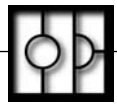

Research Article

Comparison of Body Mass Index (BMI) Categories Based on Asian and Universal Standards and Language Spoken at Home among Asian American University Students

Tiffany Ng, Shari McMahan, Michele Mouttapa, Sora Park Tanjasiri, and William Beam

ABSTRACT

Background: *The World Health Organization released lower Body Mass Index (BMI) cutoff points for Asian individuals to account for increased body fat percentage (BF%) and risk of obesity-related conditions at a lower body mass index.* ***Purpose:*** *This preliminary study: (1) explores the impact of utilizing Asian BMI standards (compared to universal standards) on the overweight/obese categorization of Asian females and males; and (2) determines whether age, gender, acculturation, and living arrangements are associated with BMI and BF%.* ***Methods:*** *Data on demographic variables, height and weight, BF%, living situation, and language spoken at home were collected from 170 Asian students enrolled in a health course at a public university in California.* ***Results:*** *When Asian BMI cutoffs were applied, categorization of Asian males and females as normal weight decreased significantly. Language spoken at home was not significantly associated with BMI; however, acculturated females tended to have higher BMIs than non-acculturated females, while acculturated males tended to have lower BMIs than non-acculturated males.* ***Discussion:*** *Utilization of Asian-specific BMI cutoffs will significantly increase the reported prevalence of overweight and obesity among Asians. Acculturation to the United States may be a risk factor for overweight/obesity especially among Asian females.* ***Translation to Health Education Practice:*** *Asian-specific BMI cutoffs may be appropriate in clinical settings, given that overweight-obesity related conditions occur at relatively lower rates of BMI and BF% among Asians.*

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BACKGROUND

The battle against obesity has become one of the greatest public health challenges of the twenty-first century.[1] Prevalence of obesity in the Asia-Pacific regions of the world have typically been lower than that in Europe or the United States.[1] However, increases in urbanization and westernization of many developing countries are now resulting in increased prevalence of overweight and obesity with trends towards more sedentary lifestyles and energy-dense diets with increased fat content.[2]

Overweight and obesity are major contributing factors for cardiovascular diseases in America; the first and second leading cause of death among Asian American and Pacific Islander men and women, respectively.[3,4] Asian American and Pacific Islander (AAPI) populations are among the fastest growing minority populations in the United States.[5] California has the highest percentage (12.1%) of Asian individuals in the United States[6] as well as the highest annual

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national medical costs related to overweight and obesity in the nation.[7] The impact of overweight and obesity, both physically and economically, is tremendous.

Changing BMI classifications for Asians

Confounding the increase in obesity and its related conditions in the Asia-Pacific regions is the fact that Asians tend to exhibit higher risk for metabolic diseases at lower body mass indices (BMI) than do Europeans, as well as higher body fat percentages (BF%) at the same age, sex, and BMI.[1] These reasons led the World Health Organization and the International Obesity Task Force to suggest lower BMI standards to classify overweight and obese Asians in the year 2000.[1] The universal standards are normal (18.6 - 24.9), overweight (25 - 29.9), and obese (> 30).[1] The lowered cutoff points for those of Asian-Pacific descent are normal (18.6 - 22.9), overweight (23 - 27.4), and obese (> 27.5).[1] The lowered cutoff points were found clinically relevant among many Asian populations in Asia, including Taiwanese,[8] Korean,[9] Japanese,[10] Chinese, Malays, and Asian Indians;[11] however, few studies have been conducted with Asian populations in the United States. If lowered BMI standards are applied to Asian American populations, prevalence of overweight and obesity among Asian Americans may be much higher than currently published levels.

Overweight/obesity among Asian American University Students

Many Asian Americans, particularly university students, exhibit lifestyle behaviors which put them at risk for overweight and obesity. In general, university students exhibit poorer dietary habits[12] and lower physical activity levels compared to high school students.[13] Lifestyle patterns during this stage of life have an important effect on long term health outcomes.[14] Asian American university students are especially at risk since they more likely to have sedentary lifestyles than other ethnic groups.[15] Asian Americans exhibit the same gender differences on levels of physical activity,[15] body fat percentage,[16] and average BMI[17] as other ethnicities.

