Ethnic-immigrant Disparities in total body and abdominal obesity in the United States

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Abstract

Background: Little published work has reported clinical differences in the risk of total and abdominal obesity across racial-ethnic groups by nativity and gender using national samples. Few studies have examined the specific contribution of health behaviors, including diet and physical activity (PA), to obesity disparities.

Purpose: This study examined whether risks of total body and abdominal obesity varied by race, ethnicity, nativity, and whether the observed differences were attributable to self-reported total caloric intake and total moderate or vigorous PA (MVPA).

Methods: Data were from 4,331 respondents age 18-64 from the 2003-2006 National Health and Nutrition Examination Survey (NHANES). Obesity risks were captured by clinically measured body mass index and waist circumference. Total MVPA was objectively measured by accelerometer data. Total caloric intake was based on self-reported two-day diet. Multiple logistic regression analyses were performed to examine ethnic-immigrant disparities in total and abdominal obesity and explore the possible mediating roles of total caloric intake and total MVPA.

Results: In total obesity, among men, foreign-born Hispanics had significantly lower risks than US-born whites and no other group difference was found; among women, US-born blacks had the highest risks with foreign-born blacks least at risk. In abdominal obesity, among men, US-born whites had the highest risk with foreign-born blacks least at risk; among women, US-born blacks had the highest risk and foreign-born whites least at risk. Total MVPA was a significant correlate of obesity risks and helped explain some effects of foreign-born Hispanic men and US-born black women. Total caloric intake was neither a covariate of obesity risks nor an explainer of obesity disparities.

Conclusions: Racial-ethnic disparities in obesity risks are large but vary by nativity. Disparity patterns differ for total body and abdominal obesity. More attention needs to be paid to white and black immigrants in obesity disparity research.

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Background

Obesity is a serious risk factor of a range of health conditions affecting longevity and quality of life[1-6]. Race-ethnicity is a significant predictor of obesity risk. According to recent national estimates[7], about 45% of the non-Hispanic black population (referred to 'black' hereafter) and 37% of Hispanics are obese compared with 30% non-Hispanic whites (referred to 'white' hereafter). These racial-ethnic disparities are particularly strong among women and less clear among men[8, 9]. Meanwhile, abundant literature also points out that nativity is an additional demographic factor of obesity with foreign-born immigrants consistently showing lower prevalence rates of obesity than their native-born co-ethnics[10, 11].

For an ordinary person, physical activity (PA) and dietary intake are direct determinants of his or her energy balance and in turn body weight. Therefore, in theory, the observed ethnic-immigrant disparities in obesity should be largely attributable to either differentials in PA or those in caloric intake or both. Many studies have examined racial-ethnic differences in leisure-time PA and find that whites are more likely to participate in leisure-time PA compared to racial-ethnic minorities partly due to their higher socioeconomic status (SES)[12, 13]. However, whether this pattern is applicable to total PA that includes occupational, transportation, household, sedentary, and leisure-time activities is less known. Previous work has found disadvantaged groups are more engaged in non-leisure time activities because they are more likely to have manually demanding jobs and more in need of taking public transportations not having a car or avoiding high gas costs[12, 14]. In addition, some ethnic minorities such as blacks and Hispanics are more likely than whites to live in disadvantaged neighborhoods while neighborhood poverty has been linked to more non-leisure walking[15]. Hence, whether blacks and Hispanics have lower levels of total PA than whites remains elusive. One study based on total reported PA found no significant difference across racial-ethnic groups[12]; but more studies are needed to further evaluate racial-ethnic disparities in total PA to better understand the role of PA in contributing to obesity disparities.

