Residential segregation and obesity among a national sample of Hispanic adults
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What is This?
Rates of obesity have exhibited problematic increases among all Americans and among Hispanics in particular (Flegal et al., 2010, 2012; Wang and Beydoun, 2007). The prevalence of obesity (a body mass index (BMI) ≥ 30) among Hispanic American women and men is significantly (about 15%) higher than that of Whites and is especially high among Mexican-American (45.1%) women compared to White (33.0%) women (Flegal et al., 2010, 2012). Low individual-level socioeconomic status (SES), generational status (first vs second generation residing in the United States), and acculturation each contribute to this disparity (primarily via associations with diet and physical activity) but do not fully explain it (Ayala et al., 2008; Wang and Beydoun, 2007; Wang and Chen, 2011). Residence in economically deprived neighborhoods (i.e. low area-level SES) contributes similarly to obesity among all ethnic groups and also to ethnic disparities in obesity, but does not fully explain these (Glass et al., 2006; Stimpson et al., 2007; Wang et al., 2007). An additional variable that might contribute is residential segregation, that is, the distribution of Hispanics into mostly Hispanic neighborhoods (enclaves) that contain few Whites. Recent data have highlighted considerable and increasing Hispanic segregation in

### Abstract

We explored the role of residential segregation in obesity among a national sample of Hispanics for the first time. Data on the 8785 Hispanic adults in the 2000 Behavioral Risk Factor Surveillance System were linked to 2000 census data on the segregation of 290 metropolitan statistical areas. Multilevel modeling revealed that after controlling for individual-level variables, the odds of being obese for Hispanics residing in high-segregated metropolitan statistical areas were 26.4 percent higher than for those residing in low-segregated metropolitan statistical areas. This segregation effect might be mediated by the obesogenic features (e.g. paucity of recreational facilities and abundance of fast-food outlets) of segregated Hispanic neighborhoods.

### Keywords

Hispanics, Latinos, neighborhoods, obesity, segregation

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the United States (Iceland and Scopilliti, 2008; Johnston et al., 2007; Wahl et al., 2007), and research on its role in Hispanic health likewise has increased. Such studies nonetheless are rare relative to those on segregation and Black/African-American health (Lee, 2009; Lee and Ferraro, 2007) and have not yet examined obesity, even though segregated Hispanic neighborhoods differ from White neighborhoods in three obesity-relevant ways.

First, segregated Hispanic neighborhoods are 8.6 times more likely to lack recreational facilities than White neighborhoods of comparable area SES; 82 percent of Hispanic (vs 70% of Black and 38% of White) neighborhoods have no recreational facilities (Moore et al., 2008; Powell et al., 2006). Given that access to such facilities plays a strong role in adult physical activity and body weight (Diez Roux et al., 2007), prevalent obesity among Hispanics might in part reflect the paucity of such facilities in Hispanic neighborhoods (Glass et al., 2006; Gordon-Larsen et al., 2006; Moore et al., 2008). This possibility is consistent with data indicating significantly lower levels of physical activity among high-segregated versus low-segregated Hispanic adults (Mellerson et al., 2010).

Second, Hispanic neighborhoods contain 2–4 times more fast-food outlets and convenience stores than White neighborhoods of matched, area SES (Morland et al., 2002; Powell et al., 2007a, 2007b). High access to such outlets is strongly associated with obesity (Mehta and Chang, 2008; Wang et al., 2007) and so might contribute to obesity among segregated Hispanics. Finally, violence (e.g. homicide) is more prevalent in high-segregated Black and Hispanic neighborhoods than in low-segregated Black and Hispanic neighborhoods (Feldmeyer, 2010). Obesity rates also are significantly higher in violent, socially disordered areas—even when controlling for ethnicity and for individual and area-level SES—due to the stress of residing there and having to stay indoors (Boardman et al., 2005; Chang et al., 2009). Hence, the high levels of violence in segregated Hispanic areas also might contribute to obesity.

Thus, although the causes of Hispanic versus Black segregation are different (Johnston et al., 2007), segregated Hispanic and Black neighborhoods are similar in that both may be obesogenic environments, that is, contexts that facilitate obesity via their paucity of recreational facilities and prevalence of unhealthy food choices (Nelson and Woods, 2009; Reidpath et al., 2002). These segregation-related, area-level factors have been shown to contribute to obesity and obesity disparities among Blacks (Boardman et al., 2005; Chang, 2006; Chang et al., 2009; Corral et al., 2012; Gordon-Larsen et al., 2006) and similarly may contribute to disparities among Hispanics. To begin to examine this possibility, we compared obesity prevalence among a national sample of high-segregated, moderate-segregated, and low-segregated American Hispanics for the first time, using data from the 2000 Behavioral Risk Factor Surveillance System (BRFSS; Centers for Disease Control and Prevention (CDC), 2000).

