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# Examining Neighborhood Environment and Central Obesity in the YES Health Study

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*We examined the relationship between neighborhood environment (e.g., objective neighborhood socioeconomic status [SES] and subjective neighborhood perceptions) and waist-hip ratio (WHR) or central obesity using logistic regression and content analysis of respondents' narratives on housing unfair treatment in the YES Health pilot study. Multivariate results showed significant relationships between low SES White, low SES Black, and middle SES Black versus middle SES White neighborhoods and total-sample and women's obesity, in almost all neighborhood perception models. Significant relationships included: disliking neighborhood and total-sample obesity; neighborhood informal monitoring/surveillance and total-sample and women's obesity; social participation and total-sample and women's obesity; and perceptions of families and total-sample and women's obesity. Qualitative results partially corroborate our quantitative results that low SES neighborhood adults were more likely to experience neighborhood disorders and safety issues. Our findings highlight examining objective and subjective neighborhood environments related to central obesity, suggesting specific health targets for neighborhood intervention programs.*

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## Introduction

Obesity is a major public health problem that could lead to cardiovascular diseases (CVDs), type II diabetes, low self-esteem, and low satisfaction with life (Ball, Crawdford, & Kenary, 2004; Singh & Newman, 2011). About 38% of adults in the United States are obese (Flegal, Carroll, Ogden, & Curtin, 2010), where body fat increases with age and shifts from the periphery to more central abdominal areas (Singh & Newman, 2011). Central obesity, measured as waist-hip ratio (WHR), is associated with metabolic indices of cardiovascular risk, such as hypertension and hyperinsulemia, and cognitive impairment, particularly for women (Lassek & Gaulin, 2008), depressive symptoms (Beydoun et al., 2009), heart attack, and mortality (Behn & Ur, 2006). Moreover, WHR could overcome the insensitivity of body mass index (BMI) in measuring obesity related to CVD in the population (Behn & Ur, 2006). Chakraborty and Chakaraboty (2007) have shown that individuals with high WHRs do not necessarily have high BMIs and were likely to be excluded from a clinically-defined, high-risk obese population. Given the different dimensions of obesity captured by WHR versus BMI, both are recommended for epidemiologic research and prevention efforts targeting obesity-related chronic diseases.

Our focus on neighborhood environment risk factors and central obesity is based on the social ecological model of health. Although individual socioeconomic position is inversely associated with WHR in the United States and other countries (Ghosh, 2006; Seeman et al., 2008), the social ecological model of health assumes that health is not only an individual responsibility but also a community responsibility. Social, cultural, and economic community contexts are antecedently linked to individual health behaviors and outcomes (Eugeni, Baxter, Mama, & Lee, 2011; Robert, 1999). Research relating community risk factors to obesity shows a link between lower objective neighborhood socioeconomic status (SES), poor objective descriptions of neighborhood conditions, and/or poorer subjective neighborhood perceptions to higher BMI (e.g., Boehmer, Hoehner, Deshpande, Brennan, Ramirez, & Brownson, 2007; Burdette & Hill, 2008; Harrison, Gemmell, & Heller, 2007). However, WHR is rarely used as an obesity measure despite its importance in detecting health risks.

Few studies examine the relationship between both objective and subjective neighborhood environments and obesity (Boehmer et al., 2007), and few studies focus on both individual and community factors related to obesity (Robert & Reither, 2004). However, these studies focus on BMI obesity. To our knowledge, no studies have examined the relationship between objective and subjective neighborhood environments and WHR obesity.

## The Social Ecological Model and Obesity

The social ecological model emphasizes that obesity prevention is most effective when it occurs at multiple levels: individual, interpersonal, community, and social institutional (Stokols, 1996). These influential levels include personal attributes like race; close social circles, such as friends and neighbors; environmental characteristics, like access to healthy stores, hazard exposure, and safety; and social policies (Bogenschneider, 1996; Stokols, 1996). According to this model, risk factors at multiple levels influence health behaviors, which, in turn, affect obesity and have interwoven relationships among these levels. Research suggests that the link between neighborhood SES and obesity is mediated by a lack of access to fresh produce (Diez-Roux & Mair, 2010); barriers to physical activity (Eugeni et al., 2011); and high crime rates (Chang, Hillier, & Mehta, 2009). Our research uses the social ecological model to examine WHR obesity in the context of interwoven individual and neighborhood factors, like SES and perceptions.

