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Ethnic Differences in the Association between Body Mass Index and Hypertension

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Interest in ethnicity-specific definitions of obesity has been hindered by a lack of data clarifying whether or not obesity-related comorbid conditions occur at different levels of body mass index (BMI) (weight (kg)/height (m)^2) in different ethnic groups. The objective of this study was to examine ethnic differences in the strength of the association between BMI and hypertension. Cross-sectional data obtained from adults aged 30–65 years in China (1997, n = 3,423), the Philippines (1998, n = 1,929), and the United States (1988–1994, n = 7,957) were used. Higher BMI was associated with a higher prevalence of hypertension in all ethnic groups. However, at BMI levels less than 25, prevalence difference figures suggested a stronger association between BMI and hypertension in Chinese men and women but not in Filipino women, compared with non-Hispanic Whites. Non-Hispanic Blacks and Filipino women had a higher prevalence of hypertension at every level of BMI compared with non-Hispanic Whites and Mexican Americans. These ethnic differences in the strength of association between BMI and hypertension and in underlying prevalence warrant further investigation into the use of ethnicity-specific BMI cutoffs in clinical settings to more accurately identify individuals at risk from obesity. *Am J Epidemiol* 2002;155:346–53.

adult; body mass index; ethnic groups; hypertension; obesity

Body mass index (BMI) (weight (kg)/height (m)^2) is positively and independently associated with morbidity and mortality from hypertension, cardiovascular disease, type II diabetes mellitus, and other chronic diseases (1). In Caucasian populations, the association between BMI and mortality is "J-shaped," and the nadir of the curve occurs between the BMI levels of 18.5 and 25 (2, 3). On the basis of this association, the World Health Organization has devised a classification wherein persons with BMIs below 18.5–24.9 are considered underweight, those with BMIs above this range are considered overweight or "at risk," and those with BMIs greater than or equal to 30 are considered obese (4, 5).

In the effort to quantify the global obesity epidemic, it has become common practice for epidemiologists to apply these cutoffs to disparate populations and ethnic groups. A problem arising from the interpretation of these comparisons is an assumption that different ethnic groups have similar risks of morbidity and mortality at similar levels of BMI. There is no evidence to suggest that this assumption is valid (6). Indeed, limited evidence that Asians have a higher prevalence of disease at lower BMI levels than Caucasians has prompted an international task force (the World Health Organization/International Obesity Task Force) to recommend that overweight status for Asian adults be based on a BMI of 23.0–24.9 (7). Support for these Asian cutoffs comes primarily from a cross-sectional study of a workforce population of Hong Kong Chinese in which morbidity risk for type II diabetes, hypertension, dyslipidemia, and albuminuria increased at a BMI of approximately 23 (8). A higher risk of type II diabetes was also observed among Indian Asians from Mauritius at this BMI level (7). Other studies have found that Asians have smaller frames than Caucasians and therefore have higher levels of body fat at similar BMIs (9, 10). However, each of these studies represents a distinct Asian ethnic group, and rather than support the notion of a set of cutoffs that is generalizable to all "Asian" populations, as has been recommended, they point to cutoffs for defining obesity and overweight that are specific to individual ethnic groups.

Ethnic differences in disease morbidity and mortality have also been recognized in US racial/ethnic groups (11), as have differences in body composition (12). However, to our knowledge, ethnicity-specific BMI cutoffs for defining overweight and obesity have not been contemplated in the United States. There is a renewed focus in the United States on understanding these racial/ethnic disparities in health (13, 14), and redefining weight status according to ethnicity could dramatically influence how these disparities are viewed.

In this study, we used data obtained from two racial/ethnic groups in Asia and three racial/ethnic groups in the United States to examine ethnic differences in the association between BMI and hypertension.

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Abbreviations: BMI, body mass index; CI, confidence interval.

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MATERIALS AND METHODS

Subjects included in our investigation were nonpregnant participants aged 30–65 years from three different health surveys: the China Health and Nutrition Survey, the Cebu Longitudinal Health and Nutrition Survey from the Philippines, and the Third National Health and Nutrition Examination Survey from the United States.

