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Ethnic-immigrant Disparities in Total and Abdominal Obesity in the US

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Abstract

Objectives—To examine sex-specific disparities in total and abdominal obesity prevalence across 6 ethnic-immigrant groups and explore whether the observed differences were attributable to diet and physical activity (PA).

Methods—Data were from 4331 respondents age 18–64 from the 2003–2006 National Health and Nutrition Examination Survey. Sex-specific multiple logistic regression analyses were performed.

Results—Regardless of race-ethnicity, immigrants exhibited lower prevalence of total and abdominal obesity than natives. Among the US-born, Whites had the lowest total obesity prevalence followed by Hispanics and then Blacks; but racial-ethnic disparities for immigrants were different. In abdominal obesity, US-born white men had the highest prevalence. PA helped explain some ethnic-immigrant disparities.

Conclusions—Complex interactions of sex by race-ethnicity and nativity exist for obesity prevalence.

Keywords

obesity disparity; accelerometer

Obesity is a serious risk factor for a range of health conditions affecting longevity and quality of life.^{1–3} Racial-ethnic disparities in obesity prevalence have been persistent. According to national estimates,⁴ about 45% of non-Hispanic Blacks (referred to as ‘Black’ hereafter) and 37% of Hispanics are obese compared with 30% non-Hispanic Whites (referred to as ‘White’ here-after). Meanwhile, abundant literature also points out that nativity is an additional factor of obesity with foreign-born immigrants consistently showing lower prevalence rates of obesity than their native-born co-ethnics, perhaps due to the less obesogenic environments of immigrants’ origin communities.^{5,6}

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Human Subjects Statement

This study has received IRB exemption from the University of Utah IRB Review Board.

Conflict of Interest Statement

The authors declare no conflict of interest.

Body weight is determined by the net difference between energy coming in (from what one eats and drinks) and energy going out (from physical activity) with other factors such as biological mechanisms also playing important roles in the process.⁷⁻¹⁰ Thus, the observed obesity disparities should largely but not entirely be attributable to disparities in total food intake and physical activity (PA). Food intake is primarily captured by subjective self-reports based on which total caloric intake can be estimated using standard formulae of food-calorie conversion. PA can be generally categorized into 2 types: leisure-time PA (LTPA), regarding PA for the purpose of exercising, weight control, health improvement, or entertainment, and non-leisure-time PA (NLTPA), referring to PA for instrumental purposes such as walking for travel and activities for work and household chores. Total PA can be computed by summing LTPA and NLTPA. PA also can be distinguished by intensity levels into light, moderate, and vigorous categories. Previous studies have shown that moderate-vigorous PA (MVPA) tends to reap greater amounts of health benefits than light PA.¹¹⁻¹⁴ Total MVPA is the sum of LTPA and NLTPA of moderate-vigorous intensity, capturing total amount of health-enhancing MVPA participation regardless of the purposes.

Many studies have examined racial-ethnic differences in LTPA and found that Whites are more likely to participate in LTPA compared to non-Whites.^{15,16} However, this pattern is not necessarily applicable to NLTPA. Evidence shows that socioeconomically disadvantaged groups are more engaged in NLTPA because they are more likely to have manually demanding jobs and be dependent on public transportation.^{15,17} In addition, some minority groups such as Blacks and Hispanics are more likely than Whites to live in disadvantaged neighborhoods which are linked to more non-leisure walking.¹⁸ Hence, Blacks and Hispanics may generally have higher levels of NLTPA than Whites, a pattern contradictory to that in LTPA possibly blurring racial-ethnic disparities in total PA. One study examined differences in LTPA, NLTPA, and total PA by race-ethnicity among middle-aged and older community-dwelling adults using data from the 1992 Health and Retirement Study.¹⁵ The results showed significantly lower LTPA prevalence rates for Blacks and Hispanics compared to Whites and also revealed the reverse pattern for NLTPA. On balance, mean total PA scores were similar across racial-ethnic groups in this sample. 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 complicate the issue further, nativity often confounds race-ethnicity in affecting weight-related outcomes. Recent decades have witnessed a rapid and continued growth of immigrants, defined as foreign-born individuals moving to the US to live permanently, in the US population. They constitute a large proportion of Hispanics and are projected to increase among Blacks.¹⁹ Immigrants appear different than their US-born co-ethnics in terms of lifestyles related to energy balance (ie, dietary intake and PA) and 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.^{5,20,21} In addition, most evidence from studies of Hispanic immigrants shows that obesity prevalence among foreign-born Hispanics is positively related to their length of US residence, a finding consistent with the acculturation hypothesis, which states that the process of acquiring dominant cultural norms in the US by immigrants is related to increases in obesity.^{6,22,23} However, the acculturation and PA association is complex; its magnitude and direction may depend on types of PA. US-born or English-speaking Hispanics seem to be more engaged in LTPA than foreign-born or Spanish-speaking ones,^{5,17} suggesting acculturation among Hispanics may have beneficial health effects via increased LTPA participation. Mean-while, acculturation may be linked to lower levels of NLTPA¹⁷ as it is often concomitant with increasing SES and higher SES often correspond to lower levels of NLTPA which, for the most part, is conducted on