To further complicate the issue, nativity often confounds race-ethnicity in affecting weight-related outcomes. Immigrants, defined as foreign-born individuals moving to the US to live, occupy increasingly greater proportions of the US population in recent years[16]. They constitute a large proportion of Hispanics and are projected to increase among blacks[17]. Immigrants appear differently than their US-born co-ethnics in terms of lifestyles related to energy balance (i.e., food intake and PA) as well as prevalence rates of overweight and obesity. In general, immigrants are healthier and more likely to follow healthful lifestyles. For example, Hispanic immigrants have lower prevalence rates of smoking and heavy drinking, consume less fat and more fiber, and generally are less likely than US-born Hispanics to be overweight/obese[10, 18]. In addition, most evidence from studies of Hispanic immigrants shows that obesity prevalence among foreign-born Hispanics is positively related to their length of U.S. residence, a finding consistent with the acculturation hypothesis that the acculturation process, defined as the process of acquiring dominant cultural norms by members of a non-dominant group[19], is related to an increase in obesity[11, 19-21]. However, more recent data show immigrant Mexican women are no longer protected against obesity[22], may be partly due to rising obesity trends in Mexico[23]. And in terms of leisure-time PA, it seems US-born or English-speaking Hispanics are more engaged than foreign-born or Spanish-speaking Hispanics[10, 14] suggesting acculturation in Hispanics may have beneficial health and body weight effects via increased leisure-time PA participation. That said, acculturation is not necessarily linked to increased non-leisure PA[14]. Suppose the observed positive impacts of acculturation on leisure-time PA is via changed cultural values towards more post-modernization health-oriented ideologies[10], then leisure-time PA rather than instrumental PA should be the form of PA that mainly manifests the acculturation effect. As acculturation levels increase, structural assimilation may also increase, leading to better socioeconomic achievements which may be linked to lower levels of instrumental PA fulfilling occupational or transportation needs. Hence, how nativity, a crude measure of acculturation, affects total PA subsequently contributing to disparities in obesity is equivocal.

As to the role of total caloric intake in contributing to obesity disparities, the literature specifically examining this intervening pathway linking race-ethnicity to obesity is sparse. One study did not find any effect of caloric intake on BMI or obesity among foreign-born or US-born Mexicans in the US[22]. A study of Hispanic adolescents reported that foreign-born Hispanic adolescents had a healthier dietary pattern, consuming more rice, fruits, and vegetables than their US-born counterparts but total caloric intake was not examined[19]. How total caloric intake and total PA jointly contribute to ethnic-immigrant disparities in obesity has not been well examined.

A common measurement issue in obesity research is the heavy reliance on self-reported height and weight to measure body mass index (BMI) and obesity. While self-reported BMI is highly correlated with objectively measured BMI, recent evidence from the 2007-2008 National Health and Nutrition Examination Survey (NHANES) showed there were systematic errors in underreporting BMI based on important demographic factors such as race-ethnicity, gender, and education[24]. Therefore, when comparing obesity risks across socio-demographic groups, objectively measured BMI is more desirable to use than self-reported BMI. Similarly, the majority of studies on leisure-time or non-leisure time PA are based on self-reported activities that are inevitably subject to response bias owing to blurred memory or social desirability tendency[25]. There can be systematic response bias over- or under-reporting PA across different socio-demographic groups.

Another gap in the literature of energy balance disparities is that immigrant blacks are rarely examined[26]. At present, over 6% of blacks living in the US are foreign-born[17]. Limited evidence showed that foreign-born blacks had a lower obesity risk, compared with US-born blacks[26, 27] although non-significant result has also been reported[28]. Even less studied are foreign-born whites. Presumably, the acculturation hypothesis should be applicable to immigrant whites as well as long as their regions of origin are less obesogenic than the U.S..

In this study, using a nationally representative cross-sectional sample, we examined the patterns of gender-specific disparities in the prevalence of total body obesity and abdominal obesity, total caloric intake, and total PA across six ethnic-immigrant groups: US-born whites (reference group), foreign-born whites, US-born blacks, foreign-born blacks, US-born Hispanics, and foreign-born Hispanics; we also explored whether total caloric intake and total PA were mediators of the observed obesity disparities. To the best of our knowledge, this is the first national study examining these questions separately for men and women, using clinical measures of total and central obesity and objectively captured total PA.

Methods

Data

The study used data from the 2003 to 2006 continuous National Health and Nutrition Examination Survey (NHANES) which measured the health of the U.S. civilian noninstitutionalized population. In 2003-2006 those who could walk were given accelerometers to wear for a week, following standard protocols[29]. We focused on adults age 18-64 of whites, blacks and Hispanics in our analyses. We excluded adults age 65+ because of the more complicated relationships between BMI and health in older populations[30]. We also excluded those with pregnancies, missing marital and educational data, with BMIs <18.5 or >60, or who did not meet accelerometer data standards, described below. The final sample size was 4,331 with 2,104 women and 2,227 men.

