and Korean Americans, Vietnamese Americans had a higher proportion of people with low family income



and low education. However, there is a scarcity of research on acculturation and BMI among Vietnamese and more studies are needed for this specific population to understand their unique acculturation process and its impact on health.

As we have hypothesized, the association between acculturation and BMI varied by the type of measures. While positive relationship between acculturation and BMI was found for SL-ASIA, age at arrival, self perception of acculturation, education in the U.S., and food preference in restaurants, no such relationship was revealed for language preference and food preference at home. Since acculturation is a complex and multi-facet process, it is possible that various measures capture different aspects of acculturation, some of which relate to the factors that contribute to weight gain while others do not. Acculturation status as measured by this shortened version of SL-ASIA was also found to be positively associated with BMI in Song et al.'s study among a mixed sample of Koreans in Seoul and Korean Americans.<sup>48</sup> Findings from Song et al.' study and the current study suggest that SL-ASIA was a useful tool in examining the relationship between acculturation and weight status among multi-ethnic Asian Americans. Our finding that age at arrival was a strong predictor of BMI increase among immigrants was also consistent with earlier studies.<sup>43, 60</sup> Those who immigrated at a younger age more resembled native-born people than those who immigrated at older age in education attainment, material earnings, language acquisition, and health behaviors such as smoking and cancer screening.<sup>61-65</sup> The lack of association between language preference and BMI was also consistent with the earlier study that used preference of English media as proxy of acculturation

among Chinese Americans.<sup>45</sup> Though language preference/English proficiency was quite often used as a proxy measure of acculturation, it is not yet clear how language might impact on physical health except that barriers it might impose on health care access.<sup>5</sup> Education in US and self perception of acculturation were less often used as measures of acculturation, but they worked just as well as other more complicated measures such as SL-ASIA in our study, yet easier to administer.

### **Strengths and Limitations**

The use of objective measure of height and weight instead of self report was a major strength of this study. Previous studies have found systematic underreporting of weight and over-reporting of height were found in self-reported height and weight and possibly underestimation of BMI.<sup>66, 67</sup> Also, the error in self-reported height and weight vary between men and women.<sup>66, 68</sup> However, previous studies that examined the association between overweight and acculturation among Asian Americans have mostly used self-reported height and weight to calculate BMI.<sup>41, 44-48</sup>

Acculturation was measured by both 12-item SL-ASIA scale and other acculturation measures including language preference, age at arrival, education in US, food preference and self perception of acculturation in this study. Very few studies have employed and contrasted multiple acculturation measures and this might help to disentangle the effect of contributing factors in the multi-dimension and multi-faceted process of acculturation on BMI.

The sample used in this study includes Chinese, Korean and Vietnamese Americans with a decent sample size that allows me to compare and contrast the association between acculturation and overweight in these three groups, where very limited studies have reported the ethnic-specific association in a setting of multi-ethnic Asian American population.<sup>44</sup> Asian Americans are not homogeneous in terms of culture, immigration background, or other demographic information that might be related to acculturation and weight status.<sup>8</sup> Thus it is meaningful to report ethnic-specific details on the association between acculturation and BMI.

Nevertheless, there are several limitations of the current study. First of all, it was a cross-sectional survey that cannot be used to infer a causal relationship between acculturation and BMI. Second, the majority of the sample was first generation immigrants and the distribution of acculturation status of the sample was towards the Asian end. This might reduce the power in detecting potential small associations between acculturation and BMI for some measures where the sample size of “acculturated” group might be small. Hence caution is needed when interpreting and generalizing the findings of the study. Third, because Chinese, Korean and Vietnamese in Maryland were hard-to-reach population, the sample in the study was a convenience sample and may represent the entire Chinese, Korean or Vietnamese population in Maryland. Lastly, this sample only included adults and three Asian subgroups, which limited its generalizability as well.

### **Public health significance**

The prevalence of overweight and obesity has been rapidly increasing in the past three decades in United States. In 2007-2008, 68.0% of the US adult population was either overweight or obese.<sup>69</sup> It was projected that, if the trend continues, 86.3% adults will be overweight or obese by 2030.<sup>70</sup> Obesity is a risk factor for a number of health problems, including cardiovascular diseases, diabetes, some types of cancer (i.e., breast cancer among women, colon cancer, and prostate cancer), breathing problems, arthritis and reproductive complications.<sup>71</sup> Obesity was responsible for an estimated 300,000 deaths every year.<sup>71</sup> In 1998, 9.8% of total US medical expenditures was attributable to overweight and obese.<sup>72</sup> Total U.S. expenditures are projected to be 16-18% by 2030, about 860-956 billion US dollars.<sup>70</sup>

National data on the prevalence of overweight and obesity among Asian Americans are scarce. The 2004-2006 National Health Interview Surveys (NHIS) indicates that 35.6% Asian Americans and Native Hawaiian or Other Pacific Islander were overweight or obese.<sup>75</sup> Specifically, about 26% of Chinese, 24% Vietnamese, and 30% Korean Americans were overweight or obese, compared to 58% of White.<sup>73</sup> An earlier study using 1992-1995 data from NHIS suggests that for both Asian American men and women, longer residence in US was accompanied by a significant increased risk of being overweight and obese.<sup>44</sup>

Despite relatively lower overall prevalence of overweight and obesity among Asian Americans nationwide, they were found to have greater prevalence of metabolic syndrome than whites in San Francisco Bay Area (30% as compared to 12% of non-Hispanic Whites).<sup>74</sup> Another study in New York City confirmed the

high prevalence of diabetes and impaired fasting glucose among Chinese immigrants even for those within normal range of BMI.<sup>75</sup>

The current study suggests that Asian Americans might have increased BMI as they acculturate to American culture. Given the epidemic of overweight/obesity nationwide and the higher prevalence of metabolic syndrome and diabetes among Asian Americans as discussed above, research is needed to identify the factors that might contribute to overweight/obesity as well as protective factors to prevent future increase in prevalence of overweight/obesity among Asian Americans. Research is also needed to examine how various aspects of acculturation such as changes in dietary patterns and physical activity contribute to the increased BMI in the acculturation process, as well as examine how these factors can be addressed in future culturally-tailored interventions to prevent overweight/obesity among Asian Americans.

## **Conclusion**

Results from the current study suggest that acculturation is moderately associated with BMI. The association between acculturation and BMI varies by measures of acculturation. The association of acculturation and BMI is moderated by sex and ethnic group.

Asian Americans are one of the fastest growing ethnic groups in the U.S.<sup>76</sup> The Asian American population in Maryland has increased by 38.1% from 2000 to 2009.<sup>77, 78</sup> Though our study does not provide direct evidence due to the cross sectional nature of the study, it is possible that we may see a rapid increase in the prevalence of overweight and obesity as Asian Americans stay in the U.S. longer

and become more acculturated. Future research may identify lifestyle factors that contribute to the increase of BMI in the acculturation process. Information from the current study and other similar studies may provide useful information for developing culturally tailored intervention to prevent an obesity epidemic of this population in the future.

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