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Impact of body mass index levels on lipid abnormalities in Chinese Asians, American Blacks and American Whites: The People's Republic of China (PRC) and Atherosclerosis Risk in Communities (ARIC) Studies

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Abstract

Background—Several researchers have reported that Chinese adults may have a greater chronic disease burden than Whites, especially at lower body mass index (BMI) levels.

Objectives—To compare the incidence of lipid abnormalities in Chinese (n=5,303), White (n=10,752) and Black (n=3,408) middle-aged adults and the effect of BMI on these incidences.

Methods—Data were from the People's Republic of China (PRC) and the Atherosclerosis Risk in Communities (ARIC) studies. In each ethnic group, we calculated the adjusted cumulative incidence for high total cholesterol (≥240 mg/dL), LDL-cholesterol (≥160 mg/dL), and triglycerides (≥200 mg/dL) and low HDL-cholesterol (≤40 in men and ≤50 mg/dL in women) adjusted for age, gender, education, field site, smoking and drinking status. Risk differences associated with BMI (referent=18.5–22.9 kg/m^2) were calculated using weighted linear regression and slopes compared using the Wald test.

Results—Chinese had lower incidence of abnormal total cholesterol, LDL-cholesterol and triglycerides than Whites in most BMI groups and had lower incidence of abnormal HDL-cholesterol and triglycerides than Blacks. Across the range of 18.5 to <30, BMI was more strongly associated with the incidence of having high total cholesterol in Chinese and Whites than in Blacks. Similar trends were seen for LDL-cholesterol and triglycerides, but were not always statistically significant. In contrast, BMI was more highly associated with incidence of low HDL-cholesterol in Whites than in Chinese or Blacks.

Conclusion—Although differences in the incidence of lipid abnormalities and the impact of BMI were identified, results varied by lipid type indicating no consistent ethnic/national pattern.

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Keywords

Obesity; Total cholesterol; LDL-cholesterol; HDL-cholesterol; Triglycerides; Ethnicity

INTRODUCTION

Data from the 2002 Chinese Nutrition and Health Survey indicated that 22.9% of Chinese adults 45–59 years of age had dyslipidemia (high total cholesterol, high triglycerides or low HDL-cholesterol) [1]. High triglycerides were the most common (15.9%) lipid abnormality. In contrast, approximately 48% of US adults had at least one lipid abnormality (high LDL-cholesterol, high triglycerides or low HDL-cholesterol) with high LDL-cholesterol being the most common (28%) [2]. A larger percentage of Americans 45–54 and 55–64 years of age meet the Adult Treatment Panel III guideline recommendation for lifestyle change (39.8% and 54.1%) or drug therapy (19.6% and 29.7%) compared to the percentage of Chinese adults in the same age categories (18.0% and 27.7% for lifestyle change and 6.8% and 11.8% for drug therapy), respectively [3]. However, due to the differences in population size the absolute number of adults who need either lifestyle change or drug therapy is higher in China than the United States.

Researchers have shown unfavorable changes in lipid levels as body mass index (BMI) increases in Asian and non-Asian populations. However, there is still debate whether the impact of BMI on lipid levels or dyslipidemia is greater among Asians compared to Caucasian (or non-Asian) populations. Many of the studies that concluded a greater impact among Asians did not include a Caucasian comparison group [4–7]. The limited number of studies that have included a Caucasian or non-Asian comparison found a greater effect of BMI on lipid levels and/or dylipidemia/lipid abnormalities [8–11]. To our knowledge, no study has longitudinally examined the effects of BMI on incident lipid abnormalities across ethnic groups. The objectives of this study were to determine and compare: 1) the incidence of lipid abnormalities in Chinese Asian, American White and American Black middle-aged adults, and 2) the effect of BMI on incident lipid abnormalities in each ethnic group.

MATERIALS AND METHODS

Study populations

Data are from two prospective cohort studies - the People's Republic of China (PRC) Study and the Atherosclerosis Risk in Communities (ARIC) Study. The PRC study examined Chinese Asian women and men living in urban and rural Beijing (northern China) and Guangzhou (southern China) [12]. Baseline data were collected in 1983–1984 with follow-up examinations in 1987–88 and 1993–94. The ARIC study examined American White and American Black men and women in four United States communities: Forsyth County, North Carolina, Jackson, Mississippi, the northwestern suburbs of Minneapolis, Minnesota and Washington County, Maryland [13]. Baseline data were collected in 1987–89 with follow-up examinations in 1990–1992, 1993–1995 and 1996–1999. Since participants from the PRC study only had two follow-up examinations, we elected to use only two follow-up examinations in ARIC therefore data from the third ARIC examination (1993–1995) was not included in the analysis. The follow-up period was 8.2 years for Chinese Asians and American Whites and 7.9 years for American Blacks.

Only participants aged 45 to 64 at baseline from the PRC study (n=6,575) were included in the analysis. This age range was select in order to match the baseline age range of participants from the ARIC study. For the ARIC cohort, we excluded Blacks from Washington County, Maryland or Minneapolis, Minnesota (n=55) and participants who did

not classify their race/ethnicity as White or Black (n=48) because they were too small in number to allow ethnic and field center-specific analyses. For both studies, participants were excluded if they were missing baseline BMI (n=58), both follow-up visits (n=1,760), all baseline lipid measures (n=884), or pertinent covariates (n=99). The analysis sample included 5,303 Chinese Asians, 10,752 American Whites and 3,408 American Blacks. These studies were approved by the Institutional Review Boards (IRB) at each field center and this analysis was approved by the University of North Carolina at Chapel Hill (UNC) Public Health IRB on research involving human subjects.

Measurements

The data collection protocols and training manuals for all measurements were developed by the Collaborative Studies Coordinating Center (CSCC) at the UNC. These protocols were very similar between the studies. In addition, the CSCC handled the review, processing and analyses of all data for both ARIC and PRC studies. In both studies, height was measured without shoes to the nearest centimeter (1 centimeter =0.394 inch) using a metal rule attached to a wall and a standard triangular headboard using a vertical ruler. Body weight was measured to the nearest pound (1 pound =0.454 kilogram) in light clothing (PRC cohort) or scrub suit (ARIC cohort) using a beam balance scale. Baseline BMI was calculated as weight in kilograms divided by height in meters squared then categorized into seven mutually exclusive categories (>18.5, ≥18.5 to <23.0, ≥23.0 to <25.0, ≥25.0 to <27.5, ≥27.5 to <30.0, ≥30.0 to <32.5, ≥32.5 kg/m^2) [14].

Education, smoking status and alcohol consumption were assessed using interviewer administered questionnaires. Since educational attainment (as measured in years) was not comparable in the United States and China, we created cohort specific education categories (low, medium, high). In ARIC, participants were categorized as less than high school graduate, high school graduate, or at least some college. In PRC, participants were categorized as less than primary education, primary education, or at least secondary education. We dichotomized participants as current smoker (cigarettes or leaf products) or non-smoker and current alcoholic beverage drinker or non-drinker.