The China Health and Nutrition Survey is an ongoing longitudinal survey conducted jointly by the Chinese Academy of Preventive Medicine and the University of North Carolina at Chapel Hill. The survey used multistage random cluster sampling to select participants from 3,800 households in eight provinces of China that vary considerably in terms of geography, stage of economic development, and health status. Further details on the design of the China Health and Nutrition Survey have been published elsewhere (15). In this analysis, we used 1997 cross-sectional data from 3,423 nonpregnant participants with blood pressure measurements.

The Cebu Longitudinal Health and Nutrition Survey is an ongoing study of a cohort of Filipino women who gave birth between May 1, 1983, and April 30, 1984 (16). Cross-sectional data from a 1998 follow-up survey of 1,929 women were included in this analysis.

For comparison with the Asian populations, similar data from 7,957 participants in the Third National Health and Nutrition Examination Survey were included. This survey, conducted by the US National Center for Health Statistics in two phases between 1988 and 1994, used a multistage sampling design to obtain national estimates of the health and nutritional status of the noninstitutionalized US population. Non-Hispanic Blacks and Mexican Americans were oversampled. Details on this survey have been published elsewhere (17) and can also be found at the National Center for Health Statistics website (http://www.cdc.gov/nchs/nhanes.htm).

Standard procedures for the measurement of blood pressure were used in all surveys (18). Three blood pressure measurements were taken by trained personnel on the right arm of each participant, who had been seated prior to measurement. Standard mercury sphygmomanometers were used with appropriate cuff sizes. Systolic blood pressure was measured at the first appearance of a pulse sound (Korotkoff phase 1) and diastolic blood pressure at the disappearance of the pulse sound (Korotkoff phase 5). We used the average of the three measurements from each of the surveys. Hypertension was defined as a systolic blood pressure greater than or equal to 140 mmHg and/or a diastolic blood pressure greater than or equal to 90 mmHg and/or the use of antihypertension medication.

An important issue related to this definition of hypertension is the potential for weight loss among persons who had been prediagnosed (i.e., those on antihypertension medication). Weight reduction is the primary lifestyle modification recommended for persons with hypertension. Moreover, this effect would be different between ethnic groups because of differences in the proportion of prediagnosed individuals (see tables 1 and 2). However, after conducting an analysis stratified by diagnosis, we chose to include persons with prediagnosed hypertension along with persons who were discovered to be hypertensive in the surveys, not only to maximize cell size but also because including them biased the data towards the null value or had no effect. For men, Chinese women, and non-Hispanic Black women, persons with prediagnosed hypertension had higher BMIs, thereby increasing the strength of the association between hypertension and BMI in each of the ethnic groups. However, the impact of including persons with prediagnosed hypertension in China was minimal, because the proportion of prediagnosed individuals was very low (6.4 percent for men and 16.2 percent for women; $p < 0.001$ compared with non-Hispanic Whites). Thus, differences observed between non-Hispanic Whites and Chinese are likely to be conservative estimates of the true association between newly diagnosed hypertension and BMI. For non-Hispanic White and Filipino women, there were no significant differences in mean BMI between hypertensive persons who had been prediagnosed and those who were discovered to be hypertensive during the surveys. Including prediagnosed individuals simply shifted the prevalence of hypertension upward, and strength-of-association comparisons between the ethnic groups were unaffected.

In each survey, height was measured in centimeters while the participant stood without shoes, and weight was measured in kilograms while the participant stood without shoes and in light clothing. BMI was calculated as weight in kilograms over height in meters squared. Waist circumference was measured in centimeters at the midpoint between the bottom of the ribs and the top of the iliac crest. Hip circumference was measured at the largest posterior extension of the buttocks.

Data from the three surveys were pooled. All analyses were stratified by gender and ethnic group. Ethnicity was self-defined in the Third National Health and Nutrition Examination Survey and geographically defined in the China Health and Nutrition Survey and the Cebu Longitudinal Health and Nutrition Survey. The data were not weighted because the two Asian surveys were not designed to be nationally representative.

