Racial and ethnic disparities in objective and subjective obesity: The role of individual and neighborhood characteristics

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Background

Obesity is a risk factor of a wide range of devastating health problems including but not limited to cancer, cardiovascular diseases, and diabetes. The prevalence rate of obesity in the United States has been persistently high in recent decades, and racial/ethnic disparities in obesity risks are routinely observed. However, most estimates of American people's weight status were based on subjectively reported body mass index (BMI), such as those from Behavioral Risk Factor Surveillance System (BRFSS) surveys. Although the validity of self-reported BMI has been reported, group-specific validity has not been well examined. Therefore, racial and ethnic disparities in obesity based on subjectively reported BMI may be tarnished by response bias. Whether the bias is random across the groups and thus can be ignored when addressing racial/ethnic disparities in obesity is not known and should not be assumed. Moreover, mechanisms underlying these disparities are not well established. Although a number of individual and contextual factors have been proposed and tested as potential pathways linking race/ethnicity to excess weight, few studies have used nationally representative data to systematically evaluate multilayered pathways underlying racial/ethnic disparities in objectively assessed risks of obesity.

Study Purposes

The study purposes are three-fold. First, using a nationally representative data set that provides objectively assessed and self-reported BMI, we examine racial and ethnic disparities in risks of obesity net of age and gender. Second, we explore whether these disparities are attributable to individual characteristics such as immigrant status, socioeconomic status, and functional limitation. Third, we further test whether neighborhood socioeconomic status, population density, and prevalence of being overweight and obese provide additional explanatory power for the observed obesity disparities by race/ethnicity. We draw upon the institutional model and socio-cultural model proposed by Jencks and Mayer [1] as the theoretical guidance of our analytical work.

Data and measures

This is a nationally representative, cross-sectional study of American adults age 20 and over. We used the 2003 and 2004 continuous National Health and Nutrition Examination Survey (NHANES) as our individual sample. Considering the well-established curvilinear relationship between age and the risk of obesity, we categorized the respondents into four age groups: age 20-29. Age 30-40, age 50-60, and age 70 or over. Four racial/ethnic groups were examined: non-Hispanic whites (NHW), non-Hispanic black (NHB), Hispanics, and Others. Immigrant status was indicated by US-born versus foreign-born. Marital status was dichotomized into married or cohabitating versus other marital status. Educational attainment was grouped into 5 levels: less than 9th grade (1), 9-11th grade (2), high school graduate or equivalent (3), some college or associate degree (4), and college or above (5). Household income was grouped into 11 levels ranging from the lowest level of $4,999 or below (1) to the highest level of $75,000 or above (11). We also included a dichotomous indicator of whether the respondent needed aid to walk as a measure of functional limitation.

We obtained neighborhood socioeconomic variables from the 2000 census and constructed a scale of neighborhood socioeconomic status (SES) based on four indicators: percent households with annual income at $75,000 or over, percent residents living in poverty, percent college educated residents, and

percent homeowners. The scale has a reasonably good reliability (alpha=0.85). We also obtained population density (number of residents per square miles) from the census data as a proxy indicator of pedestrian-friendly built environment. The SES and density measures were meant to index the institutional resources that might be protective against excess weight gain. Lastly, based on the 2000 BRFSS data, we constructed percent residents being overweight or obese to tap weight-related subcultural orientation in the neighborhood. Census tract was used to define neighborhood.

Analytical Strategy

Factor principal component analyses were performed to construct the neighborhood SES scale. Multilevel logistic regression models were fit to examine the research questions. The three neighborhood variables were standardized before they were included in the analytical models. Four models were fit separately for the two dependent variables: a dichotomous indicator of obesity based on objectively measured BMI and a dichotomous indicator of obesity based on self-reported BMI. The baseline model included age group dummy variables, male gender, and racial/ethnic group dummy variables. Model 2 added immigrant status (US-born or not), marital status (i.e., married/cohabiting or not), educational attainment (treated as a continuous variable), and household income (treated as a continuous variable) as potential socio-demographic mediators explaining racial/ethnic disparities in the risk of obesity. Model 3added functional limitation (i.e., need aid to walk or not). And Model 4 added the three neighborhood variables. There was only one difference in the two sets of models for the two outcomes: education was not a significant covariate of objective obesity but significant for subjective obesity. Therefore, for subjective obesity, educational attainment was kept in models 3 and 4 when functional limitation and neighborhood variables were sequentially added to model 2.