Study participants were instructed to fast for 12 hours prior to their clinic visit. Fasting blood were sent to laboratories in Beijing or Guangzhou, China (PRC) or in Houston, Texas (ARIC). All laboratories were standardized according to the Centers for Disease Control and Prevention protocol. Total cholesterol [15] and triglycerides [16] were determined by enzymatic methods. HDL-cholesterol was measured after dextran-magnesium precipitation [17]. The Friedewald method was used to calculate LDL-cholesterol [18]. LDL-cholesterol was not calculated for participants with triglyceride levels ≥400 mg/dL. Participants with abnormal total cholesterol (≥240 mg/dL), LDL-cholesterol (≥160 mg/dl), HDL-cholesterol (≤40 mg/dL in men and ≤50 mg/dL in women), and triglycerides (≥200 mg/dL) at baseline were excluded for the respective incidence analysis. If a participant had abnormal total cholesterol, LDL-cholesterol, HDL-cholesterol or triglycerides at either follow-up visit then they were classified as an incident case for that respective analysis. Lipid lowering medication usage was not available for the Chinese, therefore it was not used to define lipid abnormalities.

Statistical analyses

Adjusted lipid abnormalities incidence rates over approximately 8 years were calculated separately for each ethnic group using logistic regression (PROC LOGISTIC) in SAS, version 9.1 (Cary, North Carolina). This approach was selected after log binomial (with log link), binomial models (with identity link) and poisson models did not converge for several outcomes. The models were adjusted for gender, age, smoking status, alcohol consumption,

education and field center. To accommodate our focus on risk differences rather than ratios we used the same, pre-specified level or distribution for gender (54% female), age (53.2 years), smoking status (non-smoker) and alcohol consumption (non-drinker) in each race group. Because educational levels were widely divergent in the two cohorts, the weighted cumulative incidences were based on the ethnic-specific distribution. Similarly, field centers were specific to the ethnic groups. The delta method [19] was used to calculate standard errors and 95% confidence intervals for weighted cumulative incidences and risk differences. For each BMI category, the weighted cumulative incidences were compared across pairs (Chinese versus Whites, Chinese versus Blacks, and Whites versus Blacks) using the Wald statistics with one degree of freedom.

To summarize the risk difference results across BMI categories, we constructed weighted least squares regression models using the adjusted risk differences as the dependent variables and the ethnic specific median BMI within each category as independent variables. The weights used were the inverse of the estimated variances for the adjusted risk differences. Results from this analysis were also compared among ethnic group pairs using the Wald statistics with one degree of freedom.

RESULTS

Americans from the ARIC cohort were slightly older than the Chinese Asians in the PRC study (Table 1). As expected, the mean BMI among Chinese was smaller (22.4 kg/m^2) compared to mean BMI among Whites (27.0 kg/m^2) and Blacks (29.6 kg/m^2). Less than 3.0 percent of Chinese were obese (≥30.0 kg/m^2), whereas less than one percent of Americans were underweight (<18.5 kg/m^2). Chinese were more likely than Blacks and Whites to be current smokers but less likely to consume alcoholic beverages or have “high” education attainment. At baseline, low HDL-cholesterol was the most prevalent type of lipid abnormality in all ethnic groups.

We did not find significant interactions between gender and BMI categories for the four outcomes; therefore we do not show analyses by gender. The adjusted cumulative incidence for high total cholesterol, high LDL-cholesterol, low HDL-cholesterol, and high triglycerides across BMI categories are shown in figures 1a–1d, respectively. Incidence rates were not calculated for obese Chinese or underweight Americans due to small sample sizes. Across the BMI categories examined, Whites were significantly more likely to develop high total cholesterol than Chinese (Figure 1a). Blacks had lower incidence rates of high total cholesterol than Whites, although not always statistical significant. In contrast, Blacks had slightly higher (not significant) incidence rates than Chinese.

In the two normal weight categories, Whites had significantly higher incidence rates of high LDL-cholesterol than Chinese (Figure 1b). This trend continued in the higher BMI categories, although not statistically significant. The incidence rates of high LDL-cholesterol among Blacks were slightly higher than Chinese and slightly lower than Whites in the normal and overweight BMI categories. Obese Blacks had higher incidence rates of high LDL-cholesterol than Whites.

When examining the incidence of low HDL-cholesterol, we found similar incidence rates between Whites and Chinese with one exception (Figure 1c). In the ≥27.5 – <30.0 kg/m^2 category, the incidence was significantly higher among Whites than Chinese. Both Whites and Chinese had significantly higher incidence rates of low HDL-cholesterol than Blacks in all BMI categories examined except the ≥23.0 to <25.0 kg/m^2 category.

Whites had the highest incidence of high triglycerides across all BMI categories (Figure 1d). Chinese tended to have slightly lower incidence rates than Whites, although not always

statistically significant. Both Whites and Chinese had significantly higher incidence rates than Blacks.

The adjusted risk differences for the four outcomes by ethnicity are shown in table 2. In general, the risk differences in the BMI categories above the referent group (≥18.5 –<23.0 kg/m^2) were positive and tended to increase with increasing BMI. Nevertheless, the risk difference confidence intervals were wide and no BMI category differences within ethnicity.

Figures 2a–d compares the effect of BMI (as measured by the slope of the risk difference) on lipid abnormalities by ethnicity. The slopes were calculated using the full BMI range and the restricted BMI range (≥18.5 to <30.0 kg/m^2) in which all three ethnic groups had sufficient data to allow stable estimates. Statistically significant differences between pairs of estimates are indicated in the figures.

For total cholesterol (Figure 2a) the slope was steeper in Chinese than Whites and Blacks when the entire range was examined. However, using the restricted BMI range we found a slightly steeper slope in both Chinese and Whites compared to Blacks. These trends were similar for LDL-cholesterol (Figure 2b). For low HDL-cholesterol (Figure 2c) we found the effect of BMI was similar in Chinese and Whites and stronger than in Blacks when the full BMI range was examined. In the restricted BMI range, the BMI association with HDL-cholesterol was strongest in the Whites and tended to be weakest in Blacks. For triglycerides, associations were similar in Chinese and Whites (Figure 2d) when examined in both the full range and the restricted range of BMI. Associations between BMI and triglycerides were weakest in Blacks although confidence intervals overlapped with the Chinese in the restricted analysis.

DISCUSSION

In this study, we examined the impact of baseline BMI on risk differences rather than risk ratios. Stevens et al. demonstrated how comparisons of BMI risk across ethnic groups are strongly influenced by the metrics compared if the incidence of the outcomes studied were different in the reference category [20]. In those circumstances, risk differences are more relevant than risk ratios. Here, in the reference BMI range (≥18.5 – <23.0 kg/m^2) the incidence of high total cholesterol and LDL-cholesterol was lower in Chinese than in Whites ($p<0.05$) and Blacks (not significant). However, for HDL-cholesterol and triglycerides, incidence rates were similar in Chinese and Whites, and lowest in the Blacks ($p<0.05$). Although these differences were not always statistically significant, they do indicate important trends in ethnic differences among adults with a healthy weight.

Comparisons of the impact of elevated BMI across ethnicities was complicated in this analysis by the very different BMI distributions, with few obese Chinese and underweight Americans. Therefore, we examined BMI within a restricted range in which all groups had adequate representation to provide a more unbiased comparison among ethnicities. Across that range (18.5–30 kg/m^2) BMI was more strongly associated with the incidence of having high total cholesterol in Chinese and Whites than in Blacks. Similar trends were seen for LDL-cholesterol and for triglycerides, but were not always statistically significant. In contrast, BMI was more highly associated with incidence of low HDL-cholesterol in Whites than in Chinese or Blacks.