Two statistical methods were used to compare the association between BMI and hypertension across ethnic groups. First, we used logistic regression to calculate the odds of prevalent hypertension across a range of BMI categories within each ethnic group. The category 18.5–22.9 was used as the referent category. We then constructed a pooled model that included ethnicity and interaction terms between ethnicity and BMI categories to examine ethnic differences. There are a number of factors that may confound the relation between BMI and hypertension. In preliminary analysis, we tested for confounding of this association by physical activity, smoking status, and alcohol consumption within each ethnic group. For all of the gender/ethnicity subgroup models, the only group for which the BMI cutoff coefficients changed in any meaningful manner was non-Hispanic Black women. Even for this group, however, the β coefficients did not change more than 10 percent, and the significance of the BMI-hypertension association was not changed. Thus, only age, as a continuous variable in the range 30–65 years, was controlled for in the models. Second, we examined the age-adjusted prevalence of hypertension across the BMI categories and calculated prevalence differences. Statistical significance was accepted at $p < 0.05$, and all analyses were carried out using Stata software, version 7.0 (Stata Corporation, College Station, Texas).

RESULTS

Compared with the US ethnic groups, Chinese men and women had a lower prevalence of hypertension and overweight. Filipino women were less overweight but more hypertensive than non-Hispanic Whites and Mexican Americans. After adjustment for age differences between the ethnic groups, Chinese men had a significantly lower ($p < 0.001$) mean systolic blood pressure than each of the US ethnic groups and a significantly lower mean diastolic blood pressure than non-Hispanic Blacks (table 1). Chinese men were also significantly less hypertensive ($p < 0.001$), and those who were hypertensive were less likely to be on antihypertension medication. They had a significantly lower mean BMI ($p < 0.001$), a lower ($p < 0.001$) prevalence of overweight and obesity (BMI ≥ 25), and less central adiposity ($p < 0.001$ for waist circumference and waist:hip ratio).

A similar pattern was observed for Chinese women, although they had a higher mean diastolic blood pressure ($p < 0.001$) than non-Hispanic White and Mexican-American women (table 2). There was no difference in mean blood pressure between Chinese and Filipino women ($p = 0.941$), but Filipino women had a significantly higher diastolic blood pressure ($p < 0.001$) that was similar to that for non-Hispanic Blacks. Filipino women were more hypertensive than Chinese, non-Hispanic White, and Mexican-American women, and, in comparison with Chinese women, a much higher proportion of Filipino hypertensive women were on antihypertension medication ($p < 0.001$). They were intermediate between Chinese and US women with respect to overweight prevalence but no different from Chinese women in terms of central adiposity ($p = 0.976$).

There were also differences in hypertension and body mass between the US ethnic groups. In brief, non-Hispanic Blacks were more likely to be hypertensive and to receive medication for their hypertension compared with non-Hispanic Whites and Mexican Americans. Non-Hispanic Black men were less obese (BMI ≥ 30) than Mexican-American men, but non-Hispanic Black women had the highest obesity prevalence of all the ethnic groups.

The odds of prevalent hypertension increased more steeply with higher BMIs for Chinese men in comparison with non-Hispanic Whites. Chinese men in the BMI range 23.0–24.9 had hypertension odds of 2.09 (95 percent confidence interval (CI): 1.50, 2.94) as compared with Chinese men in the BMI range 18.5–22.9 (figure 1). The equivalent odds ratios for Mexican-American, non-Hispanic White, and non-Hispanic Black men were 1.23 (95 percent CI: 0.57, 2.64), 0.89 (95 percent CI: 0.54, 1.44), and 1.39 (95 percent CI: 0.86, 2.22), respectively. Adjusting for waist:hip ratio attenuated the ethnic differences but did not eliminate them. Among women, the odds of hypertension for Chinese and Filipino women did not differ significantly from the odds for non-Hispanic White women at low levels of BMI (figure 2). However, the odds of hypertension increased quite steeply for Chinese women with BMIs above 27, to a level that was not matched by non-Hispanic Whites until attainment of BMI levels around 30. Non-Hispanic Black

TABLE 1. Selected characteristics of men aged 30–65 years who participated in the China Health and Nutrition Survey (1997) and the Third National Health and Nutrition Examination Survey (1988–1994), by ethnic group