Preliminary Results

Preliminary results are presented in the enclosed three tables. Table 1 shows the sample statistics. Objectively measured prevalence of obesity was 32.89%, just slightly higher than prevalence of obesity (31.63%) estimated from self-reported BMI. Table 2 presents odds ratios of risk of obesity based on objectively measured BMI. Compared to NHW, NHB and Hispanics are significantly at higher risks of obesity whereas other groups (mostly Asians) are substantially less likely to be obese (Model 1). Immigrant status is a significant factor associated with lower obesity risks. It helps reduce a small portion of the NHW advantage compared to blacks (-5.82%) and a greater portion of the NHW disadvantage compared to the other group. This suggests that a non-trivial reason why whites seem disadvantaged to the other group is that the other group consists of a greater proportion of foreign-born immigrants who typically enjoy an initial advantage of body composition at the early stage of immigration. By the same token, whites have proportionally more immigrants than blacks, so controlling for immigrant status, the disadvantage of NHB in the risk of obesity compared to NHW, albeit remains high, gets slightly reduced. Model 3 shows functional limitation is not a mediator of these disparities; if anything, controlling for it amplifies the NHB and Hispanic disadvantage in the risk of obesity. Model 4 shows how place fits into the picture. Neighborhood SES, capturing health-promoting institutional resources, and population density, tapping pedestrian-friendly neighborhood designs, exhibit significant and negative associations with the risk of obesity, whereas present residents being overweight and obese is a significant and positive covariate. These patterns of neighborhood effects are entirely consistent with our hypotheses. More interestingly, about a third of the NHB disadvantage and a quarter of the Hispanic disadvantage are attributable to the joint forces of the three neighborhood variables. Meanwhile, place does not explain the white-other disparity in obesity.

These observed patterns for objective obesity largely hold for subjective obesity. However, three discrepancies are noteworthy. First, the Hispanic disadvantage is overestimated and the other group's advantage is underestimated based on subjective obesity, possibly because whites have a greater tendency to overestimate BMI. However, racial/ethnic differentials in the validity of self-reported BMI are not well-known. Second, educational attainment is not a significant covariate for objective obesity but it is a significant and negative covariate of risk of obesity based on self-reported BMI. It is plausible that higher educated people are more likely to under-report their problems of excess weight because they are more aware of the health-obesity link and they feel more internal pressure conforming to the mainstream norms related to weight. Third, the explanatory powers of neighborhood SES and density are smaller when subjective obesity is examined. In other words, Why this is the case remains elusive to us.

Conclusion

Using data from the 2003 and 2004 continuous NHANES, focusing on adults age 20 or above and based on objectively measured BMI, this study confirms that compared to NHW, NHB and Hispanics are at higher risks of obesity and other racial/ethnic groups (mostly Asians) are less likely to be obese. Among hypothesized individual-level socio-demographic mediators, immigrant status is the most salient contributor to the observed obesity disparities but its explanatory power is considerably smaller than that of the neighborhood variables. This study corroborates the contextual impacts of neighborhood SES, population density, and percent residents being overweight and obese, suggesting that health-enhancing institutional resources and subcultural characteristics preventive against excess weight gains are independently important and jointly contributing to the observed NHW-NHB and NHW-Hispanic obesity disparities. Meanwhile, the documented discrepancies in the analytical results between models based on objectively measured BMI versus those based on self-reported BMI indicate that future research needs to systematically assess racial/ethnic and socioeconomic differentials in the validity of self-reported BMI.

References (more references will be added in the final paper)

1. Jencks, C. and S.E. Mayer, *The social consequences of growing up in a poor neighborhood*, in *Inner City Poverty in the United States*, L.E. Lynn and M.G.H. McGeary, Editors. 1990, National Academy: Washington, DC.