To our knowledge, no other study has compared the baseline BMI-lipid relationship between Chinese and Blacks, however, we know of 8 studies [3,8–11,21–23] that compared the effect of BMI on lipid levels, dyslipidemia or lipid abnormalities in Asian and non-Asian/Caucasian adults. All of these studies were cross-sectional and the findings were mixed. Kesteloot et al. found Belgian men and women had higher total cholesterol than Koreans

and Chinese [21]. For HDL-cholesterol, there was no difference between Belgian and Chinese men but higher levels among Belgian women compared to Chinese and Korean women. Iwao et al. found Whites had higher mean BMI levels but lower prevalence of abnormal total cholesterol and LDL-cholesterol levels than Japanese [8]. They found similar prevalence of abnormal triglycerides between Caucasian and Japanese men and higher prevalence of abnormal HDL-cholesterol among Whites. Neither study examined the impact of BMI or compared groups with similar levels of BMI.

Lear et al. found similar BMI levels between adults of European and South Asian descent living in Canada [22]. However, South Asian men had higher mean total cholesterol, LDL-cholesterol, triglycerides and lower mean HDL-cholesterol than men of European decent. In women, South Asians had lower HDL-cholesterol and higher triglycerides but similar total and LDL-cholesterol than women of European descent. After adjusting for BMI, ethnicity was an independent predictor of all lipid outcomes.

Two studies have used receiver operating characteristic (ROC) curves to estimate the BMI associated with the greatest sum of sensitivity and specificity (∑SS) to identify dyslipidemia [9,10]. Both studies calculated ∑SS to be at a smaller BMI in Chinese/Asians than European/non-Asians. However, sensitivity and specificity are strongly influenced by the BMI distribution which varied across ethnicities. Therefore it is difficult to ascertain how the levels of risk associated with BMI may have differed in these groups.

CVD risk factors and prevalence vary across Asians [6,9] and between Whites living in Europe and North America [8,22,23]. Therefore, the differences in the findings between our study and previous studies could be influenced by where the subjects lived or the specific Asian ethnic group examined. Chandalia et. al found vast differences in the frequency of low HDL-cholesterol among lean women from rural India (72%) and urban India (56%) compared to Asian Indians in US (48%) and Whites (25%) [11]. Similar disparities were observed among men (52%, 42%, 28% and 35%, respectively).

The current study has several limitations. Although models were adjusted for cigarette smoking and education, these variables may mean different things in China and the US. For example, the content and concentrations of the chemicals in cigarettes may differ and could impact lipids differently. Therefore, the incidence levels presented were calculated for non-smokers. The ethnic-specific distribution of educational attainment (low, medium, high) was used to calculate the predicted incidence levels since it is plausible that high education in the US (college education) may not be equivalent to high education(post secondary) in China. Other unmeasured social and environmental covariates might have influenced the BMI-lipid relationships. Comparable diet and physical activity were not available from both studies, therefore, these variables were not included in the analysis. It is reasonable to assume that the diet and physical activity level varied between Chinese and Americans. Researchers have shown associations between these variables and lipid levels [24].

In the current study, ethnicity and nationality were confounded in all comparisons to Chinese. Although not as obvious as differences between China and the US, the environments of the White and Black participants were also likely to vary importantly. Interpretations across groups must be done with care and recognition that numerous aspects of the social, cultural, economic, geographic and political environments were likely different between groups. Therefore, differences found here cannot be attributed to racial or environmental differences, but to a combination of these and other factors. Also, the cohorts were not selected to be nationally representative although the ARIC cohort represents 4 US communities. Nevertheless, ethnic comparisons are of interest, particularly since recommended public health action points for Asians [14] are lower than the recommended

BMI cutpoints for overweight and obesity used in the US and globally (as recommended by the WHO) [25,26]. Information showing increased risk with increasing BMI in Chinese compared to Americans would support the utility of these different BMI cutpoints, albeit only for risk of lipid abnormalities in this work.

The current study has several strengths. The same coordinating center for was used for both the PRC and ARIC studies with similar data collection methods. Additionally, we compared Chinese adults living in China with two ethnic groups in the US. To our knowledge, all previous studies have been cross-sectional and only were able to examine prevalence.

Our research group has conducted similar analyses for diabetes and hypertension [27]. We found that Chinese had a higher incidence of hypertension and diabetes than Whites and Blacks. Additionally, the effect of BMI on hypertension was greater in Chinese than Whites and Blacks and the effect of BMI on diabetes was greater in Chinese and Blacks than Whites. The discrepancy in the results for hypertension, diabetes and lipid abnormalities underscores the fact that ethnic differences in risk factor patterns and the impact of BMI on those patterns may vary based on the particular risk factor studied. It may be prudent for investigators to refrain from making recommendations for a policy of different BMI cutpoints in different national or ethnic groups based on studies of risk factors, and instead to restrict the evidence base for such recommendations to studies that examined BMI associations with hard endpoints (e.g. stroke, heart disease, and total mortality).

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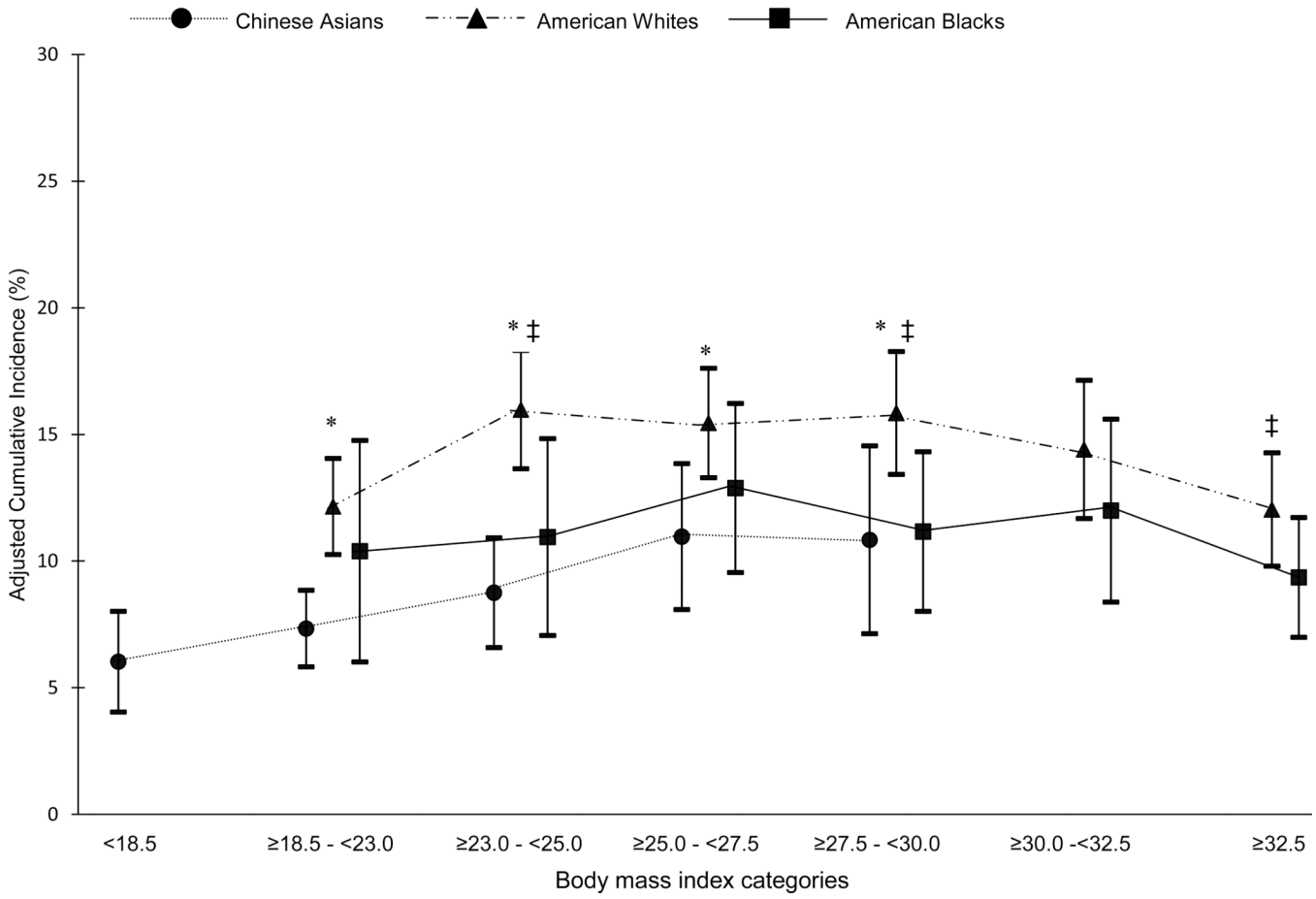
1a