demand fulfilling household-, occupation-, and transportation-based needs. Hence, how nativity as a crude measure of acculturation affects total PA as a potential mediator of obesity disparities remains equivocal.

Regarding the role of total caloric intake in contributing to obesity disparities, the literature is sparse. One study did not find any effect of caloric intake on body mass index (BMI) or obesity among foreign-born or US-born Mexicans in the US.²⁴ Other research 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; however, total caloric intake was not considered in this study.²² The mediating effects of total caloric intake and total PA on ethnic-immigrant disparities in obesity have not been well examined.

In obesity research, a common measurement issue is the heavy reliance on self-reported height and weight to measure BMI and obesity. Whereas self-reported BMI is strongly correlated with objectively measured BMI, recent evidence from the 2007–08 National Health and Nutrition Examination Survey (NHANES) showed there were systematic errors in underreporting BMI based on important demographic factors such as race-ethnicity, sex, and education.²⁵ Therefore, when comparing obesity prevalence rates across socio-demographic groups, objectively measured BMI is preferred. Similarly, the majority of studies on PA are based on self-reported activities that are inevitably subject to response bias owing to the respondent's blurred memory or tendency to answer questions in a manner that will be viewed favorably by others—labeled as “social desirability tendency.”²⁶ In the case of self-reported body weight the social desirability bias is manifested as over-reporting height and under-reporting weight and BMI²⁵ with greater prevalence observed in overweight or obese study participants.²⁷

Although BMI is the most frequently used measure of body weight in obesity research, it is not ideal as it punishes individuals with high muscle-to-fat ratios and cannot distinguish sources of body weight from lean mass or fat. In fact, body fat distribution or the location of adiposity may be a better predictor of morbidity and mortality everything else being equal. For example, central obesity measured by waist circumference (WC) is a stronger predictor of noninsulin dependent diabetes mellitus compared to BMI and other measures of adiposity²⁸ and is an independent risk factor of morbidity and mortality net of overall BMI.^{29,30} More diverse measures of body weight should be employed in obesity research.

Another gap in the literature of obesity disparities is that immigrant Blacks are rarely examined.³¹ At present, over 6% of Blacks living in the US are foreign-born.¹⁹ Limited evidence showed that foreign-born Blacks had a lower obesity risk, compared with US-born Blacks,^{31,32} although non-significant results also have been reported.³³ Even less studied are foreign-born Whites. Including these under-researched ethnic-immigrant groups in the analyses would presumably enhance our evidentiary base with regard to obesity disparities.

Meanwhile, findings from previous work suggest that it should be important to stratify by sex when exploring patterns and explainers of obesity disparities as men and women systematically differ in prevalence rates of obesity and exhibit different patterns of racial-ethnic disparities in obesity prevalence. For example, a national study analyzed a representative sample of non-institutionalized US adults collected in 2005 and observed racial disparities in obesity only among women.³⁴ Two local studies, one focusing on the Boston area in 2002–05³⁵ and the other on the state of Texas in 2003,³⁶ also confirmed sex by race-ethnicity (ie, White, Black, and Hispanic) interaction effect in obesity prevalence showing greater levels of raciaethnic disparities in obesity among women. Sex differences also have been reported in studies of the association between BMI and acculturation among immigrants.^{37–40} These converging findings point to the importance of conducting sex-

stratified analyses in assessing patterns and explainers of ethnic-immigrant disparities in obesity.

Using a nationally representative cross-sectional sample, we examined the patterns of sex-specific disparities in total and abdominal obesity, total caloric intake, and total MVPA across 6 ethnic-immigrant groups: US-born whites, 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 MVPA were mediators of the observed obesity disparities. The key contribution of this study is to present sex-specific patterns of disparities in BMI-based total obesity and WC-based abdominal obesity by both race-ethnicity (White, Black, and Hispanic) and immigrant status (US-born and foreign-born), while exploring the mediating effects of total caloric intake and total MVPA underlying these disparities, thereby providing a more complete picture of obesity disparities. Obesity researchers have called for the need of prevention and intervention programs tailored to specific socio-demographic groups to minimize cost and maximize results.^{35,36,41} Findings from the current study inform such programs and enhance our understanding of the patterns and explainers of obesity disparity in the US.