Measures

Outcome measures included a dichotomous indicator of obesity based on clinically measured BMI (kg/m^2) (30-60 versus18.5-30) and a dichotomous indicator of abdominal obesity defined as waist circumference ≥ 102 cm for men and ≥ 88cm for women given that [22]. Two variables are key independent variables of interest: total calories per day (continuous) based on self-reported 2-day dietary recalls[31] and total PA (continuous).

To measure total PA, we followed Troiano et al.'s processing of accelerometer data [32, 33]. This requires ≥2020 CPS for the moderate to vigorous physical activity (MVPA) threshold and four days of 10+ hours of accelerometer wear. Nonwear time was defined by ≥ 60 consecutive minutes of zero activity intensity counts, allowing for 1-2 minutes of <100 CPS. Wear time was defined by 24 hours minus nonwear time. Some accelerometer data were discarded if units were out of calibration when returned or measured unlikely levels of activity[33].

We added two mutually exclusive PA measures: MVPA8+ and MVPA1-7 bouts. MVPA8+ bouts represent the recommended Centers for Disease Control and Prevention (CDC) bouts. They were defined as ≥10 MVPA minutes allowing for interruptions of 1-2 minutes below threshold and were terminated by 3 minutes below the 2020 CPS threshold. MVPA1-7 minute bouts were defined as ≥ 1 MVPA minute but less than an MVPA8+ minute bout. Mean daily time in the sum of both bouts were calculated across all valid days and used to measure total PA including leisure-time and instrumental activities.

Based on past research on BMI[34], control variables included age (in years), marital status (married or cohabitating versus others), education (less than high school, high school, college or above), and self-reported poor health ("fair" or "poor" health versus "good", "very good", or "excellent" health) . We further controlled for two additional variables: income to poverty ratio[35] (<100% or not) and smoking (self-reported current smoker or not)[36]. When total MVPA was included in the model, we also adjusted for accelerometer wear time[37].

Statistical analyses

Multiple logistic regression models were performed for total obesity based on BMI and abdominal obesity based on waist circumference. Diagnostic tests revealed no problematic levels of multicollinearity. Two models were fit for each obesity outcome. Model 1 was a baseline model including five ethnic-immigrant groups with US-born whites as reference group along with six socio-demographic controls (i.e., age, marital status, poor/fair self-rated health, current smoker, education, and income poverty ratio). Model 2 added total caloric intake and total MVPA to Model 1 while controlling for one more variable—accelerometer wear time because total MVPA was measured by accelerometer data. Reductions in odds ratios of ethnic-immigrant groups would indicate mediating effects of total caloric intake or PA or both.

Considering frequently reported gender differences in health and energy balance outcomes[38, 39], statistical analyses were stratified on gender. Analyses were corrected for the complex sampling design of NHANES as recommended[40]. Sample weights were adjusted for combining 2003-2004 and 2005-2006, and for four days of valid accelerometer wear. Analyses were conducted using Stata 11.

Results

Table 1 shows sample statistics on men and women. Some patterns are similar across gender. US-born whites are slightly older than other groups. US-born blacks have the lowest rates of marriage or cohabitation. The foreign-born whites and blacks are better educated and have lower poverty prevalence than their US-born counterparts with the gap particularly remarkable among blacks. On the contrary, US-born Hispanics are much better off than the foreign-born Hispanics. Whites have the lowest rates of fair/poor self-rated health (SRH) but nativity plays a different role across gender. For men, US-born whites have the lowest rate of fair/poor SRH, whereas for women it is the foreign-born white group with the best SRH. Also different for men and women, the foreign-born white have the highest prevalence of current smokers among men, whereas for women the US-born white are most likely to be current smokers.