Some factors that may be associated with the BMI and BF% of Asian American university students are whether or not they continue to live with one or more parents and whether or not they speak an Asian language at home. Parents are extremely influential in the dietary behavior of adolescents.[18] For example, in Chinese-American homes older relatives prefer, and tend to heavily influence, the household towards a Chinese diet.[19] University students who continue to live with one or both parents may continue to be influenced by their parents' diet. In addition, their family's level of acculturation; the cultural modification of an individual, group, or people by adapting to or borrowing traits from another culture,[20] may also affect the type of diet the household conforms to. Studies in the U.S. have shown that the acculturation of Asian immigrants in the U.S. puts both males and females at greater risk of overweight and obesity[16] through adoption of a western diet as opposed to the diet from their country of origin.[21] Since language is the most frequently used proxy measure of acculturation,[22, 23] English language spoken at home may indicate higher acculturation which is associated with conforming to a Western diet.

PURPOSE

The application of more stringent BMI cutoffs for the classification of overweight and obesity among Asian Americans may lead to the timely provision of prevention services to those who are at risk for obesity-related diseases. However, it is first important to know whether more stringent BMI cutoffs lead to higher rates overweight/obese classification. Furthermore, an increased knowledge about the psychosocial risk factors of obesity among Asian Americans (e.g., acculturation status, living arrangements) may also help clinicians better identify those who may be at greater risk for obesity. Finally, differences in gender (males and females) continue to yield important information in terms of both health education and prevention measures.[24] Hence, the present exploratory study: (1) explored the impact of utilizing Asian BMI standards (compared to universal standards) on the overweight/obese categorization of Asian females and males; and (2) determined whether age, gender, acculturation, and living arrangements are associated with BMI and body fat percentage.

METHODS

Participants

This cross-sectional study included a convenience sample of students enrolled in Personal Health (Health Science 101) classes at a university in Southern California during four consecutive academic semesters from 2005-2006. Participants underwent fitness measures administered by trained laboratory technicians in a fitness assessment laboratory. The analytic sample for this study was the 170 participants who identified themselves as Asian in the self-report survey. A specific breakdown of the Asian population was not assessed in this exploratory study as the question identifying ethnicity was extracted from the 2005 Behavioral Risk Factor Surveillance Study (BRFSS).[25]

Instruments and Measurements

Data collected in the fitness lab included age, gender, height, weight, and BF%. The body composition measurements (height, weight and skinfold thickness) were taken by trained laboratory technicians under the supervision of a faculty member. Each technician previously completed a laboratory course including instruction on anthropometric measurements and had at least one year of experience measuring skinfold thicknesses. Participant body weight was measured using a Toledo platform scale with correct calibration within 20 grams. Participant body height was measured using a stadiometer as the subject stood in stocking feet, heels together, against a wall, with the head in a Frankfort plane. BMI was calculated by dividing weight (pounds) by the square of height (inches) and multiplying the result by 703.

Participant BF% was estimated using a Harpenden skinfold caliper and the Jackson & Pollock 3-site skin fold method. Of the various methods utilized to estimate BF%,

skinfold measurements are the most variable and operator-dependent.[26] Despite its drawbacks, skinfold measurements are the most commonly utilized anthropometric measures for population scale BF% because it does not require costly machinery, laboratory work, or extended periods of time for measurement.[26] Studies show that skinfold measurements have a 3-5% variability in terms of accurately predicting BF%,[27] that correlation coefficients between skinfolds and hydrostatically determined body fatness consistently range from .70 to .90,[28] and that the reliability of skinfold measurements is high with test-retest reliabilities of .94-.98.[29] Skinfold measurements are therefore useful as an inexpensive method to predict BF% on a population scale[30] but less so on an individual scale. Male participants were measured at the chest, abdomen, and thigh. Female participants were measured at the tricep, suprailiac, and thigh.

Additional demographic data was collected with survey questions modeled after: (1) the 2005 Behavioral Risk Factor Surveillance Study (BRFSS)[25] (ethnicity information and self-reported height and weight); (2) the 2000 National Health and Nutrition Examination Survey (NHANES)[31] (language spoken at home); and (3) the 1995 National College Health Risk Behavior Survey (NCHRBS)[32] (living situation). They were obtained from a self-administered survey after the fitness lab assessment. Previous studies have demonstrated that these variables have high test-retest reliability.[33-35]

PROCEDURES

Participants were students from California State University, Fullerton, a racially and ethnically diverse campus composed of over 35,000 students. The inclusion criteria for this study were enrollment in a general education personal health course at California State University Fullerton and being 18 years of age or older. All personal health courses (live, not online) participated in the survey.

This study included 947 students (603 females, 344 males) enrolled in Health Science 101 classes at California State University Fullerton (CSUF) during fall 2005 (n = 358), spring 2006 (n = 270), summer 2006 (n = 23), and fall 2006 (n = 296) semesters. Response rate approached 100% of individuals enrolled in Health Science 101. Approximately 22% of students enrolled at CSUF were of Asian descent.[36] The analytic sample included 170 Asian individuals (18% of total sample).