Method

Participants and procedure

The sample consisted of self-identified Hispanic American adults ($N = 8785$) (3608 men and 5177 women, age = $18–99$ years, mean age = 38.9 years, standard deviation (SD) = 14.8) in the 2000 BRFSS, a nationwide, random digit-dial telephone health survey conducted by the CDC.

Measures and data analytic strategy

Data on Hispanic obesity ($BMI \geq 30$, calculated from self-reported height and weight and given in the BRFSS dataset) were linked to 2000 census data on the segregation and poverty of the 290 US cities (metropolitan statistical areas (MSAs)) in the BRFSS. MSA segregation was assessed by the Isolation Index, the measure widely regarded as the most robust (Acevedo-Garcia and Lochner, 2003; Massey and Denton,
The Isolation Index (ISO) measures the separation (isolation) of Hispanics from Whites in residential areas and ranges from 0 (no separation) to 100 (total separation/isolation); it is interpreted as the probability that minorities will encounter only other minorities in their residential area. MSAs with ISO $\geq 60$ were categorized as high-segregated Hispanic, those with ISO $= 50$–60 were categorized as moderately segregated Hispanic, and those with ISO $< 50$ were categorized as low-segregated Hispanic as in prior studies (e.g. Wahl et al., 2007). MSA poverty (MSA-P) was included because the prevalence of obesity is higher in low-SES areas (Glass et al., 2006; Wang et al., 2007). Including both segregation and poverty permits preliminary analyses of their independent contributions to obesity (Corral et al., 2011). MSA-P was measured as the percentage of MSA residents below the federal poverty line (this is widely regarded as the best measure), with $<9.5$ percent (low), 9.5–12 percent (moderate), and $>12$ percent (high MSA-P), as in prior research on area-level SES (Krieger et al., 1997, 2005).

Multilevel logistic regression was used to examine the role of individual-level demographic and area-level (MSA segregation and MSA-P) variables in obesity. SAS PROC GLIMMIX was used to model the dichotomous outcome using the binomial logit link. Model parameters were estimated using the maximum likelihood procedure with the Newton–Raphson Ridge Optimization algorithm, and tests of significance were two sided at $p < 0.05$. The odds ratio (OR) and median odds ratio (MOR) were used to measure association and variation in obesity, respectively (Larsen and Merlo, 2005; Merlo et al., 2006). MOR quantifies the variation in obesity among MSAs by comparing two individuals with the same covariates from two randomly selected MSAs, with MOR of 1 indicating no difference between MSAs in the probability of obesity. The MOR was derived from the variance, as detailed by Merlo et al. (2006).

### Results

Model I used individual-level predictors, Model II used MSA-level predictors, and Model III used both. As shown in Model I (Table 1), the prevalence of obesity varied with age and education. Notably, the odds of obesity among Hispanics with less than a high school education were twice as high as those of Hispanic college graduates. Model 1 (i.e. the MSA-level variance and MOR) also revealed significant variation across MSAs in the prevalence of obesity after controlling for the individual-level variables. Model II examined the role of the MSA variables without controlling for the individual-level variables. Model II revealed that the odds of being obese were 32 percent higher among Hispanics residing in high-segregated MSAs than in low-segregated MSAs. Likewise, the odds of being obese were significantly higher among those residing in high-poverty (29%) and moderate-poverty (27%) MSAs. After controlling for the individual-level variables (i.e. Model III), relationships between poverty and obesity and between segregation and obesity remained significant. In particular, Hispanics residing in high-segregated MSAs were 26.4 percent more likely to be obese than those residing in low-segregated MSAs—irrespective of age, education, gender, and MSA poverty.

### Discussion

The finding that obesity is more prevalent in high-poverty areas is consistent with other studies (Glass et al., 2006; Wang et al., 2007) and underscores the relationship for Hispanics. The finding that residential segregation contributes...
independently and significantly to obesity among Hispanics is novel. This unique finding highlights the need for further investigation of the role of segregated Hispanic neighborhoods in Hispanic obesity and health disparities, and suggests that such neighborhoods may be obesogenic. The results also suggest that interventions designed to decrease problematic levels of obesity among Hispanics might benefit from targeting segregated Hispanic neighborhoods and their less-educated and older residents.

This study is limited, however, by measuring segregation and poverty at the MSA level; census tract-level measures of neighborhood influences are significantly more sensitive and predictive than MSA-level measures (Krieger et al., 2005). Hence, the segregation effect found here is surprising given the gross, MSA level of analysis and probably underestimates segregation’s role. Additional limitations include the inability to assess specific Hispanic ethnic groups (e.g. Mexican-American vs Cuban-American), and lack of measurement of

Table 1. Multilevel models of obesity among 8785 Hispanic adults.