Regarding total obesity risk, for both men and women, US-born blacks have the highest prevalence with foreign-born blacks least at risk. Consistent with the acculturation hypothesis, foreign-born whites, blacks and Hispanics are less likely to be obese compared to their US-born counterparts, with the largest gap found in black women and smallest gap among Hispanic men. Specifically, prevalence of obesity among US-born black women is thirty-three percentage points higher than that of foreign-born black women. For abdominal obesity, patterns are also consistent with the acculturation hypothesis although ranking of prevalence rates is not entirely the same as that for total obesity. For example, among men, the highest risk of abdominal obesity is found among US-born whites and the largest gap between the US-born and the foreign-born is observed in Hispanic men with a nearly sixteen percentage point difference.

As to total caloric intake, US-born white men and US-born black women have the highest averages respective to each gender. In terms of total MVPA, regardless of gender, foreign-born Hispanics are the most active, while the least active are foreign-born blacks among men and US-born blacks among women. Apparently, gender, race-ethnicity, and nativity all matter in energy balance factors.

Table 2 presents logistic regression odds ratios for total obesity risks. Among men, the only ethnic-immigrant group significantly different than the US-born white is foreign-born Hispanics exhibiting a significantly lower obesity risk (OR=0.62; $p<0.05$). Total caloric intake is not a significant covariate whereas total PA is (OR=0.98; $p<0.01$). Controlling for total MVPA renders the odds ratio of foreign-born Hispanics nonsignificant (OR=0.75; $p>0.10$), a 21% reduction ((.75-.62)/.62=21%). This is consistent with the descriptive statistics where foreign-born Hispanics have much higher mean daily MVPA minutes compared to all other ethnic-immigrant groups on a daily basis.

Among women, US-born blacks (OR=2.30; $p<0.01$) are at higher risks of obesity than US-born whites while foreign-born blacks (OR=0.46; $p<0.05$) and foreign-born Hispanics (OR=0.58; $p<0.05$) have lower risks. Again, total caloric intake is not a significant covariate but total MVPA is. A small proportion of US-born black women's higher obesity risks relative to US-born white women seem attributable to total MVPA.

Table 3 presents logistic regression odds ratios for abdominal obesity risks. Among men, more group differences are seen for risk of abdominal obesity than for risk of total obesity. Other than the US-born Hispanics, all other groups have lower risks of abdominal obesity than US-born whites with the foreign-born black men having the lowest risk of abdominal obesity risk.

Most of these differences are not due to caloric intake or MVPA except for foreign-born Hispanic men for whom total MVPA explains about 16% ((0.52-0.45)/0.45) of the effect.

Among women, US-born blacks are at higher risks of abdominal obesity and a small proportion of this effect is attributable to the total MVPA. Foreign-born whites are at significantly lower risk of abdominal obesity compared to US-born whites, an effect not attributable to total caloric intake or MVPA. Again, total MVPA is a significant correlate of abdominal obesity risk but not total caloric intake.

Except for marital status, all control variables are significant covariates of obesity risks, suggesting the importance of accounting for them as possible confounding factors. The effects are mostly similar across gender. Age and age-squared are both significant, showing a curvilinear relationship of advancing age with obesity risks. Poor/fair SRH is a risk factor of obesity whereas smoking is a protective factor. Individuals with college or above education are at lower risks of obesity for both men and women and for both types of obesity measures. The only gender difference in the effects of controls regards poverty. Living in poverty is negatively associated with obesity risk for men but positively for women.

Discussions

This study sought to examine detailed patterns of ethnic-immigrant disparities in total and abdominal obesity risks, exploring whether the observed ethnic-immigrant disparities are attributable to total caloric intake and total MVPA. Among the US-born men and women, whites had the lowest total obesity prevalence, followed by Hispanics with blacks at highest risks of obesity. However, these patterns were not replicated among the foreign-born where racial-ethnic disparities in total obesity vary by gender. In total obesity, among men, foreign-born Hispanics had significantly lower risks than US-born whites and no other group difference was found; among women, US-born blacks had the highest risks with foreign-born blacks least at risk. In abdominal obesity, among men, US-born whites had the highest risk with foreign-born blacks least at risk; among women, US-born blacks had the highest risk and foreign-born whites least at risk.