All participants provided written consent, and data was collected during a fitness assessment lab that included age, gender, BMI calculated by measured height and weight, and BF%.

Design and Statistical Analysis

All analyses were performed utilizing SPSS 15.0 for Windows.[37] A total of 17 statistical procedures were performed. Following the Bonferroni correction procedure, the alpha level for statistical significance would be .05 / 17 = 0.003. However, Glantz[38] reported that as the number of statistical tests increases beyond 10, the Bonferroni method becomes over-conservative. Therefore, an alpha level of .05 / 10 = 0.005 was utilized.

Traditional vs. Asian-specific BMI cutoffs. To study the impact of Asian BMI cutoffs on Asians, frequencies and percentages of participants who belonged to each of the BMI categories (underweight, normal, overweight, and obese) were calculated using both the universal and Asian cutoff points for males and females separately. McNemar's test was performed to determine whether the difference in scores were significant, thus indicating significant changes in BMI status in this sample.

Associations between language spoken at home, BMI, and BF%. BMI and BF% data were tested for normality and were found to be positively skewed for both Asian males and females. Therefore, to examine the differences in BMI and BF% by language spoken at home, four Mann-Whitney U Tests (two for males separately and two for females separately) were performed to compare the BMI and BF% of Asians who spoke an Asian language (Chinese, Vietnamese, Korean, Japanese) at home and those who spoke English at home.

Associations between living situation, BMI, and BF%. To examine the differences in BMI and BF% by living situation, four Mann-Whitney U Tests were performed to compare the BMI and BF% of those who live with at least one parent to those who live with neither parent. Again, separate analyses were done for males and females.

Multivariate analyses. Lastly, multiple linear regression of BMI (independent variable) on living situation and language spoken at home (dependent variables) was performed, with age and sex included as covariates in the model. The same multiple regression model was run a second time, including an interaction term (language spoken at home by sex) to determine whether the observed association between language spoken at home and BMI and/or BF% varied by gender. The multiple linear regressions were also performed for BF% (independent variable) utilizing the same parameters.

Effect Size Calculations. Effect size calculations were done for the statistical tests utilized in this study. The general finding was that this study had the ability to detect medium/large effect sizes according to Cohen.[39] Post hoc analyses for the significant findings from the McNemar's tests yielded effect size correlation values of 0.21 - 0.39. Post hoc analyses of the multiple linear regressions yielded adjusted R^2 values of 0.084 for the BMI analysis and 0.247 for the BF% analysis.

RESULTS

Asian American student characteristics are presented in Table 1. One hundred seventy Asian individuals (58.2% female) were included in this study. The analytic sample represents nearly two thirds (64.4%) of the Asian students who were approached in their classrooms and provided complete data on all of the variables of interest. The mean age was approximately 20 years (SD = 1.8). About three fourths of the respondents lived with one or both parents. Approximately half of the respondents spoke only English at home, about a quarter of the students spoke English and an Asian language at home, and the remaining quarter spoke only an Asian language at home. There were no significant

differences in self-reported and actual BMI for both males and females in this sample. These two measurements were strongly correlated in our study (Pearson's r = .86), thereby demonstrating high construct validity for BMI calculated by observer-reported height and weight.

The Impact of Asian BMI Cutoffs on Categorization

Asian BMI cutoffs significantly affected the BMI categorization of both males and females. When Asian BMI cutoffs were applied to Asian females and males (Table 2), those categorized as normal decreased significantly.

Differences in BMI and BF% by Language Spoken at Home

The mean BMI of Asian females who spoke English at home (22.47) was higher than that of the Asian females who did not speak English at home (20.50), but the results were not statistically significant (p = 0.58). This pattern was the opposite among the males. The BMI of Asian males who spoke English at home (BMI = 24.42) was lower than males who did not speak English at home (BMI = 26.41), but the results were not statistically significant after Bonferroni adjustment (p = 0.028). Similarly, the gender x English spoken at home interaction term was not statistically significant after Bonferroni adjustment (p = 0.048). English spoken at home was not significantly associated with BF% for both genders. (Table 3).

Differences in BMI and BF% by Living Situation

For both males and females, there were no significant differences in BMI or BF% among those who lived with at least one parent and those who did not live with at least one parent (Table 3).

Multiple Linear Regression of BMI among Asians

The multiple linear regression revealed significant gender differences, with males having a higher BMI and BF% than females (Table 4). None of the other independent variables in the model were significantly associated with the dependent variables. Spearman's rho test was used to determine whether collinearity existed for living situation and language spoken at home. Spearman's rho = -.14, which indicated no collinearity (using Spearman's rho of -.90 as the collinearity reference point).

