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# Acculturation and BMI Among Chinese, Korean and Vietnamese Adults

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## Abstract

The objective of this study is to examine the association between acculturation and BMI among Asian Americans using multiple measures of acculturation. Data of 847 Chinese, Korean and Vietnamese recruited for a health education program in Maryland during 2009 to 2010 were used. 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 regressions were used to estimate the association between acculturation and BMI. After adjusting for age, gender, education, income, marital status, and ethnicity, SL-ASIA ($\beta = 0.71$, SE = 0.28), having education in the US ($\beta = 0.56$, SE = 0.28), younger age of arrival (0–5 years: $\beta = 3.32$, SE = 0.76, 6–10 years: $\beta = 1.55$, SE = 0.78), self identified as Americans ($\beta = 1.51$, SE = 0.77) and equal preference of Asian/American food in restaurants ($\beta = 0.92$, SE = 0.28) were significantly associated with increased BMI. The association between acculturation and BMI was stronger among men than women, strongest among Chinese and weakest among Vietnamese. Acculturation was moderately associated with increased BMI among Asian Americans and this association varied by measures of acculturation. The association of acculturation and BMI was moderated by sex and ethnicity groups.

### Keywords

BMI; Obesity; Acculturation; Asian Americans

## Introduction

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 [1]. Obesity is a risk factor for a number of health problems, such as cardiovascular diseases, diabetes, breast cancer, colon cancer, and etc., and hence is responsible for an estimated 300,000 deaths every year [2, 3].


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Asian Americans are one of the fastest growing ethnic groups in the U.S. [4]. The Asian American population in Maryland has increased by 38.1% from 2000 to 2009 [5, 6]. 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 [7]. Specifically, about 26% of Chinese, 24% Vietnamese, and 30% Korean Americans were overweight or obese, compared to 58% of White.

Acculturation describes the process during which individuals from one culture adapt to the characteristics of a host culture, such as customs, traditions, practice or behaviors [8]. Existing measures of acculturation can be roughly divided into two types: scale based and non-scale based [9]. Non-scale based measures typically consist of language preference, time since immigration, birthplace, generation, and etc. Specifically designed to assess acculturation among Asian immigrants, the Suinn-Lew Asian Self-Identity Acculturation Scale (SL-ASIA) consists of 21 multiple choice questions covering language, identity, friendship choice, behavior, generation/geographic history, and attitude [10]. The SL-ASIA has been tested among various Asian American subgroups including Chinese, Korean and Vietnamese with satisfactory internal consistency [11–13].

Results from previous studies that examined the association between acculturation and obesity among immigrant populations are fairly consistent: a higher level of acculturation, assessed by various measures of acculturation including age at arrival, duration of residence, language preference, birthplace, or certain acculturation scales is associated with increased BMI or higher likelihoods of being overweight or obese [14–17]. Studies among Asian Americans also confirmed the positive relationship between acculturation and weight status [16, 18–22]. Gender difference on acculturation and weight status is also noted among Korean Americans, reporting a strong association among men than women [22].

The overall goal of this paper was to examine the relationship between acculturation, as assessed by SL-ASIA and other individual measures, and BMI among Chinese, Korean and Vietnamese adults in Maryland. Rarely done in other studies, the use of multiple acculturation measures in the same study would allow us to contrast and compare these measures and how they relate to weight status among Asian Americans. Since various measures may capture various aspect of acculturation, the difference in the association between acculturation and weight status we observe may help to better understand the contributing factors to weight change in the acculturation process. Given that only a few previous studies that examined the relationship between acculturation and weight status among Asian Americans have taken socioeconomic status into account [16, 18–22], our study would improve the understanding of the association between acculturation and weight status by adjusting for the confounding effect from socioeconomic status. Furthermore, this study would examine and compare ethnic-specific association, which was rarely done in similar studies among Asian Americans. Lastly, the use of objective measure of height and weight might reduce errors in self reported height and weight that have been found in previous studies [23, 24].

## Methods

### Participants

The current study used data from a randomized community trial on liver cancer prevention conducted by the JHSPH and the UMCP School of Public Health in Chinese, Korean and Vietnamese communities in Maryland from November 2009 to June 2010. Considering it was a hard-to-reach population, a convenience sample was recruited through community-based or faith-based organizations (i.e., churches or language schools, Asian grocery markets/restaurants, nail salons and universities). 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. Each participant was asked to fill out a 51-item questionnaire, from which demographic information and acculturation questions were used for the current study. When they completed the questionnaire, height and weight were measured by the research team at the study sites.