Holding race-ethnicity constant, the foreign-born were at lower risks of total and abdominal obesity compared to their US-born co-ethnics, a finding consistent with the acculturation hypothesis. One implication of the acculturation hypothesis is that the social, physical and cultural environments of the American society are more obesogenic[19] than most immigrants' original societies; therefore, as newcomers spend more time in the US they tend to adopt American lifestyle norms that are somehow linked to greater BMI[10]. Although our study were not designed to directly examine the acculturation hypothesis, the results suggest that the acculturation hypothesis is likely extendable to white and black immigrants. These two groups are largely ignored in the acculturation and obesity literature[10, 19, 27, 41] and should be paid more attention in future work.

Without taking nativity into account, nuanced group differences in obesity risks would not have been revealed. Among blacks, the foreign-born are at considerably lower risk of total obesity than their US-born counterparts and this advantage cannot be explained by their higher SES. For example, among women, the US-born black have the highest risk of total obesity among all groups while the foreign-born black least at risk. Evidence on obesity heterogeneity within the black group is not readily available as blacks are often grouped together wearing the same hat labeled as "blacks" or sometimes "African Americans" regardless of nativity or nationality. The finding of advantage associated with immigrant status among blacks agrees with findings from some studies[26, 27] but not others.[28, 42] As to whites, we also found remarkable advantage of immigrants relative to natives; however, due to small evidence, we cannot put this finding into context. More work is needed to examine obesity issues in under-researched groups such as white and black immigrants and Native Americans.

Compared to total obesity, abdominal obesity has been less examined in obesity research. Previous work shows that central adiposity measured by waist circumference is a stronger predictor of noninsulin dependent diabetes mellitus compared to BMI and other measures of adiposity[43] and is an independent risk factor of morbidity and mortality net of overall BMI[44]. The current study finds that among men US-born whites have the highest risk of abdominal obesity compared to other groups except US-born Hispanics. Considering that abdominal fat accumulation is particularly linked to defeat reaction and psychosocial stress[45], a pattern particularly found for men[46], it may be argued that our finding suggests white men in the US perceive higher levels of psychosocial stress compared to other groups of men holding a range of risk factors constant. This hypothesis is not in line with the general belief that immigrants face acculturative stress and native ethnic minorities are more deprived and discriminated than whites thus experiencing heightened levels of stress[11]. While intuitively appealing, these hypotheses on the stress distribution across groups have not been adequately corroborated with clinic data of stress such as cortisol secretion. In any event, our findings on disparities in abdominal obesity need to be compared to findings of other studies but the literature is very small. One study using data from the 1988-1994 third NHANES[11] reported that for both men and women US-born Spanish-speaking Mexican Americans had higher risk of abdominal obesity than English-speaking Mexican Americans and US-born whites suggesting acculturation is protective against abdominal obesity. A more recent study shows that the relationship between acculturation and total and abdominal obesity is not linear but nonlinear and multifaceted depending on other factors such as age[47]. Whether these empirical discrepancies reflect true differences in temporal trends in disparities in abdominal obesity or result from design issues are not known. The present study expanded previous work on abdominal obesity disparities by adding immigrant whites and blacks to the picture and using more recent data of a national sample. More studies need to be done to better understand disparities in and correlates of central adiposity which may differ from those regarding total obesity. Presumably, our knowledge of obesity epidemiology would be enhanced if future studies use more sophisticated measures of obesity based on body mass distribution rather than self-reported BMI.

Another purpose of the current study was to explore whether group differences are in part attributable to lifestyle factors including total caloric intake and total MVPA. The results show that total caloric intake is not a significant covariate of total or abdominal obesity and cannot explain any of the observed ethnic-immigrant disparities. By contrast, total MVPA is a significant covariate of both obesity outcomes and can explain some effects of foreign-born Hispanic men and US-born black women. That physical activity is a more important contributor of obesity than diet is consistent with the key conclusion of a review article[48] where the authors discussed findings on the three major factors modulating body weight, metabolic factors, diet, and physical activity, and provided convincing evidence to show that the rising obesity trend witnessed in the past two decades in Western societies cannot be explained by secular changes in diet, which exhibited reductions in average fat and energy intake over the same time[49], or metabolic factors, which received mixed evidence[48]; by contrast, reduced activity-related energy expenditure seemed to play an important or even primary role[50].