Table 1 Sample Statistics

Individual variables	All sample (percent/mean)
Prevalence of obesity based on objectively measured BMI	32.89%
Prevalence of obesity based on objectively measured BMI	31.63%
Age 20-29	17.08%
Age 30-49	38.19%
Age 50-69	25.10%
Age 70 or over	19.63%
Male	47.72%
Non-Hispanic whites	72.10%
Non-Hispanic blacks	11.25%
Hispanics	11.19%
Others	5.47%
Married or cohabitating	63.49%
Education	3.53
Household income	7.5
Need aid to walk	7.85%
Neighborhood variables	
SES: Percent households with annual income at $75,000 or over	19.90%
SES: Percent residents living in poverty	15.50%
SES: Percent college educated residents	30.86%
SES: Percent homeowners	61.41%
Population density	8523/mi^2
Percent being overweight and obese	21.48%
Sample size	*4,421*

Table 2: Multilevel Logistic Models for Risk of Obesity based on Objectively Measured BMI

	Model 1	Model 2	Model 3	Model 4
Individual-level variables				
Age 20-29	*REF*	*REF*	*REF*	*REF*
Age 30-40	1.44***	1.51***	1.44***	1.44***
Age 50-69	1.68***	1.69***	1.54***	1.52***
Age 70 or over	1.01	0.98	0.84	0.81†
Male	0.70***	0.72***	0.71***	0.71***
Non-Hispanic whites (NHW)	*REF*	*REF*	*REF*	*REF*
Non-Hispanic blacks (NHB)	1.84***	1.78***	1.82***	1.44***
Hispanics	1.29***	1.63***	1.71***	1.46***
Others	0.54**	0.67*	0.68†	0.69†
US-born		1.70***	1.67***	1.61***
Married or cohabitated		0.94		
Educational attainment		0.98		
Family income		0.98		
Need aid to walk			2.05***	2.02***
Neighborhood-level variables				
Institution model: Socioeconomic status (SES)				0.83***
Institution model: Population density				0.91*
Socio-cultural model: Percent residents being overweight and obese				1.13**
% change in the NHB coefficients between two adjacent models		*-5.82%*	*+4.08%*	*-31.61%*
% change in the Hispanic coefficients between two adjacent models		*+40.49%*	*+8.33%*	*-22.12%*
% change in the Other coefficients between two adjacent models		*-13.89%*	*no change*	*no change*

Sample size=4,421; * p<=0.05; ** p<=0.01; *** p<=0.001

Table 3: Multilevel Logistic Models for Risk of Obesity based on Subjectively Measured BMI

	Model 1	Model 2	Model 3	Model 4
Individual-level variables				
Age 20-29	*REF*	*REF*	*REF*	*REF*
Age 30-40	1.58***	1.62***	1.57***	1.57***
Age 50-69	1.83***	1.79***	1.66***	1.66***
Age 70 or over	0.99	0.91	0.80†	0.80†
Male	0.74***	0.75***	0.75***	0.75***
Non-Hispanic whites (NHW)	*REF*	*REF*	*REF*	*REF*
Non-Hispanic blacks (NHB)	1.82***	1.73***	1.74***	1.45***
Hispanics	1.48***	1.61***	1.64***	1.48***
Others	0.62*	0.72*	0.73	0.74
US-born		1.49***	1.47***	1.38**
Married or cohabitated		0.98		
Educational attainment		0.91**	0.91**	0.95†
Family income		0.99		
Need aid to walk			1.75***	1.74***
Neighborhood-level variables				
Institution model: Socioeconomic status (SES)				0.82***
Institution model: Population density				0.88**
Socio-cultural model: Percent residents being overweight and obese				1.11**
% change in the NHB coefficients between two adjacent models		*-8.61%*	*no change*	*-25.17%*
% change in the Hispanic coefficients between two adjacent models		*+13.89%*	*no change*	*-14.79%*
% change in the Other coefficients between two adjacent models		*-10.52%*	*no change*	*no change*

Sample size=4,421; * p<=0.05; ** p<=0.01; *** p<=0.001