METHODS

Data

The study used data from the 2003 to 2006 continuous National Health and Nutrition Examination Survey (NHANES) based on a nationally representative cross-sectional sample of the US civilian non-institutionalized population. In 2003–06 those who could walk were given accelerometers to wear for a week, following standard protocols.⁴² The initial sample size was 20,474 cases. We focused on adults who were 18–64 years old and were white, black, or Hispanic in our analyses (7956 cases remained). We excluded adults age 65 years or older because of the more complicated relationships between BMI and health in later life. We further excluded pregnant women (585 cases dropped), observations missing covariate information (5 cases dropped), BMI outliers (<18.5 or >60; 403 cases dropped), and those without valid accelerometer data (2633 cases dropped) described below. The final analytical sample size was 4331 with 2104 women and 2227 men.

Measures

Outcome measures included a dichotomous indicator of obesity based on clinically measured BMI (kg/m^2) (30.0–60.0 versus 18.5–29.9) and a dichotomous indicator of abdominal obesity defined as WC ≥ 102 cm for men and ≥ 88 cm for women. These cutoff points were used following the convention in obesity research²⁴ supported by findings that obesity defined in these ways is predictive of subsequent morbidity and mortality. That said, predictive values of these obesity measures may vary according to individuals' socio-demographic background.⁴³ For example, a 14-year prospective observational study of more than one million Americans demonstrated that the BMI of minimum mortality for black women was 25.0–26.4 kg/m^2 versus 22.0–23.4 kg/m^2 for white women.⁴⁴ However, our knowledge on these variations is too limited to provide solid guidance on using alternative cutoff points to define obesity in empirical analyses.

In terms of key independent variables of interest, 2 variables were included: total one-day caloric intake (continuous) based on self-reported 2 one-day dietary recalls and total MVPA based on accelerometer readings (continuous). NHANES contains data on 2 non-consecutive days of dietary intake using 24-hour recalls, with the first day data collected by in-person interview and the second day by telephone interview. Data were collected using the US Department of Agriculture (USDA) dietary data collection instrument and the Automated

Multi-Pass Method (AMPM). The USDA processes these data using USDA's Food and Nutrient Database for Dietary Studies. As a result of this processing, total caloric intake for each day was computed and included in the NHANES data (<http://www.ars.usda.gov/Services/docs.htm?docid=13793>). For our study, we averaged the 2 day caloric intakes unless only one day data were available. For respondents with missing values on both days (about 3%), we imputed the value by adding a random component to the weighted sample mean.

We measured total MVPA through objective accelerometer data. NHANES collected objective information on the intensity and duration of common locomotion activities such as walking and jogging using the ActiGraph AM-7164, manufactured by ActiGraph of Ft Watson Beach, FL. (http://www.cdc.gov/nchs/data/nhanes/nhanes_03_04/paxraw_c.pdf). The participants were instructed to wear an accelerometer on an elastic belt around their waist during waking hours of the day for 7 days. The accelerometer data were processed following previous work.^{45,46} This requires 2020 CPS for the MVPA threshold and 4 days of 10+ hours of accelerometer wear. Non-wear 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 non-wear time. Some accelerometer data were discarded if units were out of calibration when returned or if unlikely levels of activity were measured.^{45,46}

We used 2 mutually exclusive MVPA measures: MVPA8+ and MVPA1-7 episodes. MVPA8+ episodes represent the recommended Centers for Disease Control and Prevention (CDC) levels. 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 episodes were defined as 1 MVPA minute but less than an MVPA8+ minute episode. Mean daily time in the sum of both episodes were calculated across all valid days and used to measure total MVPA.

Control variables included age (years), marital status (married or cohabitating versus others), education (less than high school, high school, college or above), and fair/poor self-rated health (SRH) ("fair/poor" health versus "good," "very good," or "excellent" health). We further took into account 2 additional variables: income to poverty ratio and smoking (self-reported current smoker or not). These variables have been found to be significant correlates of obesity prevalence and are often controlled in the analyses of obesity disparities as potential confounders.^{47–52} When total MVPA was included in the model, we also adjusted for accelerometer wear time.⁵³

Statistical Analyses

ANOVA and chi-square tests were used to compare group differences in total and abdominal obesity prevalence rates and the covariates included in the analyses. Sex-specific multiple logistic regression analyses were performed for total obesity based on BMI and abdominal obesity based on WC. Analyses were corrected for the complex sampling design of NHANES as recommended.⁵⁴ Sample weights were adjusted for combining 2003–04 and 2005–06, and for 4 days of valid accelerometer wear. Diagnostic tests revealed no problem with multicollinearity. Analyses were conducted using Stata 11.