	Chinese	White	Black	Mexican-American
Source survey	CHNS*	NHANES III*	NHANES III	NHANES III
No. of men in study	1,553	1,490	1,116	1,136
Mean age (years)	46.3 (9.4)†	47.4 (10.6)	44.6 (10.5)	46.2 (9.4)
Mean systolic blood pressure (mmHg)	119.2 (15.5)	125.3 (14.6)	128.4 (16.4)	125.7 (15.3)
Mean diastolic blood pressure (mmHg)	78.1 (10.3)	78.7 (9.4)	80.5 (10.8)	78.6 (9.5)
Hypertension‡ (%)	19.0	28.3	35.2	23.6
Taking antihypertension medication§ (%)	6.4	47.2	46.3	33.6
Mean weight (kg)	60.4 (9.5)	85.1 (16.3)	83.8 (18.4)	80.2 (14.8)
Mean height (cm)	164.8 (6.4)	176.8 (6.5)	176.4 (6.9)	169.6 (6.5)
Mean body mass index¶	22.2 (2.8)	27.2 (4.8)	26.9 (5.4)	27.8 (4.6)
Body mass index ≥25 (%)	15.6	65.7	60.2	73.6
Body mass index ≥30 (%)	1.1	22.9	22.9	27.5
Mean waist circumference (cm)	78.9 (9.1)	98.7 (12.4)	93.9 (14.4)	97.7 (11.9)
Mean waist:hip ratio	0.87 (0.07)	0.98 (0.06)	0.94 (0.07)	0.99 (0.06)

* CHNS, China Health and Nutrition Survey; NHANES III, Third National Health and Nutrition Examination Survey.
† Numbers in parentheses, standard deviation.
‡ Systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg or use of antihypertension medication.
§ Proportion of persons with hypertension who were taking antihypertension medication.
¶ Weight (kg)/height (m)^2.

TABLE 2. Selected characteristics of women aged 30–65 years who participated in the China Health and Nutrition Survey (1997), the Cebu Longitudinal Health and Nutrition Survey (1998), and the Third National Health and Nutrition Examination Survey (1988–1994), by ethnic group

	Chinese	Filipino	White	Black	Mexican-American
Source survey	CHNS*	CLHNS*	NHANES III*	NHANES III	NHANES III
No. of women in study	1,870	1,929	1,712	1,362	1,141
Mean age (years)	46.0 (9.4)†	42.1 (6.1)	46.8 (10.6)	43.9 (10.2)	44.6 (10.7)
Mean systolic blood pressure (mmHg)	116.6 (18.4)	113.4 (17.9)	119.6 (16.3)	124.6 (19.8)	121.6 (18.6)
Mean diastolic blood pressure (mmHg)	75.6 (10.7)	76.8 (11.9)	73.8 (8.6)	76.5 (10.9)	73.6 (9.0)
Hypertension‡ (%)	16.2	23.4	21.5	33.8	20.5
Taking antihypertension medication§ (%)	16.2	52.2	61.7	64.8	48.7
Mean weight (kg)	54.0 (8.9)	53.7 (10.4)	71.7 (17.3)	79.8 (20.3)	71.3 (15.5)
Mean height (cm)	154.5 (6.1)	150.7 (4.9)	163.0 (6.2)	163.3 (6.3)	156.5 (6.1)
Mean body mass index¶	22.6 (3.2)	23.6 (4.1)	27.0 (6.4)	29.9 (7.3)	29.1 (6.1)
Body mass index ≥25 (%)	21.1	35.0	54.4	73.1	73.6
Body mass index ≥30 (%)	2.2	6.7	27.5	44.3	37.9
Mean waist circumference (cm)	77.0 (9.5)	76.0 (9.3)	90.4 (15.3)	96.1 (16.4)	94.3 (13.3)
Mean waist:hip ratio	0.84 (0.08)	0.84 (0.05)	0.87 (0.08)	0.89 (0.08)	0.90 (0.07)

* CHNS, China Health and Nutrition Survey; CLHNS, Cebu Longitudinal Health and Nutrition Survey; NHANES III, Third National Health and Nutrition Examination Survey.

† Numbers in parentheses, standard deviation.

‡ Systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg or use of antihypertension medication.

§ Proportion of persons with hypertension who were taking antihypertension medication.

¶ Weight (kg)/height (m)^2.

women had lower odds of prevalent hypertension than non-Hispanic White women for most categories of BMI.