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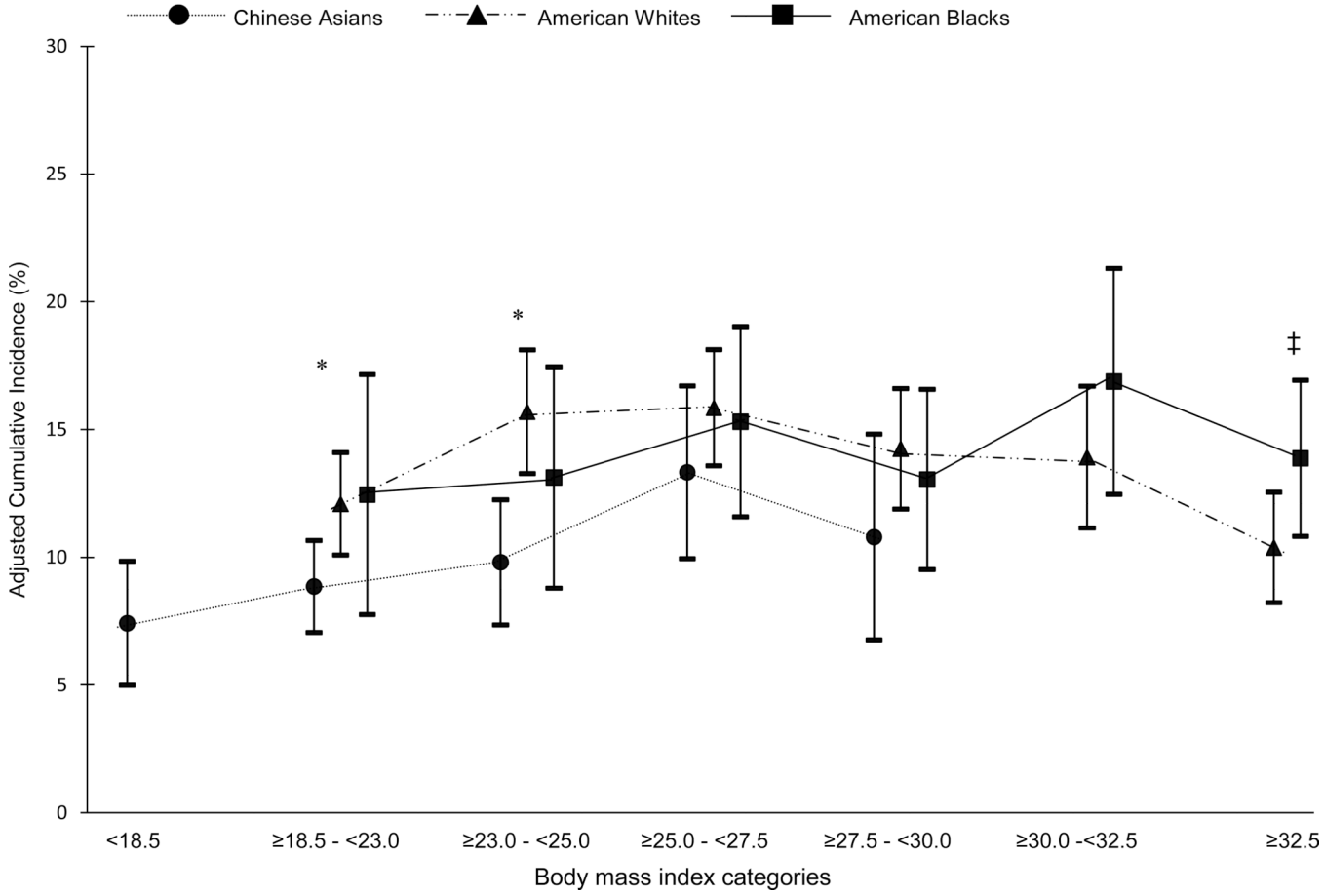