Model configurations were identical to both obesity outcomes. Model 1 was a baseline model including 5 ethnic-immigrant groups with US-born Whites as reference group along with 6 socio-demographic controls (ie, age, marital status, poor/ fair SRH, 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 MVPA or both. To make a

formal comparison of US-born Blacks versus other groups in the odds of obesity, Model 2 was refit using US-born Blacks, instead of US-born Whites, as the reference group for both obesity outcomes.

RESULTS

Tables 1 and 2 show socio-demographic characteristics, health and lifestyle factors, and obesity prevalence rates of the sample stratified by sex and ethnic-immigrant group. Some common patterns are detected across sex. Hispanics are the youngest group, regardless of nativity. Whites have the lowest rates of fair/poor SRH and generally higher socioeconomic status compared to other groups. The role of nativity depends on race-ethnicity. For example, whereas foreign-born Whites and Blacks are better educated and have lower poverty prevalence than their US-born counterparts, US-born Hispanics are much better off than Hispanic immigrants.

Regarding total obesity disparity, for both men and women, the highest prevalence rate is found in US-born Blacks and the lowest in foreign-born Blacks. Consistent with the acculturation hypothesis, regardless of race-ethnicity, the US-born have higher prevalence rates than the foreign-born, with the largest gap found in black women and the smallest in white men. Specifically, the prevalence rate of obesity among US-born black women is 33 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, US-born Whites have the highest prevalence rate of abdominal obesity and the largest gap between the US-born and the foreign-born is observed in Hispanic men and white women exhibiting a nearly 16 percentage point difference, whereas there seems little difference by nativity among Hispanic women.

With respect to total caloric intake, US-born white men and US-born black women have the highest levels respective by sex. In terms of total MVPA, foreign-born Hispanics are the most active for both men and women, whereas the least active are foreign-born Blacks among men and US-born Blacks among women. This pattern of results lends evidence that sex, race-ethnicity, and nativity have important interactions on energy balance.

Table 3 presents logistic regression odds ratios for total obesity. Among men, the only ethnic-immigrant group significantly different than US-born Whites is foreign-born Hispanics exhibiting a lower obesity odds (OR=0.62; $p < .05$). Total caloric intake is not a significant covariate whereas total MVPA is (OR=0.98; $p < .01$). Controlling for total MVPA renders the odds ratio of foreign-born Hispanics non-significant (OR=0.75; $p > .10$), 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.

Among women, US-born Blacks (OR=2.30; $p < .01$) have a higher odds of total obesity than US-born Whites whereas foreign-born Blacks (OR=0.46; $p < .05$) and foreign-born Hispanics (OR=0.58; $p < .05$) have lower odds. Again, total caloric intake is not a significant covariate but total MVPA is (OR=0.97; $p < .01$). A small proportion of US-born black women's higher odds of total obesity relative to US-born white women seem attributable to total MVPA (about 5%).

Table 4 presents logistic regression odds ratios for abdominal obesity prevalence. Among men, more group differences are seen for odds of abdominal obesity than for that of total obesity. Other than US-born Hispanics, all other groups of men have lower odds of abdominal obesity than US-born white men (foreign-born White: OR=0.68, $p < .10$; US-

born Black: OR=0.71, $p < .05$; foreign-born Black: OR=0.24, $p < .01$; and foreign-born Hispanic: OR=0.45, $p < .01$). 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 have a higher odds of abdominal obesity (OR=1.85, $p < .01$) and a small proportion of this effect is attributable to total MVPA (about 5%). Foreign-born Whites have a lower odds of abdominal obesity compared to US-born Whites (OR=0.53, $p < .10$), an effect neither attributable to total caloric intake nor MVPA. Again, total MVPA is a significant correlate of abdominal obesity odds (OR=0.98, $p < .01$) and total caloric intake is not.

The observed large differences in the odds ratio of the black race by nativity motivated us to rerun Model 2 using US-born Blacks as the reference group to test these differences formally. The results are presented in Table 5. Among Blacks, the foreign-born have lower odds of total and abdominal obesity than the US-born for both men and women although in abdominal obesity the difference was not statistically significant among women (foreign-born black men: OR on total obesity= 0.41, $p < .05$; OR on abdominal obesity=0.32, $p < .01$; foreign-born black women: OR on total obesity= 0.20, $p < .05$; OR on abdominal obesity=0.67, $p > .10$). Compared to other groups, among women, US-born Blacks have higher odds of total obesity (US-born White: OR=0.46, $p < .01$; foreign-born White: OR=0.32, $p < .01$; US-born Hispanics: OR=0.61, $p < .05$, foreign-born Hispanics: OR=0.28, $p < .01$) and of abdominal obesity (US-born White: OR=0.57, $p < .01$; foreign-born White: OR=0.32, $p < .01$; US-born Hispanics: OR=0.68, $p < .05$, foreign-born Hispanics: OR=0.46, $p < .01$) but the pattern is less clear among men.