Findings from the current study should be interpreted with study limitations in mind. Most importantly, no causality should be assumed in the observed associations due to the cross-sectional design. That said, reverse causation is not a problem for the effect of an ascribed status such as race-ethnicity on a behavioral outcome such as obesity. The measure of diet, namely total caloric intake, is based on self-reports which are inevitably subjected to response bias[51]. This measure also cannot distinguish healthy dietary intake from unhealthy ones. The physical activity measure, albeit based on objective readings of accelerometer data, is not free of bias and does not include information on types of physical activity. Sample sizes of foreign-born whites and blacks are small, limiting the study power to detect significant group differences and examine differences by region of origin.

Despite these limitations, the study makes unique contributions to the obesity research literature by presenting national evidence on ethnic-immigrant differences in clinically measured total and abdominal obesity including under-research immigrant groups like foreign-born blacks and whites. The within-race heterogeneity found by nativity lends support to environmental explanations of obesity[52, 53]. While there is little doubt that genetic factors matter for individual risks of obesity[54], they cannot explain obesity disparities across socio-culturally constructed groups such as those based on race, ethnicity, or nativity. Although public health messages frequently point to black women's highest prevalence of obesity across all race-ethnicity-gender subgroups in the US, they seem to be mainly applicable to natives. Typically not addressed in national obesity prevalence estimates, foreign-born black women are in fact at the lowest risks of obesity across all groups in our sample. Obesity disparities observed in this study can be, in a small proportion, attributable to total MVPA, whereas total caloric intake is not a significant correlate or explainer. This contrast suggests active living lifestyles may play a more dominant role in contributing to obesity disparities than dietary behaviors. However, to put the present study into perspectives, more research is warranted to further examine obesity disparities across a broader range of ethnic-immigrant groups. More knowledge on group-specific etiology of obesity is needed to make effective and evidence-based policy recommendations on obesity prevention and reduction tailored to specific group needs.

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Conflict of Interest

No conflict of interest is disclosed.

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Table 1a: Sample Statistics on Men

	Total	White (US-born)	White (Foreign-born)	Black (US-born)	Black (Foreign-born)	Hispanic (US-born)	Hispanic (Foreign-born)
Age (mean)	40.10	41.21	39.53	38.19	43.76	35.96	35.57
Married (%)	69.22	71.40	74.94	55.21	76.24	56.54	70.38
Fair/poor self-rated health (%)	11.78	9.76	12.13	13.63	14.19	15.03	22.42
Current smoker (%)	26.41	26.19	35.75	29.24	17.93	30.79	20.32
Less than high school (%)	14.64	7.82	5.23	21.94	17.92	19.79	56.74
High school graduates (%)	25.43	26.21	21.26	27.95	23.03	23.69	19.92
College or above (%)	25.24	29.49	31.32	14.24	33.69	12.66	8.05
Income to poverty ratio < 100 (%)	10.01	6.53	5.65	15.6	13.13	12.01	29.38
Total caloric intake[a] (mean; 100 calories)	27.13	27.76	26.09	26.1	21.66	27.41	24.84
Total physical activity[b] (mean; daily minutes)	35.53	33.72	37.94	35.25	30.82	37.53	47.52
Accelerometer wear time (mean)	14.55	14.57	14.07	14.94	15.17	14.31	14.18
Prevalence of total obesity[c] (%)	31.53	32.08	28.64	35.99	22.33	32.53	24.91
Prevalence of abdominal obesity[d] (%)	41.08	44.81	34.64	34.91	20.32	42.03	26.4
Sample size	*2,227*	*1,012*	*61*	*473*	*54*	*202*	*425*

a. Total caloric intake per day is calculated total calories based on 2-day dietary recalls divided by 100.
b. Total physical activity is measured by average daily moderate or vigorous physical activity (MVPA) minutes accelerometer data based on 1 or plus minute bouts.
c. Obesity is indicated by 30 kg/m^2 or over based on objectively measured height and weight.
d. Abdominal obesity is indicated by waist circumference of 102cm or over for men.