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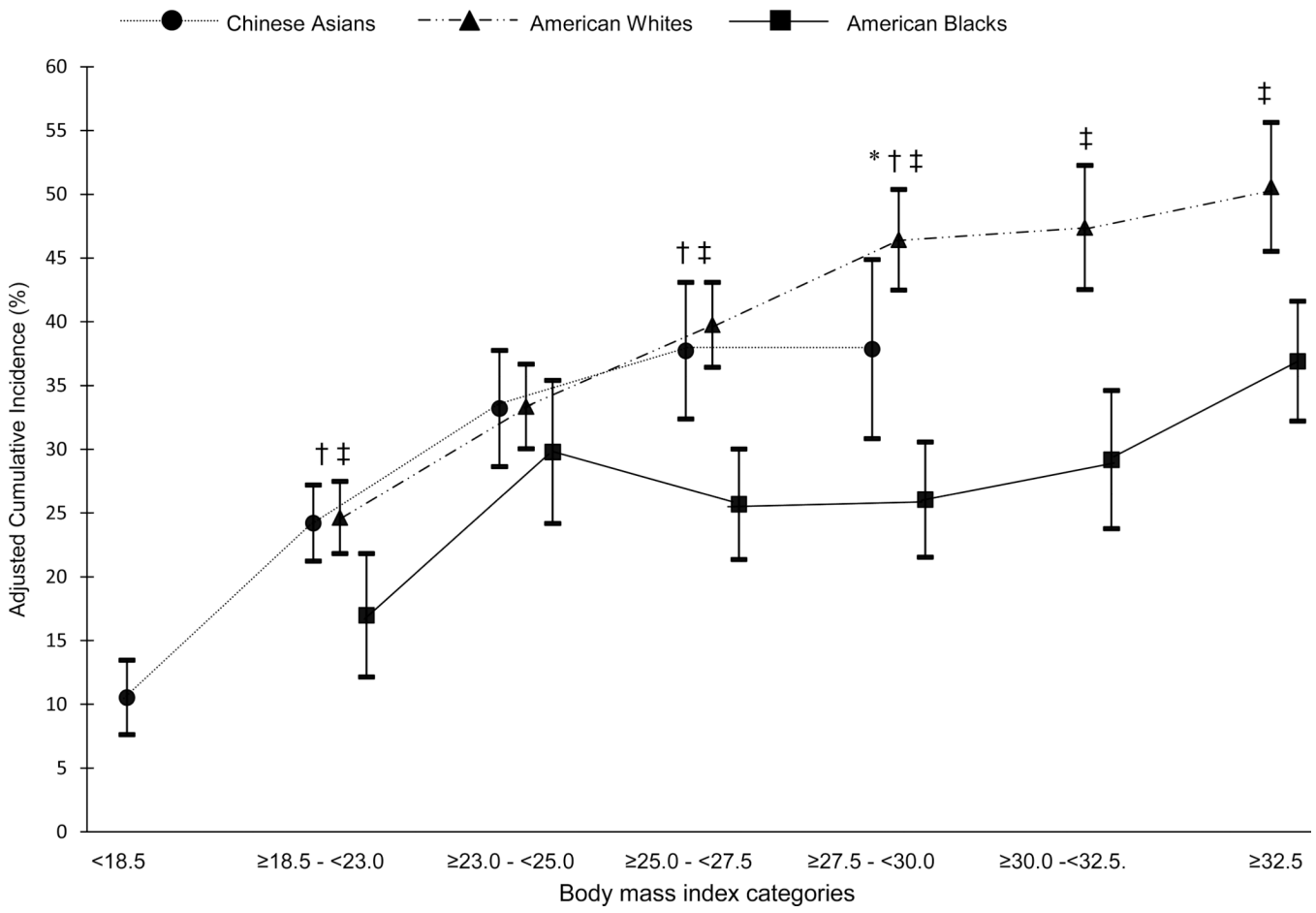