When we examined the age-adjusted prevalence of hypertension across categories of BMI, the pattern was one of more prevalent hypertension with higher BMIs for all ethnic groups. However, the slope appeared to be steeper for Chinese men at lower levels of BMI (figure 3). To confirm this, we examined prevalence differences between BMI categories for each ethnic group (table 3). There was a 10.8 percent increase in prevalent hypertension for Chinese men between the BMI categories of 18.5–22.9 and 23.0–24.9, as compared with a 1.8 percent decrease for non-Hispanic Whites, a 5.5 percent increase for non-Hispanic Blacks, and a 1.8 percent increase for Mexican Americans. The biggest

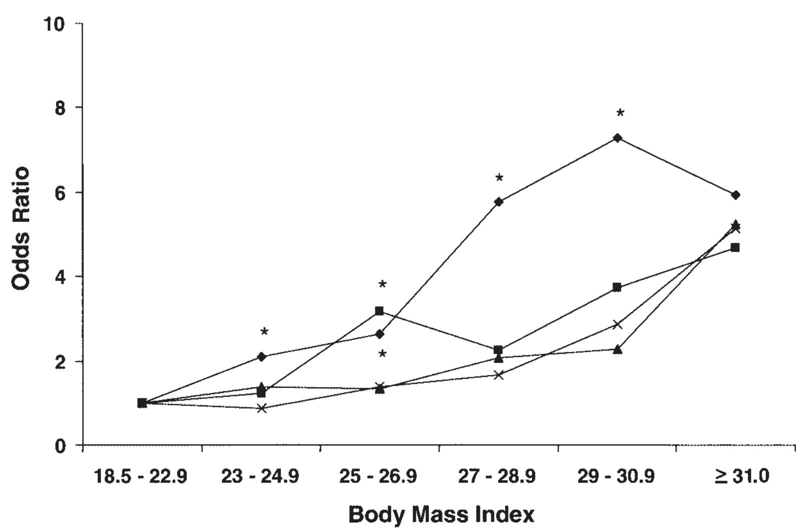

FIGURE 1. Age-adjusted odds of having hypertension over a range of body mass index (weight (kg)/height (m)^2) categories, by ethnic group, among men from three health surveys (the China Health and Nutrition Survey (1997), the Cebu Longitudinal Health and Nutrition Survey (1998), and the Third National Health and Nutrition Examination Survey (1988–1994)). ◆, Chinese; ×, non-Hispanic White; ▲, non-Hispanic Black; ■, Mexican-American. (*$p < 0.05$ for difference from non-Hispanic White men).

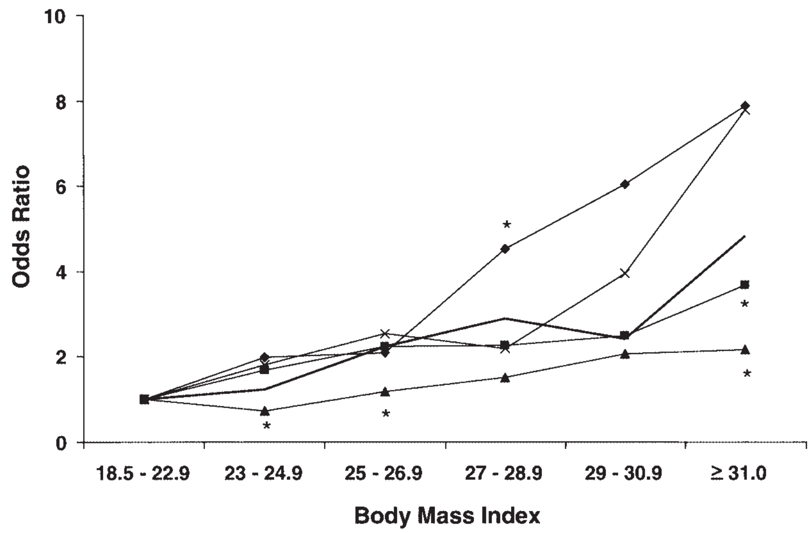

FIGURE 2. Age-adjusted odds of having hypertension over a range of body mass index (weight (kg)/height (m)²) categories, by ethnic group, among women from three health surveys (the China Health and Nutrition Survey (1997), the Cebu Longitudinal Health and Nutrition Survey (1998), and the Third National Health and Nutrition Examination Survey (1988–1994)). ◆, Chinese; ×, non-Hispanic White; ▲, non-Hispanic Black; ■, Mexican-American; —, Filipino. (* $p < 0.05$ for difference from non-Hispanic White women).