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, only those had information on both height and weight were included, reducing the sample to 847 participants.

The study was approved by the Institutional Review Board of Johns Hopkins School of Public Health (JHSPH) and University of Maryland, College Park (UMCP).

## Acculturation

Acculturation was measured using the revised 12-item SL-ASIA adapted by Hoffstetter et al. [25] and other non-scale based measures. The revised SL-ASIA included questions on language, friendship choice, behavior, years of education and years of residence in the country of origin and in the US, respectively, and country of birth. The summary score of the revised SL-ASIA was the average of the standardized scores (i.e., z-score) of each item. 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 $\alpha$ = 0.88–0.90) [25–27].

Other non-scale based measures included age at arrival in the US, education in the US, self identity, language preference, and food preference at home and in restaurants. These individual measures were calculated or categorized based on the information obtained from the revised SL-ASIA.

## BMI

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

## Statistical analysis

Descriptive analysis was conducted to assess the distribution of sociodemographic characteristics and acculturation variables. Mean BMI was compared among subgroups by sociodemographic characteristics and acculturation status using Anova (multi-group mean comparison) and *t* test (two-group mean comparison).

Bivariate linear regression and multiple linear regressions were performed to assess the unadjusted, age adjusted and multivariate adjusted association between each acculturation measure and BMI respectively. Covariates included age, sex, ethnicity, income, marital status, and education. Covariates were added into the model one by one to assess the confounding effect. Multicollinearity tests were performed using a variance inflation factor (VIF) and all VIF values were in an acceptable range.

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.

## Results

Table 1 shows the socio-demographic characteristics and acculturation status of the study sample. Among 847 participants, approximately 58% were female, and each ethnicity accounted for about one-third of the sample. The mean age was 45 years and the majority was married. Our participants were 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.

Participants were in general less acculturated as reflected by various acculturation measures. Ninety-seven percent of them were first generation immigrants. The mean age at arrival in the US was 30. About 68% preferred using Asian language over 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 US and 77% perceived themselves as ‘Asians’ rather than ‘Americans’. Having majority participants less acculturated was due to the nature of the main study, liver cancer prevention program, which targeted at the first generation immigrants.

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 US at different ages.

Table 2 shows unadjusted, age adjusted and multivariate adjusted (adjusting for age, sex, education, income, marital status and ethnicity) parameter estimates for all acculturation variables. Age had the biggest confounding effect among all covariates. In multivariate-adjusted models, higher SL-ASIA ($\beta = 0.71$, SE = 0.28), having education in the US ($\beta = 0.56$, SE = 0.28), younger age of arrival (0–5 years: $\beta = 3.32$, SE = 0.76; 6–10 years: $\beta = 1.55$, SE = 0.78), self identified as Americans ($\beta = 1.51$, SE = 0.77) and equal preference of Asian/American food in restaurants ($\beta = 0.92$, SE = 0.28) were significantly associated with increased BMI. 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.

SL-ASIA summary score, self identity 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 was not accompanied by significant increase in BMI among women. Among men, those who perceived themselves as ‘Americans’ had 3.88 (SE = 1.06) unit increase in BMI 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 (Table 3).

The association between acculturation and BMI varied by three ethnic groups. As shown in Table 4, younger age at arrival was associated with increased BMI among Korean and Chinese groups, but no significant difference in BMI was found among Vietnamese who came to the US at different ages. Only among Chinese group those who perceived themselves as ‘Americans’ had a significant increase in BMI ($\beta = 6.60$, SE = 1.67).

## Discussion

This study found that more acculturated Asian Americans were more likely to have increased BMI, as indicated by SL-ASIA, age at arrival in the US, education in the US, self identity, and food preference in restaurants. The relationship between certain acculturation measures (i.e., SL-ASIA, age at arrival and self identity) and BMI was modified by gender. 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 US at different age. We also observed ethnic difference in the association between acculturation and BMI: it was strongest among Chinese and weakest among Vietnamese.

Consistent with earlier studies among Asian Americans, acculturation was positively associated with weight status [19, 21, 22, 28] This may be explained by the adaption to 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 [20, 22, 29–31]. However, some studies also suggest that more acculturated Korean Americans tended to exercise more frequently compared to less acculturated counterparts [22, 32]. 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 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 [21, 22]. The mechanism of the gender difference 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 [9]. Our data also suggest that women were less acculturated than men as indicated by significantly lower SL-ASIA score. Additionally, gender differences in the desired body size exist among Asians Americans, specifically more men preferred a larger body size over same or smaller body size while more women preferred a smaller body size [33].