Table 1. Asian Female and Male Sample Population Characteristics

	Female		Male	
Total (N=170)	Asian (n=99)		Asian (n=71)	
	Mean	SD	Mean	SD
Age	19.8	1.84	20.07	1.80
Height (inches)	62.35	2.29	67.78	2.79
Weight (pounds)	121.77	8.14	161.08	27.80
BMI (kg/m2)	21.99	4.76	24.73	3.96
Body fat %	24.70	6.09	17.17	7.10
	n	%n	n	%n
English only	50	50.5	36	50.7
English & Asian language	26	26.3	18	25.4
Asian language only	23	23.2	17	23.9
Live with one or both parents	68	68.7	55	77.5

DISCUSSION

The BMI distribution of this sample of university students was very similar to the national comparison average BMI distribution for university students as reported by the American College Health Association for Spring 2006.[17] When the universal BMI standards were applied to Asian American female participants, the findings were consistent with many studies which reported that Asian individuals have lower rates of overweight and obesity than other groups.[16, 40, 41]

A greater proportion of the Asian American males in this sample were overweight under the universal standards compared to the Asian females. These results appear to reflect the national obesity prevalence trends published by the Centers for Disease Control[41] which show Asian and Pacific Islander males having a greater percentage overweight than their female counterparts, despite rates of obesity being relatively equal for Asian males and females. When the lowered Asian BMI cutoffs were applied to both Asian females and males, however, the categorization of individuals in the normal category decreased, with statistical significance for Asian males; while those categorized as overweight and obese nearly matched or exceeded the national average. These findings indicate that in our sample, a larger proportion of males relative to females were borderline overweight or obese according to national standards.

This study did not find a significant association between BMI and living with one or both parents. Although the BF% of males who lived with at least one parent was over 2.5% higher than males who did not live with at least one parent, it is unclear whether or not parental influence plays a role in the dietary behavior of university students. This study did, however, find that Asian American females tended to have higher BMI and BF% when English was spoken at home; however, these results did not reach statistical significance. The tendency for higher BMI and BF% among acculturated Asian females was consistent with literature[16] which suggests that higher acculturation is associated with higher BMI and BF%. In contrast, Asian males showed increased BMI and BF% when Asian languages were spoken at home, although these results did not reach statistical significance.

Table 2. Impact of Universal and Asian BMI standards on Overweight Categorization of Asian Females and Males

	Universal Standards	Universal Standards		Asian Standards			
Group	National Average[a]	Asian Sample		Asian Sample		Asian Sample	p-value
	%	N	%	n	%	% change	
Females							
Underweight	5.6	15	15.2	15	15.2	0	1.000
Normal	67.6	69	69.7	58	58.6	-11.1	0.0026*
Overweight	17.8	10	10.1	16	16.2	+6.1	0.041
Obese	8.9	5	5.1	10	10.1	+5.0	0.074
Total	99.9	99	100.0	99	100.0		
Males							
Underweight	2.6	1	1.5	1	1.5	0	1.000
Normal	58.2	34	50.7	21	31.3	-19.4	0.0009*
Overweight	28.8	26	38.8	31	46.3	+7.5	0.073
Obese	10.3	6	9.0	14	20.9	+11.9	0.013
Total	99.9	67	100.0	67	100.0		

[a]Averages based on American College Health Association National College Health Assessment for Spring 2006.
*Significant after Bonferroni adjustment.

Table 3. BMI and Body Fat Percentage of Asian Males and Females by Language Spoken at Home and Living Situation

	Female (n=99)				Male (n=71)			
	Mean	SD	Mann-Whitney U Statistic	P value	Mean	SD	Mann-Whitney U Statistic	P value
Mean BMI (kg/m2)								
English spoken at home	22.47	4.98			24.42	4.08		
			645.0	0.58			229.5	0.029
Asian language spoken at home	20.64	3.75			26.41	3.47		
Live with one or both parents	21.80	4.13			24.76	4.01		
			993.0	0.645			373.0	0.798
Do not live with parents	22.42	5.98			24.63	3.88		
Mean Body Fat %								
English spoken at home	25.00	5.97			16.27	6.57		
			813.0	0.678			373.0	0.288
Asian language spoken at home	24.35	6.06			19.04	8.34		
Live with one or both parents	24.74	5.99			17.75	7.28		
			966.5	0.68			310.0	0.142
Do not live with parents	24.63	6.43			15.02	6.15		

Table 4. Multiple Linear Regression of the BMI and BF% of Asians and Age, Sex, Living Situation and Language Spoken at Home