Except for marital status, all the control variables are found to be significant on both outcomes, suggesting the importance of controlling for them as possible confounding factors in obesity disparity research. The effects are mostly similar across sex. Age and age-squared are both significant, showing a curvilinear relationship of advancing age with the odds of obesity. College education and smoking are negatively linked to the odds of obesity whereas poor/fair SRH is a positive covariate. The only sex difference in the effects of controls is observed in the poverty-obesity link. Living in poverty is a negative covariate for men but a positive one for women.

DISCUSSION

This study sought to examine detailed patterns of ethnic-immigrant disparities in total and abdominal obesity prevalence, exploring whether the observed ethnic-immigrant disparities are attributable to total caloric intake and total MVPA. Among the US-born, for both men and women, Blacks had the highest total obesity prevalence, followed by Hispanics and then Whites. However, these patterns were not replicated among the foreign-born where Blacks showed the lowest prevalence. In abdominal obesity, among men, US-born Whites had the highest prevalence with the lowest prevalence found in foreign-born Blacks, suggesting that white privilege in obesity is not universal but dependent on gender and specific measures of obesity. Among women, US-born Blacks had the highest prevalence of abdominal obesity with foreign-born Whites having the lowest. These results confirm the presence of complex interactions among sex, race-ethnicity, and immigrant status for total and abdominal obesity prevalence.

Holding race-ethnicity constant, foreign-born respondents on average had lower odds of total and abdominal obesity compared to their US-born co-ethnics, a finding consistent with the acculturation hypothesis predicting worsened health status and behavior with increasing

acculturation. One implication of the acculturation hypothesis is that the social, physical and cultural environments of the American society are more obesogenic²² than immigrants' original societies; therefore, as newcomers spend more time in the US they tend to adopt American lifestyles that are linked to greater prevalence of obesity.⁵ Although our study was not designed to examine the acculturation hypothesis directly, the results suggest that the acculturation hypothesis likely extends to white and black immigrants. These 2 groups are largely ignored in the acculturation and obesity literature^{5,22,32} and should receive more attention in future work.

Without taking nativity into account, nuanced group differences in obesity prevalence would not have been revealed. Among Blacks, the foreign-born have a considerably lower prevalence rate of total obesity than their US-born counterparts and this advantage cannot be explained by their higher SES. This finding is in agreement with some research^{31,32} but not all.^{33,55} Evidence on obesity heterogeneity within the black group is sparse as Blacks are often grouped together regardless of nativity or nationality. Regarding Whites, we also found remarkable advantage of immigrants relative to natives; however, due to a small literature, we cannot fully put this finding into context. More work is needed to examine obesity issues in under-researched groups such as white and black immigrants.

Compared to total obesity, abdominal obesity is an under-examined outcome in obesity disparity research. The current study found that among men, US-born Whites had the highest odds of abdominal obesity compared to other groups except for US-born Hispanics. Abdominal fat accumulation has been particularly linked to psychosocial stress and defeat reaction, or emotionally charged reaction to negative environmental stimuli,⁵⁶ a pattern particularly documented for men.⁵⁷ No other evidence or theory is readily available to explain discrepancies in total versus abdominal obesity. One study showed that the relationship between acculturation and total and abdominal obesity was not linear but nonlinear and multifaceted depending on other factors such as age.⁵⁸ The present study expands 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 research is needed to improve understanding of the disparities in central adiposity, which may differ from those regarding total obesity. Our knowledge of obesity epidemiology would be enhanced if future studies employ sophisticated measures of obesity based on body mass distribution rather than just 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 showed that total caloric intake was neither a covariate of total or abdominal obesity nor an explainer of the observed ethnic-immigrant disparities. In contrast, total MVPA was a significant covariate of both obesity outcomes while explaining some advantages of foreign-born Hispanic men and a small portion of disadvantages of US-born black women. That PA or energy expenditure is a more important contributor to obesity disparity than diet or energy input is consistent with the key conclusion of one review article.⁵⁹ These authors identified 3 major factors modulating body weight, namely metabolic factors, diet, and PA, and provided convincing evidence to show that the rising obesity trend witnessed in the past 2 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,⁶⁰ or metabolic factors, which received mixed evidence;⁵⁹ by contrast, reduced activity-related energy expenditure seemed to play an important or even primary role in the obesity trend.⁶¹

This study had several limitations. First, causality should not 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. Second, the measure of diet, namely total caloric intake, is based on self-reports, which are inevitably subject to response and recall bias. This measure also cannot distinguish healthy dietary intake from unhealthy ones. Third, the physical activity measure, albeit based on objective readings of accelerometer data, is not free of bias and cannot capture some types of physical activity such as swimming. Fourth, 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. National surveys that over sample these under-researched immigrant groups would be helpful for our studying their obesity patterns.