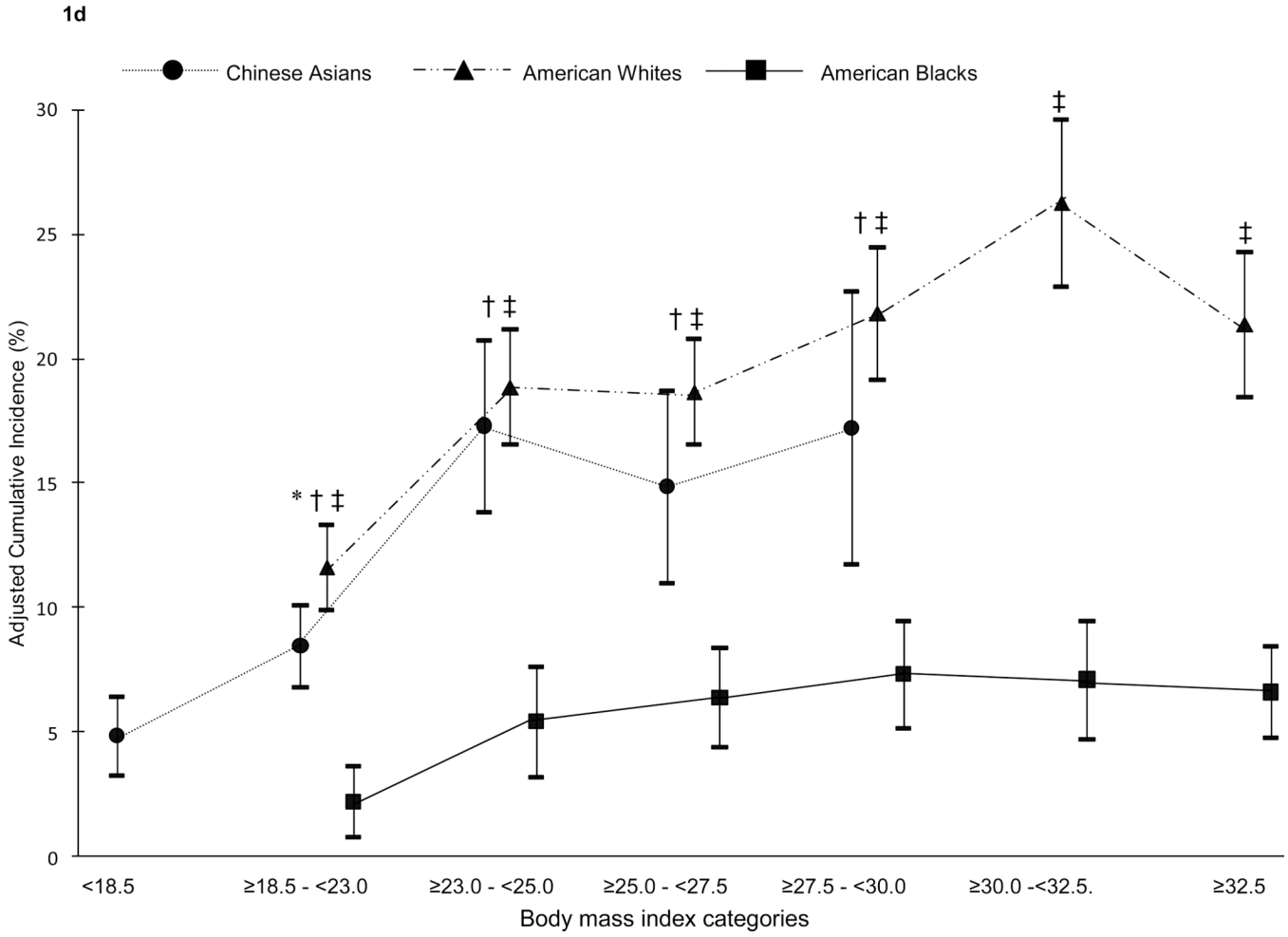
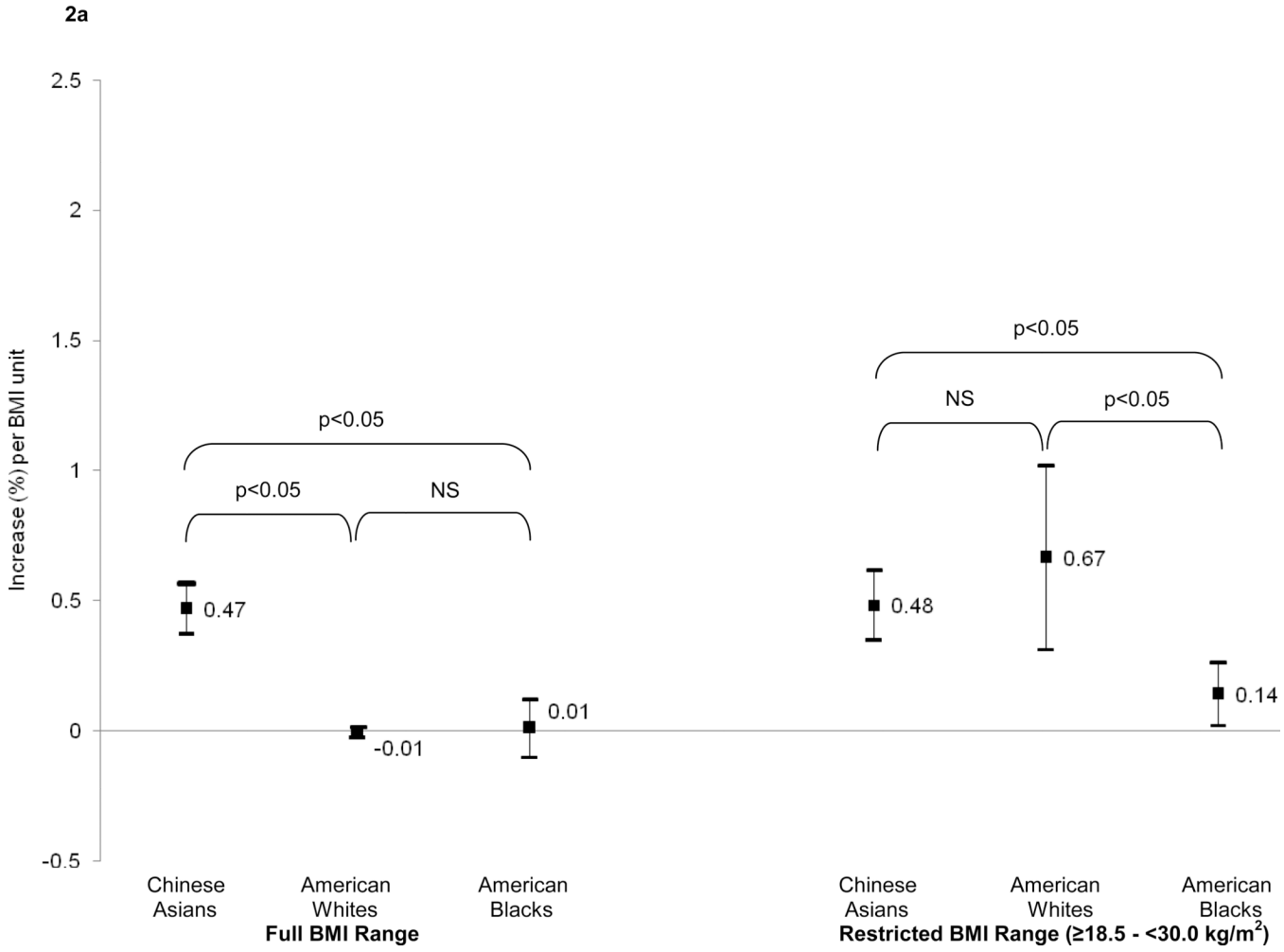
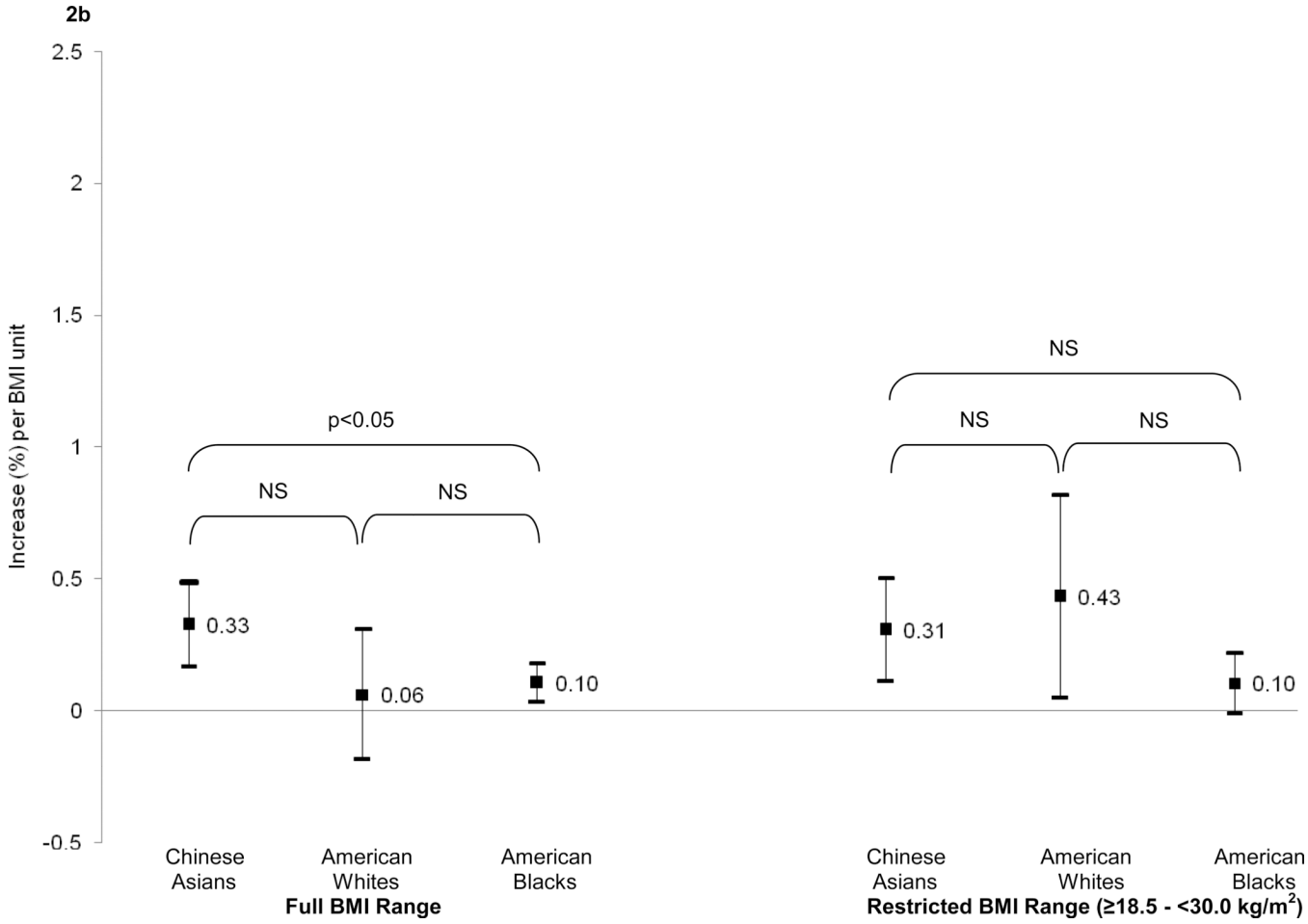
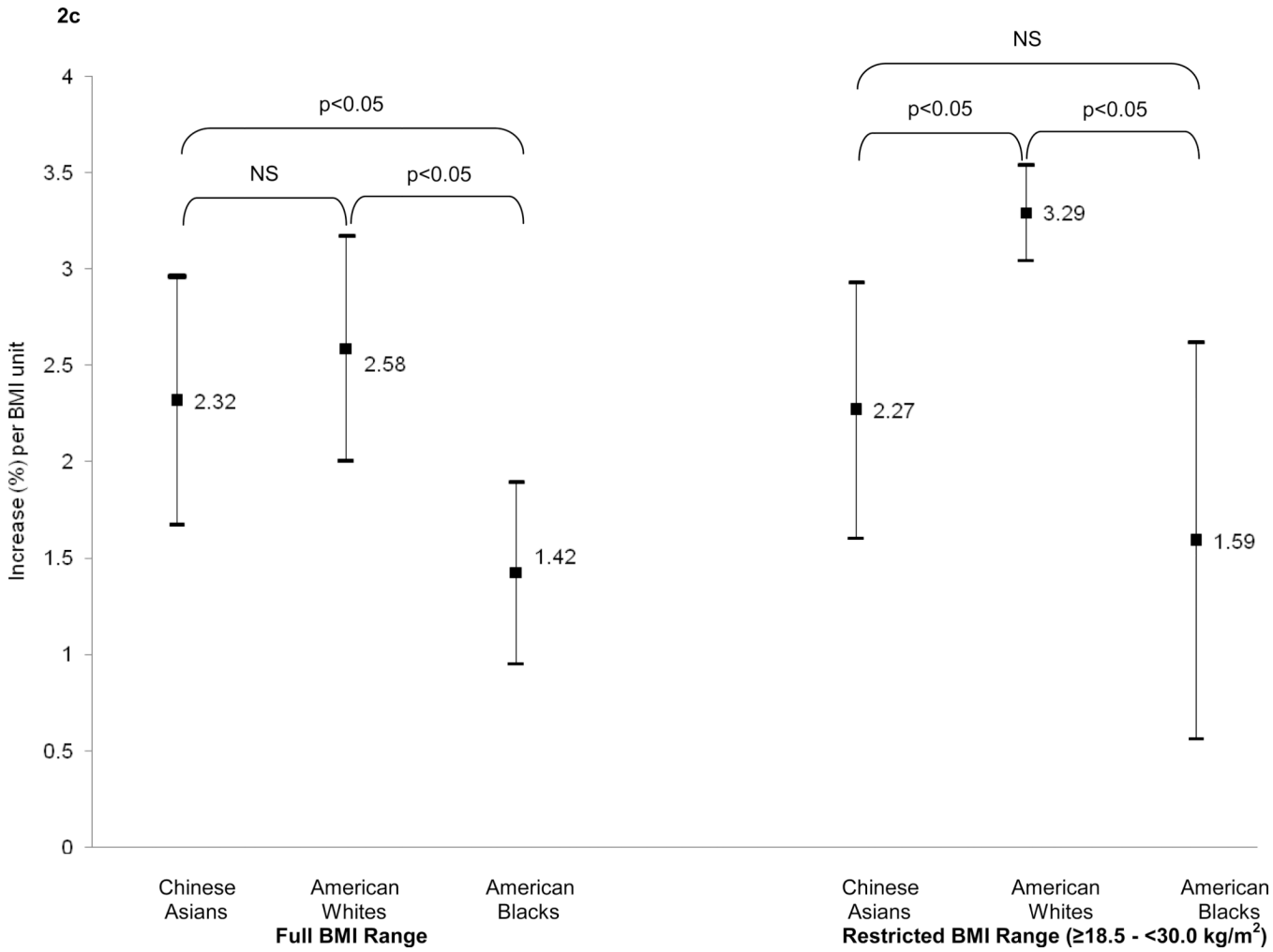