	Total (n=170) Beta (BMI)	P value	Total (n=170) Beta (BF%)	P value
Age	-0.006	-0.086	-0.06	0.359
Gender	0.55	0.000*	-0.48	0.000*
English Language Spoken at Home	0.18	0.070	0.05	0.432
Living Situation	-0.002	0.978	0.07	0.447
Gender x English Language Spoken at Home	-0.32	0.048	-0.03	0.752

* Significant after Bonferroni adjustment

The Asian female and the Asian male samples differed in nearly all areas of comparison with regards to BMI and BF%. Regarding gender differences in health behaviors, the results from this study had similar patterns to those of Ma et al.[20] where higher acculturation was associated with increased smoking among Asian females, but decreased smoking among Asian males. Ma et al.[20] attributed these findings to a shift in gender roles that occurs when Asians immigrate to the United States. Behaviors that are acceptable for males in Asia (e.g., smoking) is not as highly acceptable in the U.S., while Asian females in the U.S. are not as burdened by the gender constraints of the Asian culture (e.g., It is not acceptable for women to smoke). Although our findings did not quite reach statistical significance, they do suggest that acculturation to the U.S. may have a differential impact on obesity-related health behaviors among Asian males and females. Additional research is needed to further explore these gender differences.

Limitations and Precautions

Several limitations of this study may reduce the generalizability to larger populations. First, the participants in this study were recruited from a single public university in California. Therefore, we cannot be certain as to whether our findings generalize well to college-aged Asians outside of the university setting, those who live in different regions of the United States, and those whose country of origin may not have been represented in this study. Although California has the largest population of Asians in the United States,[6] large Asian populations exist throughout the state and across the United States. We recommend that future studies should explore the BMI and BF% among Asian Americans in non-university settings and in regions other than Southern California.

This study utilized an ethnicity question modeled after the 2005 Behavioral Risk Factor Surveillance Study (BRFSS),[25] which aggregated the various Asian groups into one Asian population. Studies have found that different Asian groups tend to show different patterns of body fat distribution[11] and that disaggregated data for Asians reveal health disparities specific to particular Asian groups.[42] Future studies on Asian groups should consider the implications of aggregating data for all Asians, and endeavor to segregate data by Asian subgroups by utilizing a ethnicity question more similar to that used by the U.S. Census Bureau. The addition of Asian subgroups may lead to accurate self-reports of ethnicity as well. For example, individuals in the Filipino ethnic group tend to split their self-reported ethnicity between Asian and Pacific Islander. Specific delineations in ethnicity survey questions would eliminate the confusion of which ethnic group Filipinos should report.

Why is the country of origin important? Research has shown that different Asian subgroups have observed differences in BF% at varying BMI[11] as well as observed differences in the prevalence of obesity and obesity-related conditions. Therefore, it is vitally important to conduct subsequent studies on Asian Americans of differing countries of origin.

The small sample size of Asian American students (n = 170) limited the types of analyses that could be performed and the robustness of the findings presented. Given the time and the resources available to us, the recruitment of additional Asian students in the study was not possible, nor was the collection of additional measures known to be associated with BMI and BF% (e.g., total caloric intake, fat intake, exercise, sedentary behavior, and frequency of meals eaten outside of home) an option. It is strongly recommended that future studies employ a larger sample size and a more comprehensive set of measures that may further illuminate predictors of overweight and obesity in the Asian population.

TRANSLATION TO HEALTH EDUCATION PRACTICE

Despite the differences in BMI distributions and patterns observed among the Asian females and males found in this study, the overall observation of this exploratory study is that Asians are not as underweight or normal as previously believed. When Asian BMI cutoffs were applied to Asian males and females, categorization of overweight and obesity increased to meet or exceed that the prevalence of overweight and obesity of other groups. These findings suggest that Asians should not be excluded from overweight and obesity prevalence reports, especially in study areas where the Asian population is particularly high, such as in California. The lowered Asian cutoff points should also be applied, at the very least, as a warning point to inform Asian Americans that they are at elevated risk of disease above a BMI of 23. Among

Asian populations, acculturation may play a role in dietary behaviors; therefore, measures of acculturation should be considered as potential factors contributing to the overall health of the individual. It is also important that physicians, health educators, and Asian communities are informed about the fact that Asians are at risk for overweight/obesity-related conditions at lower BMIs and BF% relative to other ethnic groups. The high rate of diabetes mellitus, cardiovascular disease, and cancers related to overweight and obesity observed among Asian populations[43, 44] may be potentially lowered if Asian individuals are made aware of their risks.

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