prevalence differences for the US ethnic groups occurred at higher levels of BMI. Mexican-American men had a jump in hypertension prevalence in the BMI category 25.0–26.9 that may have been due to the small sample sizes in the preceding two categories. According to the prevalence patterns, the association between hypertension prevalence and BMI may also be steeper in Chinese women than in US women (figure 4), a result that was not obvious in the logistic regression analysis. Hypertension was 7.6 percent higher for Chinese women in the BMI category 23.0–24.9 than in the category 18.5–22.9 (table 3). The increase in hypertension over the same BMI range for non-Hispanic Whites was 4.3 percent. When age was taken into account, Filipino women had a higher prevalence of hypertension than the other ethnic groups across the middle of the BMI range. A fairly sharp rise (10.8 percent) in hypertension was observed for this ethnic group between the BMI categories 23.0–24.9 and 25.0–26.9. Compared with non-Hispanic Whites, non-Hispanic Black women had a higher prevalence of hypertension at every level of BMI. Moreover, prevalence

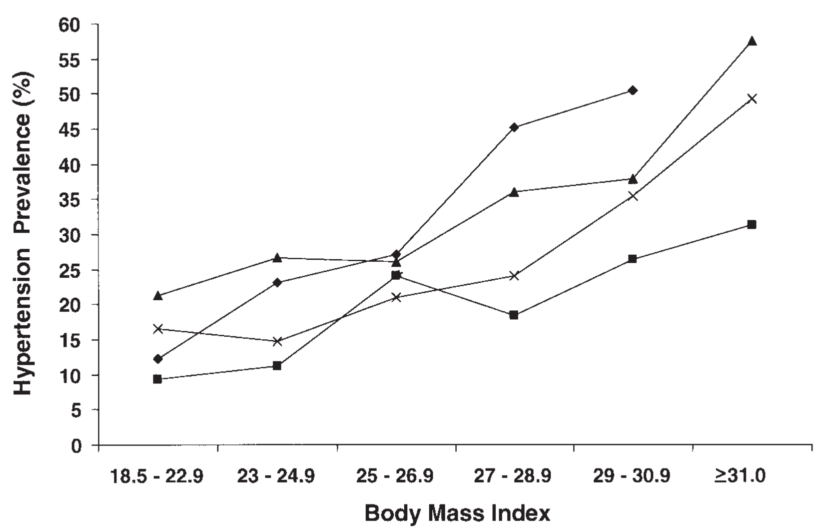

FIGURE 3. Age-adjusted prevalence of hypertension over a range of body mass index (weight (kg)/height (m)²) categories, by ethnic group, among men from three health surveys (the China Health and Nutrition Survey (1997), the Cebu Longitudinal Health and Nutrition Survey (1998), and the Third National Health and Nutrition Examination Survey (1988–1994)). ◆, Chinese; ×, non-Hispanic White; ▲, non-Hispanic Black; ■, Mexican-American.

TABLE 3. Age-adjusted prevalence of hypertension over a range of body mass index categories, by ethnic group, in combined data from three health surveys*

Gender and body mass index†	Prevalence of hypertension									
	Chinese		Filipino		White		Black		Mexican-American	
	%	No.	%	No.	%	No.	%	No.	%	No.
Men										
18.5–22.9	12.3	936			16.5	288	21.2	244	9.3	129
23.0–24.9	23.1	277			14.7	273	26.7	184	11.1	162
25.0–26.9	27.1	148			21.0	305	26.0	177	24.1	235
27.0–28.9	45.1	65			24.1	236	36.0	173	18.4	209
29.0–30.9	50.4	28			35.3	171	37.8	115	26.3	147
≥31.0	—‡				49.1	267	57.4	207	31.2	245
Women										
18.5–22.9	9.0	976	16.0	743	6.5	466	21.7	208	6.3	134
23.0–24.9	16.6	365	19.0	335	10.8	264	17.4	130	10.1	159
25.0–26.9	17.0	221	29.8	300	14.7	222	24.9	155	13.4	173
27.0–28.9	31.0	109	35.6	185	12.8	166	31.2	155	15.1	152
29.0–30.9	36.9	42	31.6	104	21.1	140	37.0	163	14.3	159
≥31.0	43.3	23	48.2	86	34.5	404	38.0	523	19.5	365

* The China Health and Nutrition Survey (1997), the Cebu Longitudinal Health and Nutrition Survey (1998), and the Third National Health and Nutrition Examination Survey (1988–1994).