The difference in the relationship between acculturation and BMI among three Asian American subgroups in the current study is noteworthy. Very few studies have looked at the heterogeneity among Asian subgroups in the association of acculturation and weight status. Refugee background might distinguish Vietnamese from Chinese and Koreans in our study. There is a scarcity of research on acculturation among non-college-student 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 acculturation measures. Since acculturation is a complex and multi-faceted 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. SL-ASIA has been used to link acculturation to BMI in Korean population without adjusting for socioeconomic status [22]. Findings from our study suggest that SL-ASIA can be a useful tool in examining the relationship between acculturation and weight status among multi-ethnic Asian Americans and its effect was independent from socioeconomic factors. Age at arrival was a strong factor associated with BMI increase in non-Asian population [17, 34]. Our finding suggests that it may be an important factor in weight change in acculturation process among

Asian Americans as well 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 [35–39]. The lack of association between language preference and BMI was noted in earlier studies [19]. 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 [40]. Self identity was less often used as a measure of acculturation, but it worked just as well as other more complicated measures such as SL-ASIA in our study, yet easier to administer.

Nevertheless, there are several limitations of the current study and caution is needed for the interpretation of the study results. First of all, it was a cross-sectional study and a causal relationship between acculturation and BMI cannot be inferred. Second, the majority of the sample was first generation immigrants and in general less acculturated. This might reduce variability in acculturation status and further the power in detecting potential associations between acculturation and BMI for some measures where the sample size of ‘acculturated’ group might be small. This may also result in reduced generalizability. Third, because Chinese, Korean and Vietnamese in Maryland were hard-to-reach population, the sample in the study was a convenience sample and may not represent the entire Chinese, Korean or Vietnamese population in Maryland.

## Conclusion

Findings from our study suggest a moderate increase of BMI associated with acculturation among Asian Americans indicated by multiple measures of acculturation. This relationship was stronger among male than female, and varied by ethnicity. Though our results do not provide direct evidence of a causal relationship 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 live in the US longer and become more acculturated. Future research may examine the various aspects of acculturation such as changes in dietary pattern and physical activity and how they contribute to the increased BMI in the acculturation process. With these factors identified, intervention programs that address these particular issues in respect to overweight/obesity can be tailored to the needs of Asian Americans and may help to prevent overweight/obesity epidemic in this population group.

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## Table 1

Mean BMI by sociodemographic characteristics and acculturation variables (Maryland, USA, $n = 847$)

| Characteristics | *n* | % | Mean BMI (SD) | *P* value |
|---|---|---|---|---|
| Age, y (mean = 45.00, SD = 13.47) | | | | <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) | |
| Sex | | | | <.0001 |
| Female | 493 | 58.2 | 23.21 (3.50) | |
| Male | 354 | 41.8 | 24.51 (3.38) | |
| Ethnicity | | | | 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) | |
| Education | | | | 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) | |
| Annual family income | | | | 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) | |
| Marital status | | | | 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) | |
| SL-ASIA | | | | 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) | |
| Age at arrival in years (mean = 30, SE = 14.12) | | | | 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) | |

| Characteristics | *n* | % | Mean BMI (SD) | *P* value |
|---|---|---|---|---|
| 31–40 | 215 | 25.4 | 23.95 (3.23) | |
| 41 and above | 155 | 18.3 | 24.22 (3.58) | |
| Language preference | | | | 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) | |
| Education in the US | | | | 0.703 |
| Had any | 448 | 52.9 | 23.71 (3.69) | |
| None | 393 | 46.4 | 23.83 (3.31) | |
| Food preference at home | | | | 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) | |
| Food preference in restaurant | | | | 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) | |
| Self identity | | | | 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) | |

*SD* Standard deviation, *n* number in sample

## Table 2

Parameter estimates for linear regression models of acculturation variables and BMI (Maryland, USA, $n$ = 847)