Table 1b: Sample Statistics on Women

	Total	White (US-born)	White (Foreign-born)	Black (US-born)	Black (Foreign-born)	Hispanic (US-born)	Hispanic (Foreign-born)
Age (mean)	40.88	41.89	41.74	39.42	39.09	34.83	38.22
Married (%)	63.03	67.73	64.21	36.00	54.98	54.26	72.05
Fair/poor self-rated health (%)	13.83	10.75	6.88	20.44	23.25	17.15	30.00
Current smoker (%)	20.70	22.90	17.81	17.09	2.17	17.21	13.62
Less than high school (%)	11.20	6.34	5.23	14.34	7.49	15.97	49.49
High school graduates (%)	22.55	23.36	17.01	20.59	22.47	22.69	21.07
College or above (%)	27.21	31.23	37.68	20.52	31.60	13.53	6.01
Income to poverty ratio < 100 (%)	10.54	6.70	5.11	20.34	13.58	14.30	28.2
Total caloric intake[a] (mean; 100 calories)	18.72	18.63	17.51	19.86	16.48	18.79	18.49
Total physical activity[b] (mean; daily minutes)	20.98	20.94	24.01	18.46	21.53	20.65	24.23
Accelerometer wear time (mean)	14.18	14.18	14.32	14.25	14.87	14.06	13.89
Prevalence of total obesity[c] (%)	35.15	32.57	23.62	55.37	22.27	39.96	29.18
Prevalence of abdominal obesity[d] (%)	58.83	57.40	41.82	71.01	62.89	59.13	58.77
Sample size	*2,104*	*954*	*52*	*479*	*48*	*243*	*328*

a. Total caloric intake per day is calculated total calories based on 2-day dietary recalls divided by 100.
b. Total physical activity is measured by average daily moderate or vigorous physical activity (MVPA) minutes accelerometer data based on 1 or plus minute bouts.
c. Obesity is indicated by 30 kg/m^2 or over based on objectively measured height and weight.
d. Abdominal obesity is indicated by waist circumference of 88 cm or over for women.

Table 2: Logistic Regression Odds Ratios for Overall Obesity

	Risk of Overall Obesity among Men (BMI ≥ 30kg/m^2)		Risk of Overall Obesity among Women (BMI ≥ 30kg/m^2)	
White (Foreign-born)	0.87	0.89	0.65	0.70
	(0.51 - 1.48)	(0.52 - 1.51)	(0.32 - 1.32)	(0.33 - 1.46)
Black (US-born)	1.22	1.23	2.30***	2.18***
	(0.89 - 1.67)	(0.88 - 1.72)	(1.65 - 3.22)	(1.56 - 3.03)
Black (Foreign-born)	0.53	0.51*	0.46**	0.44**
	(0.24 - 1.16)	(0.23 - 1.11)	(0.23 - 0.89)	(0.20 - 0.95)
Hispanic (US-born)	1.04	1.08	1.35	1.32
	(0.75 - 1.44)	(0.77 - 1.53)	(0.90 - 2.03)	(0.86 - 2.05)
Hispanic (Foreign-born)	0.62**	0.75	0.58**	0.60*
	(0.42 - 0.91)	(0.51 - 1.09)	(0.34 - 0.99)	(0.34 - 1.06)
Age	1.07*	1.08**	1.17***	1.18***
	(0.99 - 1.15)	(1.00 - 1.17)	(1.10 - 1.25)	(1.11 - 1.25)
Age-squared	1.00	1.00**	1.00***	1.00***
	(1.00 - 1.00)	(1.00 - 1.00)	(1.00 - 1.00)	(1.00 - 1.00)
Married/cohabitating	1.14	1.14	0.92	0.88
	(0.81 - 1.62)	(0.81 - 1.61)	(0.67 - 1.28)	(0.63 - 1.22)
Poor/fair self-rated health	2.43***	2.11***	1.86***	1.78***
	(1.71 - 3.47)	(1.46 - 3.04)	(1.40 - 2.47)	(1.30 - 2.44)
Current smoker	0.58***	0.54***	0.67**	0.61***
	(0.41 - 0.82)	(0.39 - 0.77)	(0.50 - 0.91)	(0.44 - 0.84)
Below high school	1.00	0.98	1.08	1.19
	(0.62 - 1.61)	(0.61 - 1.58)	(0.69 - 1.68)	(0.76 - 1.85)
College or above	0.68**	0.69*	0.54***	0.63***
	(0.48 - 0.97)	(0.48 - 1.01)	(0.41 - 0.71)	(0.48 - 0.83)
Income to poverty ratio < 100	0.71*	0.66**	1.35*	1.32*
	(0.47 - 1.05)	(0.44 - 0.99)	(0.97 - 1.86)	(0.98 - 1.79)
Total caloric intake		1.00		1.01
		(0.98 - 1.02)		(0.99 - 1.02)
Total physical activity		0.98***		0.97***
		(0.97 - 0.99)		(0.96 - 0.98)
Accelerometer wear time		0.99		1.06
		(0.92 - 1.06)		(0.98 - 1.15)
Sample size	2,227	2,227	2,104	2,104