† Weight (kg)/height (m)^2.

‡ There were only six Chinese men with a body mass index ≥31.0.

increased in a linear fashion across the overweight range (BMI 25.0–29.9), whereas for non-Hispanic Whites there was evidence of a plateau.

DISCUSSION

Hypertension is an antecedent of heart disease and stroke, both leading causes of morbidity and mortality in the United States and developing nations (19–21). In this study, we found a stronger association between prevalent hypertension and BMI for Chinese men and women and a higher baseline prevalence for Filipino women in comparison with US ethnic groups.

Positive associations between body mass and blood pressure have been well documented in both cross-sectional and prospective studies of Caucasian populations (22–24). Cross-

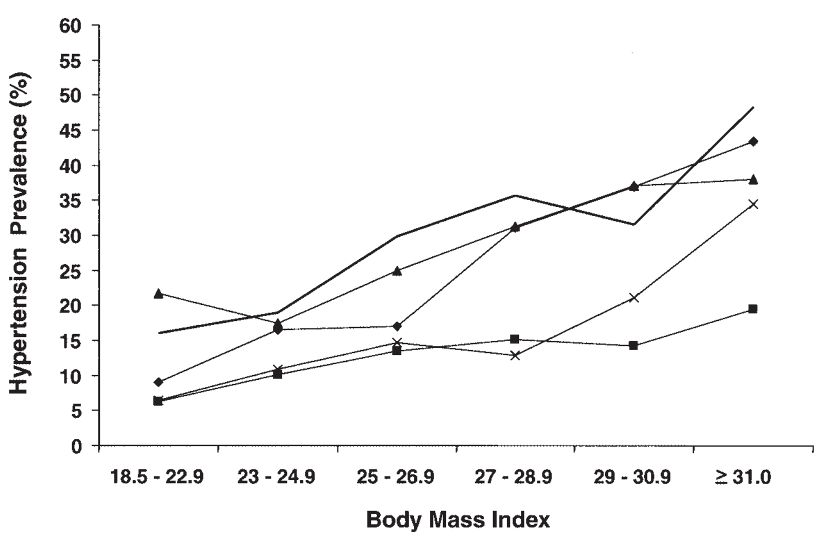

FIGURE 4. Age-adjusted prevalence of hypertension over a range of body mass index (weight (kg)/height (m)^2) categories, by ethnic group, among women from three health surveys (the China Health and Nutrition Survey (1997), the Cebu Longitudinal Health and Nutrition Survey (1998), and the Third National Health and Nutrition Examination Survey (1988–1994)). ◆, Chinese; ×, non-Hispanic White; ▲, non-Hispanic Black; ■, Mexican-American; —, Filipino.

sectional studies have documented an association in East Asian populations that is similar but may be stronger (8, 25, 26). Our data add to evidence suggesting that the curve is steeper in Chinese populations. Ko et al. (8) found that the optimal BMI cutoff for predicting hypertension in Hong Kong Chinese was 23.8, which is considerably lower than the cutoff of 25 recommended for Caucasian populations. Optimal cutoffs for type II diabetes, dyslipidemia, and albuminuria were also lower than 25. A study from Japan noted that the risk of hypertension for persons with BMIs greater than or equal to 25 was twice that of persons with BMIs of 22 (7); this is a higher risk than has been observed for Caucasians. However, we could not provide evidence to suggest that the association between hypertension and BMI is stronger in Filipinos.