| Variable | Parameter estimates | | |
|---|---|---|---|
| | Unadjusted beta estimate (SE) | Age adjusted beta estimate (SE) | Multivariate adjusted beta estimate (SE)[a] |
| SL-ASIA summary score | −0.06 (0.22) | 0.70 (0.26)[c] | 0.71 (0.28)[b] |
| Age at arrival | | | |
| 0–5 | 0.70 (0.62) | 3.27 (0.75)[c] | 3.32 (0.76)[c] |
| 6–10 | −0.54 (0.70) | 1.62 (0.79)[b] | 1.55 (0.78)[b] |
| 11–15 | −0.91 (0.58) | 1.16 (0.68) | 1.06 (0.68) |
| 16–20 | −0.84 (0.47) | 0.91 (0.55) | 0.85 (0.55) |
| 21–30 | −0.86 (0.35)[b] | 0.61 (0.43) | 0.53 (0.43) |
| 31–40 | −0.27 (0.37) | 0.68 (0.40) | 0.45 (0.40) |
| 41 and above | REF | REF | REF |
| Language preference | | | |
| Asian | REF | REF | REF |
| Equal | −0.15 (0.29) | 0.19 (0.30) | 0.44 (0.32) |
| English | −0.41 (0.42) | 0.33 (0.44) | 0.44 (0.45) |
| Education in the US | | | |
| Had any | −0.11 (0.24) | 0.51 (0.27) | 0.56 (0.28)[b] |
| No | REF | REF | REF |
| Food preference at home | | | |
| Asian | REF | REF | REF |
| Equal | 0.04 (0.32) | 0.37 (0.32) | 0.25 (0.32) |
| American | −0.48 (1.57) | 0.37 (1.56) | 0.01 (1.52) |
| Food preference in restaurant | | | |
| Asian | REF | REF | REF |
| Equal | 0.52 (0.27) | 0.96 (0.27)[c] | 0.92 (0.28)[c] |
| American | −0.38 (0.91) | 0.08 (0.90) | 0.01 (0.88) |
| Self identity | | | |
| Asian | REF | REF | REF |
| Equal | 0.15 (0.30) | 0.34 (0.29) | 0.40 (0.29) |
| American | 1.27 (0.79) | 1.75 (0.79)[b] | 1.51 (0.77)[b] |

*SE* standard error

[a] Parameter estimates adjusted for age (as continuous), sex, education, household income, marital status and ethnicity

[b] *P* value < 0.05

[c] *P* value < 0.01

## Table 3

Parameter estimates for linear regression models of acculturation variables and BMI by sex (Maryland, USA, $n = 847$)

| Variables | Parameter estimates (SE)[a] | |
|---|---|---|
| | Male | Female |
| SL-ASIA | 1.35 (0.43)[c] | 0.32 (0.37) |
| Self identity | | |
| Asian | REF | REF |
| Equal | 0.54 (0.42) | 0.29 (0.39) |
| American | 3.88 (1.06)[c] | −1.08 (1.09) |
| Age at arrival in years | | |
| 0–5 | 4.65 (1.03)[c] | 1.65 (1.13) |
| 6–10 | 1.32 (1.11) | 2.43 (1.08)[b] |
| 11–15 | 1.83 (0.97) | 0.67 (0.93) |
| 16–20 | 0.80 (0.82) | 1.04 (0.71) |
| 21–30 | 1.04 (0.68) | 0.37 (0.56) |
| 31–40 | 0.74 (0.62) | 0.23 (0.52) |
| 41 and above | REF | REF |

*SE* standard error

[a] Parameter estimates adjusted for age (as continuous), education, household income, marital status and ethnicity

[b] *P* value < 0.05

[c] *P* value < 0.01

## Table 4

Parameter estimates for linear regression models of acculturation variables and BMI by ethnicity (Maryland, USA, $n = 847$)

| | Parameter Estimates (SE)[a] | | |
|---|---|---|---|
| | **Korean** | **Chinese** | **Vietnamese** |
| Self identity | | | |
| Asian | REF | REF | REF |
| Equal | 0.82 (0.58) | 0.55 (0.45) | −0.02 (1.15) |
| American | 1.24 (1.33) | 6.60 (1.67)[c] | −0.02 (0.49) |
| Age at arrival in years | | | |
| 0–5 | 4.92 (1.49)[c] | 9.34 (1.86)[c] | 1.85 (1.22) |
| 6–10 | 0.52 (1.42) | 6.99 (1.93)[c] | 0.87 (1.26) |
| 11–15 | 0.89 (1.19) | 2.31 (1.39) | 0.97 (1.15) |
| 16–20 | 0.07 (0.93) | 2.16 (1.03)[b] | 0.72 (0.94) |
| 21–30 | 0.03 (0.70) | 1.57 (0.81) | 0.71 (0.79) |
| 31–40 | −0.18 (0.65) | 1.60 (0.73)[b] | 0.38 (0.79) |
| 41 and above | REF | REF | REF |

*SE* standard error

[a] Adjusted for age (as continuous), sex, education, household income, and marital status

[b] *P* value < 0.05

[c] *P* value < 0.01