95% confidence intervals in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

Table 3: Logistic Regression Odds Ratios for Abdominal Obesity Risks

	Risk of Abdominal Obesity for Men (waist circumference ≥ 103 cm)		Risk of Abdominal Obesity for Women (waist circumference ≥ 88 cm)	
White (Foreign-born)	0.68*	0.70	0.53*	0.56*
	(0.44 - 1.07)	(0.44 - 1.11)	(0.28 - 1.00)	(0.29 - 1.07)
Black (US-born)	0.71**	0.71**	1.85***	1.76***
	(0.54 - 0.95)	(0.52 - 0.95)	(1.40 - 2.44)	(1.34 - 2.30)
Black (Foreign-born)	0.24***	0.23***	1.23	1.18
	(0.13 - 0.43)	(0.12 - 0.41)	(0.54 - 2.82)	(0.51 - 2.75)
Hispanic (US-born)	1.07	1.12	1.22	1.19
	(0.71 - 1.61)	(0.74 - 1.70)	(0.79 - 1.88)	(0.76 - 1.86)
Hispanic (Foreign-born)	0.45***	0.52***	0.78	0.80
	(0.31 - 0.65)	(0.36 - 0.75)	(0.50 - 1.21)	(0.51 - 1.26)
Age	1.11***	1.13***	1.12***	1.13***
	(1.04 - 1.19)	(1.05 - 1.21)	(1.07 - 1.19)	(1.07 - 1.19)
Age-squared	1.00**	1.00**	1.00***	1.00***
	(1.00 - 1.00)	(1.00 - 1.00)	(1.00 - 1.00)	(1.00 - 1.00)
Married/cohabitating	1.11	1.11	1.15	1.11
	(0.83 - 1.46)	(0.84 - 1.46)	(0.86 - 1.55)	(0.82 - 1.51)
Poor/fair self-rated health	2.15***	1.92***	1.58***	1.53***
	(1.44 - 3.20)	(1.27 - 2.89)	(1.25 - 2.00)	(1.18 - 1.98)
Current smoker	0.57***	0.54***	0.76*	0.70**
	(0.45 - 0.74)	(0.42 - 0.71)	(0.57 - 1.02)	(0.52 - 0.95)
Below high school	1.03	1.01	1.18	1.31
	(0.72 - 1.46)	(0.71 - 1.43)	(0.77 - 1.80)	(0.84 - 2.04)
College or above	0.72**	0.74*	0.50***	0.57***
	(0.52 - 0.99)	(0.53 - 1.02)	(0.38 - 0.65)	(0.43 - 0.75)
Income to poverty ratio < 100	0.69*	0.65**	1.41	1.42
	(0.46 - 1.02)	(0.44 - 0.96)	(0.91 - 2.19)	(0.92 - 2.19)
Total caloric intake		1.00		1.00
		(0.99 - 1.02)		(0.99 - 1.02)
Total physical activity		0.98***		0.98***
		(0.98 - 0.99)		(0.97 - 0.98)
Accelerometer wear time		1.01		1.04
		(0.93 - 1.08)		(0.97 - 1.12)
Sample size	2,227	2,227	2,104	2,104

95% confidence intervals in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%