Research shows that obesity measured with BMI or WHR is inversely related to neighborhood SES, such as income and poverty (Ellaway, Anderson, & Macintyre, 1997; Robert & Reither, 2004). Findings also confirm that greater perceived neighborhood disorder, neighborhood hazards, and lower collective efficacy are strongly related to obesity risk (Burdette & Hill, 2008; Burdette, Wadden, & Whitaker, 2006; Fish, Ettner, Ang, & Brown, 2010). However, this research rarely addresses both objective and subjective neighborhood risk factors.

According to the social ecological model, community-level factors can directly affect personal experiences of residents in neighborhoods, such as neighbor interactions, trust in the community, and perceptions of neighborhood safety, social control, and surveillance (Robert, 1999). Wilkinson (1996) argues that economic deprivation in the community leads to lower levels of social cohesion and trust among residents. Our research can add to the literature by investigating participants' neighborhood perceptions across four neighborhood SES groups and the association between neighborhood perceptions and WHR obesity.

Our study also emphasizes the interrelationship between individual social statuses, such as gender and race, community, and obesity. Flegal et al. (2010) found that gender and race were associated with obesity, where women had a higher obesity rate (35.5%) than men (32.2%). Robert (1999) states that community socioeconomic position may be particularly salient to the lives and health of women compared to men. Two studies found that lower neighborhood SES and racial isolation were associated with obesity among women but not among men (Chang et al., 2009; Robert & Reither, 2004). Our study addresses potential gender differences by examining relationships between neighborhood environment and WHR obesity stratified by sex.

Relating race to neighborhood environments and obesity, we know that African Americans have a higher rate of obesity than non-Hispanic Whites (Flegal et al., 2010). Boardman, Onge, Rogers, & Denney (2005) argue that elevated obesity risk among non-Hispanic Blacks is due, in part, to residential racial concentration. And, due to racial residential segregation patterns, many African Americans are concentrated in neighborhoods that also concentrate poverty and poverty-related social problems (Williams & Collins, 2001). Higher proportions of Black residents in a neighborhood were associated with a higher obesity rate and increased risk of alcohol use and abuse; these negative health outcomes were due to a lack of health-promoting infrastructures and the disproportionate concentration of alcohol retailers in the neighborhood (Boardman et al., 2005; Scribner, Cohen, Kaplan, & Allen, 1999). Our research examines objective neighborhood SES by race, among Black and White adults, related to WHR obesity.

In sum, obesity across the social landscape does not translate into equal risks for all groups. Individual and community factors create differential risk factors for WHR obesity and may lead to disparities in chronic diseases, particularly CVD and type II diabetes (Behn & Ur, 2006; Lloyd-Jones et al., 2010). The following are our research questions and hypotheses:

(1) For our quantitative research, what is the relationship between neighborhood environment and WHR obesity? We hypothesize that: a) living in low SES Black and White and middle SES Black versus middle SES White neighborhoods will be related to a greater likelihood of WHR obesity; and b) poorer neighborhood perceptions will be related to a greater likelihood of WHR obesity.

(2) For our qualitative research, what aspects of the neighborhood environment made life difficult (i.e., daily events contributing to chronic stress and related to central obesity risk) for participants and in what ways?

## Method

### *Procedure*

We used the YES Health study to investigate the relationship between objective and subjective neighborhood environments and WHR obesity. The YES Health study, a quantitative and qualitative pilot study collected from 1999 to 2000, was designed to investigate: 1) macro and micro factors in the etiology and course of physical and mental health, including stress related to unfair treatment (UT), race, and SES; 2) pathogenic factors as well as SES, psychological, and cultural resources that facilitate processes of coping and adaptation; and 3) promising strategies and policies for reducing health disparities. Data were collected at a

community hospital as part of a larger study on stress, health, and health history, in three 2-hour face-to-face interviews over three consecutive weeks. Sections of each interview session involving lengthy open-ended questions were tape recorded and later transcribed.