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 particularly among Blacks found by nativity lends support to environmental explanations of obesity.⁶² Whereas there is little doubt that genetic factors matter for individual odds of obesity,⁶³ they cannot explain obesity disparities across socio-culturally constructed groups such as those based on race-ethnicity and/or nativity. Although public health messages frequently point to black women's highest prevalence of obesity across all race-ethnicity-sex subgroups in the US, they seem to be mainly applicable to natives. Typically not addressed in national obesity prevalence estimates, foreign-born black women have the lowest prevalence rate of total 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. This contrast suggests active lifestyles may play a more dominant role in contributing to obesity disparities than dietary behaviors. However, to put the present study into perspective, more research is warranted to examine obesity disparities further 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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Table 1

Sample Statistics on Men

	White		Black		Hispanic		Total
	(US born)	(Foreign born)	(US born)	(Foreign born)	(US born)	(Foreign born)	
Age (mean) ****	41.21	39.53	38.19	43.76	35.96	35.57	40.10
Married (%) ****	71.40	74.94	55.21	76.24	56.54	70.38	69.22
Fair/poor self-rated health (%) ****	9.76	12.13	13.63	14.19	15.03	22.42	11.78
Current smoker (%) **	26.19	35.75	29.24	17.93	30.79	20.32	26.41
Less than high school (%) ****	7.82	5.23	21.94	17.92	19.79	56.74	14.64
High school graduates (%) ****	26.21	21.26	27.95	23.03	23.69	19.92	25.43
College or above (%) ****	29.49	31.32	14.24	33.69	12.66	8.05	25.24
Income to poverty ratio < 100 (%) ****	6.53	5.65	15.6	13.13	12.01	29.38	10.01
Total caloric intake ^a (mean; 100 calories) ****	27.76	26.09	26.1	21.66	27.41	24.84	27.13
Total physical activity ^b (mean; daily minutes) ****	33.72	37.94	35.25	30.82	37.53	47.52	35.53
Accelerometer wear time (mean; hours) ****	14.57	14.07	14.94	15.17	14.31	14.18	14.55
Prevalence of total obesity ^c (%) ****	32.08	28.64	35.99	22.33	32.53	24.91	31.53
Prevalence of abdominal obesity ^d (%) ****	44.81	34.64	34.91	20.32	42.03	26.4	41.08
Sample size	1012	61	473	54	202	425	2227

** significant at .05;

*** significant at .01

Note.

Total caloric intake per day is the average daily total calories divided by 100 calculated based on two one-day dietary recalls.

Total physical activity is measured by average daily moderate-to-vigorous physical activity (MVPA) minutes based on accelerometer data of 1-minute episodes.

Obesity is indicated by $\geq 30 \text{ kg/m}^2$ based on objectively measured height and weight.

Abdominal obesity is indicated by waist circumference of $\geq 102\text{cm}$ or over for men.

Table 2

Sample Statistics on Women

	White		Black		Hispanic		Total
	(US born)	(Foreign born)	(US born)	(Foreign born)	(US born)	(Foreign born)	
Age (mean)***	41.89	41.74	39.42	39.09	34.83	38.22	40.88
Married (%)***	67.73	64.21	36.00	54.98	54.26	72.05	63.03
Fair/poor self-rated health (%)***	10.75	6.88	20.44	23.25	17.15	30.00	13.83
Current smoker (%)***	22.90	17.81	17.09	2.17	17.21	13.62	20.70
Less than high school (%)***	6.34	5.23	14.34	7.49	15.97	49.49	11.20
High school graduates (%)***	23.36	17.01	20.59	22.47	22.69	21.07	22.55
College or above (%)***	31.23	37.68	20.52	31.60	13.53	6.01	27.21
Income to poverty ratio < 100 (%)***	6.70	5.11	20.34	13.58	14.30	28.2	10.54
Total caloric intake ^a (mean; 100 calories)**	18.63	17.51	19.86	16.48	18.79	18.49	18.72
Total physical activity ^b (mean; daily minutes)	20.94	24.01	18.46	21.53	20.65	24.23	20.98
Accelerometer wear time (mean)***	14.18	14.32	14.25	14.87	14.06	13.89	14.18
Prevalence of total obesity ^c (%)***	32.57	23.62	55.37	22.27	39.96	29.18	35.15
Prevalence of abdominal obesity ^d (%)***	57.40	41.82	71.01	62.89	59.13	58.77	58.83
Sample size	954	52	479	48	243	328	2104

* significant at .10;

** significant at .05;

*** significant at .01

Note.