To explain why these ethnic differences in the strength of the BMI-hypertension association exist, we need to consider genetically determined differences in body composition and metabolic response, as well as clustering of risk factors due to differences in social and environmental factors (Bell et al., unpublished manuscript). East Asian populations are known to have greater levels of total body fat and abdominal body fat at lower levels of BMI than Caucasians. Deurenberg et al. (10) have observed ethnic differences in BMI at similar levels of percentage of body fat. They found Chinese, Indonesian, and Thai populations to have BMI values that were 1.9, 3.2, and 2.9 BMI units lower than those of Caucasians (American, Australian, and European Whites analyzed as one group) with a similar percentage of body fat. The distribution of body fat may also differ between ethnic groups. For example, Asian Indians have been found to have more abdominal fat than Caucasians (27). In this study, adjustment for waist:hip ratio only slightly attenuated the differences between racial/ethnic groups, and waist:BMI ratio (centimeters of waist circumference per unit of BMI) was very similar for Chinese men (3.5 cm per BMI unit) and women (3.4 cm per BMI unit) as compared with non-Hispanic White men (3.6 cm/unit) and women (3.2 cm/unit), respectively. One mechanism through which body fat is thought to influence hypertension is increased insulin resistance. Body fat, particularly abdominal fat, may lead to an increase in fatty acids in the portal blood vessels, enhancing insulin resistance and leading to the development of hypertension and other metabolic complications (28, 29). It is also possible that Asian populations are more insulin-resistant than Caucasian populations for reasons other than increased central adiposity (30). Zimmet et al. (31, 32) summarized results of a series of studies which showed that relative risk of insulin resistance and adult-onset diabetes is high in Asians and Hispanics compared with Caucasians.

Socioeconomic and cultural factors may also contribute to these ethnic differences. The prevalence patterns reveal considerable underlying variation in hypertension prevalence. Stress and/or other unmeasured risk factors, such as acculturation in the case of Mexican Americans, may play an important role in determining this underlying variation. In other work, we found that unmeasured or poorly measured risk factors associated with socioeconomic status were more strongly associated with hypertension in US women than obesity, physical activity, and alcohol consumption (Bell et al., unpublished manuscript). A direct comparison of socioeconomic status was not possible in this study of populations from countries at different stages of development.

Our analysis of the relation between BMI and hypertension was complicated by differences in the baseline prevalence of hypertension between ethnic groups. The odds ratio analysis obscured these differences by assuming that the odds of hypertension were identical for each of the ethnic groups in the referent BMI category. This is potentially misleading, because it enhanced the odds of hypertension with increasing BMI among Chinese men and women and diminished the odds of hypertension with increasing BMI among Filipino women and non-Hispanic Blacks. The prevalence difference analysis allowed for differences in baseline prevalence but in this case did not lead to different conclusions regarding Chinese men and women. Prevalence differences tell a different story for non-Hispanic Blacks, however. They may in fact be at greater risk of hypertension with increasing BMI than non-Hispanic Whites, rather than at lower risk as the odds ratios suggested. Filipino women may also be at greater risk, but there was no evidence of a greater prevalence difference between the BMI categories 18.5–22.9 and 23.0–24.9, which was the contrast of primary interest.

This study was limited by the use of cross-sectional data. To truly test for differences in risk of hypertension with increasing BMI, one would need to monitor people from these populations over time. In preliminary analyses, we tested physical activity, alcohol consumption, and smoking as potential confounders of the BMI-hypertension association. These factors did not appear to be confounders, but the variables were not identical between the ethnic groups (i.e., we used work-related physical activity in China and leisure-time physical activity in the United States).

Finally, blood pressure is somewhat sensitive to salt intake, and we did not have adequate measures of salt consumption in any of the populations. Compared with the US population, the Chinese and Filipino populations probably have lower salt intakes, and inconsistent associations between BMI and blood pressure have been found in populations with low salt intakes (33). However, this study and other recent studies have shown strong associations (34).

Should there be lower cutoffs to define overweight and obesity status for Asian populations? Our data suggest that the new Asian BMI cutoff values are appropriate for Chinese men and women, on the basis of a stronger association between BMI and hypertension in comparison with Whites, and possibly for Filipino women, on the basis of a high baseline prevalence. Moreover, these data provide some evidence that the association between BMI and hypertension and underlying prevalence varies within US ethnic groups. The utility of having a single international weight classification based on BMI is the ability to compare populations and monitor changes over time using a simple measure. At this level, we do not see the advantage of having a separate classification for Asians, particularly if it does not apply to all Asians. In addition, "Asian" ethnicity is very difficult to define. In a clinical setting, however, the value of ethnicity-specific BMI cutoffs can readily be seen. They would enable clinicians to more appropriately identify individuals at increased risk of hypertension and other comorbid conditions. Further research is needed to test the utility of ethnicity-specific BMI cutoffs for defining obesity in clinical settings.

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