*Sample*

The YES Health study included 99 Black and White adults, evenly split by sex, aged 25–55. However, two participants did not answer the neighborhood perception questions, leaving a sample of 97 adults. One quarter of participants were from each of the following neighborhood SES and racial groups: low SES Black ($n = 24$), middle SES Black ($n = 24$), low SES White ($n = 24$), and middle SES White ($n = 25$). These neighborhoods were based on five preselected census tracts in the 1990 decennial Census, with samples from one block group. When one block group did not yield the appropriate sample size, two block groups were used. Each block group was either predominately Black (e.g., between 57% and 95% of the block group population) or White (e.g., 94–98% of the block group population) and low or middle SES based on earnings at or below median income versus above median income (e.g., ≤150% vs. >150% of the poverty line) in a small Midwestern city. We obtained Institutional Review Board approval from the University of Colorado Denver.

*Measures*

*Dependent variables.* WHR, or waist/hip measurement in inches, was used to examine central obesity. We created a total-sample WHR measure (normal [≤.8] vs. obese [>.8]). We also created sex-stratified WHR measures for women (normal [≤.8] vs. obese [>.8]) and men (normal [≤.9] vs. obese [>.9]) based on the World Health Organization's categories, which correspond to an overweight BMI range (Huxley, Mendis, Zheleznyakov, Reddy, & Chan, 2010). The literature shows gender differences in the association between psychosocial measures and WHR, as well as subsequent risk for CVD (Duncan et al., 1995; Huxley et al., 2010).

*Independent variables.* Objective and subjective neighborhood environments, including neighborhood SES and perceptions, are compositional measures based on averaged participants' characteristics. Neighborhood SES was based on living at or below versus above median income within Census block groups identified in a small Midwestern city. Race was determined by respondents' self-identification as either Black or White. As an objective neighborhood measure, we used a combination of neighborhood SES and racial groups, where middle SES

White neighborhoods were the reference group compared with low SES White, low SES Black, and middle SES Black neighborhoods in multivariate analyses.

Subjective neighborhood environment, based on collective efficacy questions adapted from the Community Survey of the Project on Human Development in Chicago Neighborhoods (Sampson, 1995), included participants' lifetime neighborhood perceptions from nine questions. 1) Do you like or dislike your neighborhood as a place to live (e.g., like or dislike neighborhood)? 2) Do you strongly agree, agree, disagree, or strongly disagree with each of the following seven statements: if a problem exists in your neighborhood neighbors get together to deal with it; this is a close-knit neighborhood; there are adults in this neighborhood that children can look up to; people are willing to help their neighbors; people in this neighborhood generally do not get along with each other; people in this neighborhood do not share the same values; and people in this neighborhood can be trusted. We created a social cohesion and trust scale from the prior items, reverse coding two negative items including: neighbors do not get along and neighbors do not share the same values. Scale reliability was 0.827. 3) Is it very likely, likely, unlikely, or very unlikely that people in your neighborhood would act for each of the next three questions: if a group of neighborhood children were skipping school and hanging out on a street corner; if some children were spray-painting graffiti on a local building; and if there were a fight in front of your house and someone was being beaten or threatened? We created an informal monitoring and surveillance scale from the prior items. Scale reliability was 0.799. 4) Would you say it is easy or difficult for you to pick out people who are outsiders or do not live in this area (e.g., easy or difficult noticing outsiders)? 5) How often (often, sometimes, rarely, or never) do you do the following things with your neighbors: favors for each other, such as watching each other's children, helping with shopping, lending garden or household tools, and other small acts of kindness; when a neighbor is not at home, watch their property; and visit each other's homes or meet in the street? We created a social participation scale from the prior items. Scale reliability was 0.832. 6) In response to each statement, please tell me whether it applies to almost all, more than half, about half, about a quarter, or almost none of your neighbors: families in this neighborhood know each other; people in this neighborhood are religious or attend church regularly; people in this neighborhood make part or all of their income from selling drugs; and adults in this neighborhood make some or part of their income with a regular full- or part-time job? We created perceptions of families scale from the prior items, reverse coding one negative item: neighbors make income from selling drugs. Scale reliability was 0.570. 7) How long (in months) have you lived in this neighborhood (e.g., months lived in neighborhood)? 8) Does the neighborhood have a block group, tenet association, or other groups to deal with local issues (e.g., neighborhood has group(s) to deal with local issues)? 9) How many neighborhood, professional, religious, political, fraternal, or social organizations do you

belong to (e.g., number of organizations you belong to)? For each scale, a higher score means lower perceptions of the neighborhood environment. Each scale was totaled and divided by the number of items in the scale to get an easily interpretable score.