<table>
<thead>
<tr>
<th>Predictors</th>
<th>% Obese</th>
<th>Model I: individual-level variables</th>
<th>Model II: area-level variables</th>
<th>Model III: both</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>OR 95% CI</td>
<td>OR 95% CI</td>
<td>OR 95% CI</td>
</tr>
<tr>
<td>Individual-level variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Women (REF)</td>
<td>23.0</td>
<td>0.942 0.847, 1.049</td>
<td>0.94 0.845, 1.047</td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>21.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;55 (REF)</td>
<td>25.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18–34</td>
<td>18.3</td>
<td>0.669 0.571, 0.784***</td>
<td>0.676 0.577, 0.792**</td>
<td></td>
</tr>
<tr>
<td>35–44</td>
<td>25.1</td>
<td>1.055 0.890, 1.249</td>
<td>1.064 0.898, 1.260</td>
<td></td>
</tr>
<tr>
<td>45–54</td>
<td>28.8</td>
<td>1.256 1.042, 1.514***</td>
<td>1.259 1.044, 1.518***</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>College graduates(REF)</td>
<td>15.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than a high school</td>
<td>28.0</td>
<td>2.011 1.693, 2.390**</td>
<td>1.987 1.672, 2.361**</td>
<td></td>
</tr>
<tr>
<td>High school graduates</td>
<td>21.7</td>
<td>1.551 1.306, 1.840**</td>
<td>1.543 1.399, 1.832**</td>
<td></td>
</tr>
<tr>
<td>Some college</td>
<td>21.6</td>
<td>1.550 1.295, 1.856**</td>
<td>1.542 1.289, 1.848**</td>
<td></td>
</tr>
<tr>
<td>Area (MSA)-level variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Segregation (Isolation Index)</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Low (=50)(REF)</td>
<td>21.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate (50–59)</td>
<td>22.0</td>
<td>1.21 0.928, 1.576</td>
<td>1.149 0.879, 1.501</td>
<td></td>
</tr>
<tr>
<td>High (≥60)</td>
<td>25.5</td>
<td>1.32 1.047, 1.664</td>
<td>1.264 1.000, 1.598***</td>
<td></td>
</tr>
<tr>
<td>Poverty (% below poverty)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low (=&lt;5.5%)(REF)</td>
<td>18.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate (&gt;5.5%−12%)</td>
<td>22.7</td>
<td>1.27 1.049, 1.538**</td>
<td>1.283 1.058, 1.557**</td>
<td></td>
</tr>
<tr>
<td>High (&gt;12%)</td>
<td>24.2</td>
<td>1.29 1.064, 1.580***</td>
<td>1.259 1.032, 1.538**</td>
<td></td>
</tr>
<tr>
<td>Measures of clustering</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSA-level variance(SE)</td>
<td>0.053 (0.01866)**</td>
<td>0.045 (0.01650)**</td>
<td>0.046 (0.01684)</td>
<td></td>
</tr>
<tr>
<td>Median odds ratio(MOR)</td>
<td>1.245</td>
<td>1.224 1.226</td>
<td>1.226</td>
<td></td>
</tr>
<tr>
<td>ICC</td>
<td>0.016</td>
<td>0.014 0.014</td>
<td>0.014</td>
<td></td>
</tr>
</tbody>
</table>

OR: odds ratio; CI: confidence interval; MSA: metropolitan statistical area; SE: standard error; ICC: intraclass correlation coefficient.* p < .05; ** p < .01.
acculturation (e.g. nativity and language use) and generation status; unfortunately, these obesity-related variables are absent from the 2000 BRFSS. Hispanics residing in segregated areas might be less acculturated than those residing in more integrated areas (Corral and Landrine, 2008), and hence, it is possible that acculturation may at least in part account for these segregation findings. Likewise, we used data from 2000 because 2010 US Census and BRFSS data are not yet fully available. Segregation (Wahl et al., 2007) and obesity (Flegal et al., 2012) levels no doubt have increased since 2000 in the United States, and relationships found here for 2000 may be stronger in 2012. Moreover, because the goal of this initial study was to explore if segregation contributes to obesity among Hispanics, we did not assess the obesogenic features (e.g. number of recreational resources and nature of food outlets) of the MSAs investigated. Doing so is critical to ascertain the mediators/moderators of the segregation effect found. Studies that assess specific Hispanic subgroups, acculturation, generation status, and built environment features will clarify the role of demographic, cultural, and area-level factors in Hispanic obesity in a manner consistent with multilevel, ecological approaches (e.g. Lee and Ferraro, 2007) to understand and reduce Hispanic health disparities.

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**References**