Figure 1.

Adjusted cumulative incidence (and 95% confidence interval) for **(A)** high total cholesterol (≥240 mg/dL), **(B)** high LDL-cholesterol (≥160 mg/dL), **(C)** low HDL-cholesterol (≤40 mg/dL in men and ≤50 mg/dL in women), and **(D)** high triglycerides (≥200 mg/dL) by BMI categories and ethnicity, the Atherosclerosis Risk in Communities (ARIC) Study, 1987–1998 and the People's Republic of China (PRC) Study, 1983–1994. Models were adjusted for age, gender, field center, education, smoking status and drinking status. Point estimates for the same BMI categories are slightly shifted in the horizontal plane so that confidence intervals are clearly visible. * Chinese Asians and American Whites are significantly different ($p<0.05$); † Chinese Asians and American Blacks are significantly different ($p<0.05$); ‡ American Whites and American Blacks are significantly different ($p<0.05$).







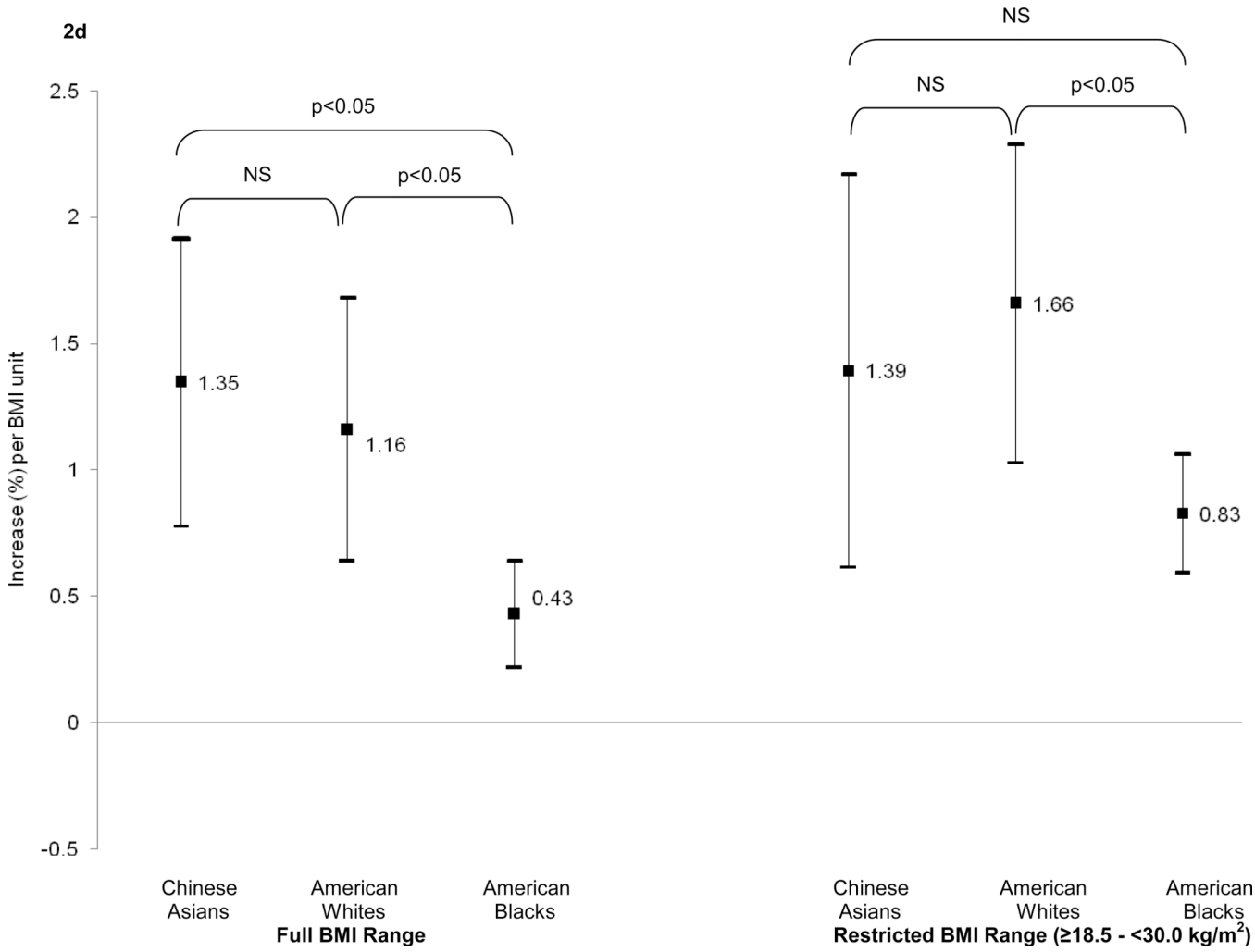


Figure 2.