*Control variables.* We included age (continuous), sex (men = 0 and women = 1), education (i.e., respondent's highest grade of school completed, continuous), physical inactivity (i.e., three combined items in an index, including: how often people worked in their gardens or yards; how often they engaged in active sports or exercise; and how often they took walks; House, 2008), and depressive symptoms using the CESD 20 scale (a higher score means respondents were more likely to have depressive symptoms). Each physical inactivity question response could be: often (1), sometimes (2), rarely (3), or never (4); a higher score means people did less physical activity. Physical inactivity is positively associated with WHR, as a risk factor for cardiovascular outcomes (Duncan et al., 1995). Depressive symptoms are positively associated with WHR (Beydoun et al., 2009) and inversely associated with neighborhood physical environment quality and social environment connections (Diez-Roux & Mair, 2010).

The study collected interview data on UT as acute stressors across five domains, including: employment, housing, education, police or courts, and other service situations. For our qualitative research, we focused on interview responses to housing. Respondents were asked if they were ever: 1) unfairly prevented from moving into a neighborhood because the landlord or a realtor refused to sell or rent a house or apartment to them; 2) unfairly treated by neighbors who made life difficult for them or their families; and 3) experienced other housing UT.

*Statistical Analysis*

We used SPSS version 19.0 for quantitative bivariate and multivariate analyses, with no weights. At the bivariate level, we ran Pearson's correlations for all variables by our three WHR obesity measures (e.g., total-sample, women's, and men's). Tests for colinearity of the variables were significant between: females and total-sample WHR (correlation = 0.338, $p = .001$), informal monitoring and surveillance scale and total-sample WHR (correlation = 0.321, $p = .001$), and perceptions of families scale and total-sample WHR (correlation = 0.201, $p = .049$). We ran cross-tabulations and means for the association between our independent and control measures and each WHR measure with chi-square and ANOVA tests. We ran cross-tabulations for the association between each neighborhood perception scale and item and neighborhood SES by race measure with chi-square and ANOVA tests. We included the prior descriptive analysis because we wanted to know if subjective neighborhood perception varied by objective neighborhood SES and race. The literature often focuses on objective

neighborhood SES measures, where low SES is associated with more obesity, but why this relationship exists is not clear. We believe that the subjective neighborhood perception measures can help us understand which aspects of objective neighborhood SES and race are associated with obesity. At the multivariate level, we ran logistic regression for the relationship between neighborhood environment (e.g., neighborhood SES and race and neighborhood perception) and WHR obesity (e.g., total-sample, women's, and men's WHR). For each WHR outcome, we ran the following models: 1) age, sex (which was omitted in the sex-stratified models), education, neighborhood SES and race, and each of the neighborhood perception scales or items in separate runs (Model 1) and 2) adding physical inactivity and the CESD scale to the prior model (Model 2).

For Model 1, we ran separate models with each of the nine neighborhood perception scales or items because we could not add all measures into the same model given our limited sample size. Additionally, six of our measures showed significant Pearson correlations, where multicollinearity would inhibit us from adding all measures into one model. The social cohesion and trust scale was significantly associated with the like or dislike neighborhood item (0.654, $p = .000$), the informal monitoring and surveillance scale (0.594, $p = .000$), the social participation scale (0.525, $p = .000$), the perceptions of families scale (0.606, $p = .000$), and the neighborhood has group(s) to deal with local issues item ($-.240$, $p = .02$).

Qualitative research can make visible the reasons for observed phenomena in quantitative research. Thus, we used qualitative content analysis to code respondents' descriptions of their UT housing experiences, interpreting what aspects of their neighborhoods made life difficult to gain insight about the process linking neighborhood environment to WHR obesity. Interview data were independently coded by two team members (Y.X. and R.N.R.) using Excel 2010 (Swallow, Newton, & Van Lottum, 2003). To our knowledge, no existing research uses quantitative and qualitative data to examine neighborhood environment related to WHR obesity.