Total caloric intake per day is the average daily total calories divided by 100 calculated based on two one-day dietary recalls.

Total physical activity is measured by average daily moderate-to-vigorous physical activity (MVPA) minutes based on accelerometer data of 1-minute episodes.

Obesity is indicated by 30 kg/m^2 based on objectively measured height and weight.

Abdominal obesity is indicated by waist circumference of $\geq 88 \text{ cm}$ for women.

Table 3

Logistic Regression Odds Ratios for Total Obesity

	Odds of Total Obesity among Men (body mass index 30kg/m ²)		Odds of Total Obesity among Women (body mass index 30kg/m ²)	
	Model 1	Model 2	Model 1	Model 2
White (US-born)	Reference	Reference	Reference	Reference
White (Foreign-born)	0.87 (0.51 – 1.48)	0.89 (0.52 – 1.51)	0.65 (0.32 – 1.32)	0.70 (0.33 – 1.46)
Black (US-born)	1.22 (0.89 – 1.67)	1.23 (0.88 – 1.72)	2.30*** (1.65 – 3.22)	2.18*** (1.56 – 3.03)
Black (Foreign-born)	0.53 (0.24 – 1.16)	0.51* (0.23 – 1.11)	0.46** (0.23 – 0.89)	0.44** (0.20 – 0.95)
Hispanic (US-born)	1.04 (0.75 – 1.44)	1.08 (0.77 – 1.53)	1.35 (0.90 – 2.03)	1.32 (0.86 – 2.05)
Hispanic (Foreign-born)	0.62** (0.42 – 0.91)	0.75 (0.51 – 1.09)	0.58** (0.34 – 0.99)	0.60* (0.34 – 1.06)
Age (in 5-year unit)	1.38* (0.96 – 1.98)	1.49** (1.02 – 2.18)	2.18*** (1.58 – 3.00)	2.25*** (1.65 – 3.07)
Age (in 5-year unit)- squared	0.98 (0.96 – 1.01)	0.98** (0.95 – 1.00)	0.96*** (0.94 – 0.98)	0.95*** (0.94 – 0.97)
Married/cohabitating	1.14 (0.81 – 1.62)	1.14 (0.81 – 1.61)	0.92 (0.67 – 1.28)	0.88 (0.63 – 1.22)
Poor/fair self-rated health	2.43*** (1.71 – 3.47)	2.11*** (1.46 – 3.04)	1.86*** (1.40 – 2.47)	1.78*** (1.30 – 2.44)
Current smoker	0.58*** (0.41 – 0.82)	0.54*** (0.39 – 0.77)	0.67** (0.50 – 0.91)	0.61*** (0.44 – 0.84)
Equal to or less than high school education	1.00 (0.62 – 1.61)	0.98 (0.61 – 1.58)	1.08 (0.69 – 1.68)	1.19 (0.76 – 1.85)
Some college education or above	0.68** (0.48 – 0.97)	0.69* (0.48 – 1.01)	0.54*** (0.41 – 0.71)	0.63*** (0.48 – 0.83)
Poverty income ratio < 100	0.71* (0.47 – 1.05)	0.66** (0.44 – 0.99)	1.35* (0.97 – 1.86)	1.32* (0.98 – 1.79)
Total caloric intake^a		1.00 (0.98 – 1.02)		1.01 (0.99 – 1.02)
Total moderate-vigorous physical activity (MVPA)^b		0.98*** (0.97 – 0.99)		0.97*** (0.96 – 0.98)
Accelerometer wear time		0.99 (0.92 – 1.06)		1.06 (0.98 – 1.15)
Sample size		2227		2104

95% confidence intervals in parentheses;

* significant at .10;

** significant at .05;

*** significant at .01

Note.

Total caloric intake per day is the average daily total calories divided by 100 calculated based on two one-day dietary recalls.

Total physical activity is measured by average daily moderate or vigorous physical activity (MVPA) minutes accelerometer data based on 1-minute episodes.