Percent increase per BMI unit (and 95% confidence interval) from weighted least squares regression of risk differences for **(A)** high total cholesterol (≥240 mg/dL), **(B)** high LDL-cholesterol (≥160 mg/dL), **(C)** low HDL-cholesterol (≤40 mg/dL in men and ≤50 mg/dL in women), and **(D)** high triglycerides (≥200 mg/dL) over the full and restricted (≥18.5 – <30.0 kg/m^2) BMI ranges by ethnicity, the Atherosclerosis Risk in Communities (ARIC) Study, 1987–1998 and the People's Republic of China (PRC) Study, 1983–1994.

TABLE 1

Baseline demographic characteristics among Chinese Asians, American Whites and American Blacks, the Atherosclerosis Risk in Communities (ARIC) Study, 1987–1998 and the People's Republic of China (PRC) Study, 1983–1994

	Chinese Asians N=5,303	American Whites N=10,752	American Blacks N=3,408
Age (years, mean (SD[†]))	50.5 (3.8)	54.3 (5.7)	53.4 (5.8)
Gender (% female)	50.6	53.0	62.6
Baseline body mass index (kg/m^2, mean (SD))	22.4 (3.6)	27.0 (4.8)	29.6 (6.1)
Baseline body mass index (kg/m^2) category (%)			
<18.5	13.3	0.8	0.8
≥18.5 – <23.0	46.7	19.3	9.0
≥23.0 – <25.0	17.4	17.3	11.5
≥25.0 – <27.5	13.2	23.4	19.5
≥27.5 – <30.0	6.8	16.8	18.7
≥30.0 – <32.5	2.0	10.6	14.5
≥32.5	0.6	11.9	25.8
Cigarette or leaf smoking status (% current)	48.1	26.3	30.0
Alcoholic beverage consumption status (% current)	27.3	65.2	31.5
Educational Attainment (% high)	17.1	47.3	38.8
Baseline prevalence (%)			
High total cholesterol[a]	7.7	24.2	27.1
High LDL-cholesterol[b]	7.3	25.4	27.8
Low HDL-cholesterol[c]	25.3	41.5	32.9
High triglycerides[d]	7.9	15.2	7.6

[†]SD, standard deviation

[a]High total cholesterol was defined as ≥240 mg/dL.

[b]High LDL-cholesterol was defined as ≥160 mg/dL.

[c]Low HDL-cholesterol was defined as ≤40 mg/dL in men and ≤50 mg/dL in women.

[d]High triglycerides was defined as ≥200 mg/dL.

TABLE 2

Adjusted risk differences (RD)[a] and 95% confidence intervals for incident lipid abnormalities among Chinese Asians, American Whites, and American Blacks by body mass index categories, the Atherosclerosis Risk in Communities (ARIC) Study, 1987 – 1998 and the People's Republic of China (PRC) Study, 1983 – 1994

	Chinese Asians		American Whites		American Blacks	
	RD	**(95% CI)**	**RD**	**(95% CI)**	**RD**	**(95% CI)**
High total cholesterol[b]						
<18.5	−1.3	(−11.7, 9.0)				
≥18.5 – <23.0	0.0		0.0		0.0	
≥23.0 – <25.0	1.4	(−7.7, 10.5)	3.8	(−5.4, 13.1)	0.6	(−1.9, 3.0)
≥25.0 – <27.5	3.6	(−20.6, 27.9)	3.3	(−4.2, 10.8)	2.5	(−6.3, 11.3)
≥27.5 – <30.0	3.5	(−26.0, 33.0)	3.7	(−5.4, 12.8)	0.8	(−2.2, 3.7)
≥30.0 – <32.5			2.3	(−4.7, 9.2)	1.6	(−4.8, 8.0)
≥32.5			−0.1	(−0.5, 0.2)	−1.0	(−4.7, 2.6)
High LDL-cholesterol[c]						
<18.5	−1.4	(−12.4, 9.5)				
≥18.5 – <23.0	0.0		0.0		0.0	
≥23.0 – <25.0	0.9	(−5.0, 6.9)	3.6	(−5.1, 12.3)	0.7	(−1.9, 3.2)
≥25.0 – <27.5	4.5	(−23.4, 32.4)	3.8	(−4.6, 12.2)	2.8	(−5.7, 11.4)
≥27.5 – <30.0	1.9	(−15.0, 18.9)	2.2	(−3.4, 7.7)	0.6	(−1.3, 2.5)
≥30.0 – <32.5			1.8	(−3.9, 7.5)	4.4	(−9.7, 18.6)
≥32.5			−1.7	(−7.3, 3.9)	1.4	(−2.6, 5.4)
Low HDL-cholesterol[d]						
<18.5	−13.7	(−82.7, 55.3)				
≥18.5 – <23.0	0.0		0.0		0.0	
≥23.0 – <25.0	9.0	(−12.6, 30.5)	8.7	(−0.9, 18.3)	12.8	(−14.8, 40.4)
≥25.0 – <27.5	13.5	(−18.1, 45.1)	15.1	(2.1, 28.1)	8.7	(−9.3, 26.7)
≥27.5 – <30.0	13.6	(−27.1, 54.4)	21.8	(4.7, 38.9)	9.1	(−10.0, 28.1)
≥30.0 – <32.5			22.7	(1.4, 44.1)	12.2	(−14.5, 38.9)
≥32.5			25.9	(4.0, 47.9)	19.9	(−11.9, 51.7)
High triglycerides[e]						

	Chinese Asians		American Whites		American Blacks	
	RD	**(95% CI)**	**RD**	**(95% CI)**	**RD**	**(95% CI)**
<18.5	−3.6	(−31.1, 23.8)				
≥18.5 – <23.0	0.0		0.0		0.0	
≥23.0 – <25.0	8.8	(−31.1, 48.8)	7.2	(−6.7, 21.2)	3.2	(−13.2, 19.6)
≥25.0 – <27.5	6.4	(−30.4, 43.1)	7.0	(−5.5, 19.6)	4.2	(−12.8, 21.2)
≥27.5 – <30.0	8.8	(−52.2, 69.7)	10.2	(−8.8, 29.2)	5.1	(−14.7, 24.9)
≥30.0 – <32.5			14.6	(−14.1, 43.4)	4.9	(−16.2, 26.0)
≥32.5			9.8	(−11.0, 30.5)	4.4	(−12.0, 20.8)

[a] Models were adjusted for age, gender, field center, education, smoking status and drinking status.

[b] High total cholesterol was defined as ≥240 mg/dL.

[c] High LDL-cholesterol was defined as ≥160 mg/dL.

[d] Low HDL-cholesterol was defined as ≤40 mg/dL in men and ≤50 mg/dL in women.

[e] High triglycerides was defined as ≥200 mg/dL.