Table 4

Logistic Regression Odds Ratios for Abdominal Obesity

	Odds of Abdominal Obesity for Men (waist circumference 103cm)		Odds of Abdominal Obesity for Women (waist circumference 88cm)	
	Model 1	Model 2	Model 1	Model 2
White (US-born)	Reference	Reference	Reference	Reference
White (Foreign-born)	0.68* (0.44 – 1.07)	0.70 (0.44 – 1.11)	0.53* (0.28 – 1.00)	0.56* (0.29 – 1.07)
Black (US-born)	0.71** (0.54 – 0.95)	0.71** (0.52 – 0.95)	1.85*** (1.40 – 2.44)	1.76*** (1.34 – 2.30)
Black (Foreign-born)	0.24*** (0.13 – 0.43)	0.23*** (0.12 – 0.41)	1.23 (0.54 – 2.82)	1.18 (0.51 – 2.75)
Hispanic (US-born)	1.07 (0.71 – 1.61)	1.12 (0.74 – 1.70)	1.22 (0.79 – 1.88)	1.19 (0.76 – 1.86)
Hispanic (Foreign-born)	0.45*** (0.31 – 0.65)	0.52*** (0.36 – 0.75)	0.78 (0.50 – 1.21)	0.80 (0.51 – 1.26)
Age (in 5-year unit)	1.71*** (1.22 – 2.40)	1.83*** (1.28 – 2.62)	1.80*** (1.37 – 2.36)	1.85*** (1.40 – 2.43)
Age (in 5-year unit) - squared	0.98** (0.96 – 1.00)	0.97** (0.95 – 0.99)	0.98*** (0.96 – 0.99)	0.97*** (0.96 – 0.99)
Married/cohabitating	1.11 (0.83 – 1.46)	1.11 (0.84 – 1.46)	1.15 (0.86 – 1.55)	1.11 (0.82 – 1.51)
Poor/fair self-rated health	2.15*** (1.44 – 3.20)	1.92*** (1.27 – 2.89)	1.58*** (1.25 – 2.00)	1.53*** (1.18 – 1.98)
Current smoker	0.57*** (0.45 – 0.74)	0.54*** (0.42 – 0.71)	0.76* (0.57 – 1.02)	0.70** (0.52 – 0.95)
Equal to or less than high school education	1.03 (0.72 – 1.46)	1.01 (0.71 – 1.43)	1.18 (0.77 – 1.80)	1.31 (0.84 – 2.04)
Some college education or above	0.72** (0.52 – 0.99)	0.74* (0.53 – 1.02)	0.50*** (0.38 – 0.65)	0.57*** (0.43 – 0.75)
Poverty income ratio < 100	0.69* (0.46 – 1.02)	0.65** (0.44 – 0.96)	1.41 (0.91 – 2.19)	1.42 (0.92 – 2.19)
Total caloric intake^a		1.00 (0.99 – 1.02)		1.00 (0.99 – 1.02)
Total moderate-vigorous physical activity (MVPA)^b		0.98*** (0.98 – 0.99)		0.98*** (0.97 – 0.98)
Accelerometer wear time		1.01 (0.93 – 1.08)		1.04 (0.97 – 1.12)
Sample size		2227		2104

95% confidence intervals in parentheses;

* significant at .10;

** significant at .05;

*** significant at .01

Note.

Total caloric intake per day is the average daily total calories divided by 100 calculated based on two one-day dietary recalls.

Total physical activity is measured by average daily moderate or vigorous physical activity (MVPA) minutes accelerometer data based on 1-minute episodes.

Table 5Logistic Regression Odds Ratios for Overall and Abdominal Obesity among Men and Women^a

	Total Obesity	Total Obesity	Abdominal Obesity	Abdominal Obesity
	(Men)	(Women)	(Men)	(Women)
US-born black	Reference	Reference	Reference	Reference
Foreign-born black	0.41 ** (0.18 – 0.94)	0.20 *** (0.09 – 0.46)	0.32 *** (0.17 – 0.61)	0.67 (0.27 – 1.69)
US-born white	0.81 (0.58 – 1.14)	0.46 *** (0.33 – 0.64)	1.41 ** (1.05 – 1.91)	0.57 *** (0.44 – 0.75)
Foreign-born white	0.72 (0.39 – 1.32)	0.32 *** (0.15 – 0.70)	0.99 (0.56 – 1.75)	0.32 *** (0.16 – 0.65)
US-born Hispanic	0.88 (0.62 – 1.26)	0.61 ** (0.39 – 0.95)	1.58 * (1.00 – 2.50)	0.68 ** (0.48 – 0.94)
Foreign-born Hispanic	0.61 ** (0.41 – 0.89)	0.28 *** (0.16 – 0.47)	0.74 (0.47 – 1.16)	0.46 *** (0.29 – 0.72)

95% confidence intervals in parentheses;

* significant at .10;

** significant at .05;

*** significant at .01

Note.

Treating US-born black as the reference group, Model 2 was refit for the 2 obesity outcomes by sex.