## Results

### *Quantitative Analyses*

Table 1 shows descriptives of the sociodemographic measures by normal versus obese WHR, stratified by sex, using cross-tabulations and means (with chi-square and ANOVA tests). WHR obesity had a marginally significant association with neighborhood SES and race ($p = .060$) and significant associations with less informal monitoring and surveillance ($p = .001$) and lower perceptions of families ($p = .036$) in the neighborhood. WHR obesity significantly varied by neighborhood SES and race for women ($p = .008$). Women's WHR obesity had a marginally

**Table 1.** Descriptives of the Sociodemographic Measures by Normal versus Obese Waist Hip Ratio (WHR), Stratified by Sex, Percentages, and Means

| | Total ($n = 97$) | | | Men ($n = 49$) | | | Women ($n = 48$) | | |
|---|---|---|---|---|---|---|---|---|---|
| Sociodemographic measures | Normal | Obese (≥.8) | $p$ | Normal | Obese (≥.9) | $p$ | Normal | Obese (≥.8) | $p$ |
| Neighborhood SES and race, % | | | .060 | | | ns | | | .008 |
| Low SES White | 25.0% | 23.5% | | 19.2% | 26.1% | | 21.4% | 26.5% | |
| | (4) | (19) | | (5) | (6) | | (3) | (9) | |
| Low SES Black | 18.8% | 27.2% | | 30.8% | 26.1% | | 14.3% | 26.5% | |
| | (3) | (22) | | (8) | (6) | | (2) | (9) | |
| Low SES White | 18.8% | 27.2% | | 30.8% | 26.1% | | 14.3% | 26.5% | |
| | (8) | (17) | | (8) | (5) | | (8) | (4) | |
| Middle SES Black | 6.3% | 28.4% | | 19.2% | 26.1% | | 7.1% | 35.3% | |
| | (1) | (23) | | (5) | (6) | | (1) | (12) | |
| Like or dislike neighborhood, % | | | ns | | | ns | | | .066 |
| Like it | 93.8% | 81.3% | | 76% | 87% | | 100% | 79.4% | |
| | (15) | (65) | | (19) | (20) | | (14) | (27) | |
| Dislike it | 6.3% | 18.8% | | 24% | 13% | | 0% | 20.6% | |
| | (1) | (15) | | (6) | (3) | | (0) | (7) | |
| Social cohesion and trust scale, mean | 2.1 | 2.2 | ns | 2.2 | 2.1 | ns | 2.2 | 2.2 | ns |
| | (16) | (80) | | (25) | (23) | | (14) | (34) | |
| Informal monitoring and surveillance scale, mean | 1.2 | 1.8 | .001 | 1.7 | 2.0 | ns | 1.2 | 1.7 | .023 |
| | (16) | (80) | | (25) | (23) | | (14) | (34) | |
| Noticing outsiders, % | | | ns | | | ns | | | ns |
| Easy | 75% | 78.8% | | 72% | 78.3% | | 71.4% | 85.3% | |
| | (12) | (63) | | (18) | (18) | | (10) | (29) | |
| Difficult | 25% | 21.3% | | 28% | 21.7% | | 28.6% | 14.7% | |
| | (4) | (17) | | (7) | (5) | | (4) | (5) | |

*Continued*

**Table 1.** Continued

| Sociodemographic measures | Total ($n = 97$) Normal | Total ($n = 97$) Obese (≥.8) | $p$ | Men ($n = 49$) Normal | Men ($n = 49$) Obese (≥.9) | $p$ | Women ($n = 48$) Normal | Women ($n = 48$) Obese (≥.8) | $p$ |
|---|---|---|---|---|---|---|---|---|---|
| Social participation scale, mean | 1.7 | 1.9 | ns | 1.8 | 1.9 | ns | 1.8 | 2.0 | ns |
| | (16) | (80) | | (25) | (23) | | (14) | (34) | |
| Perceptions of families scale, mean | 1.8 | 2.2 | .036 | 2.1 | 2.1 | ns | 1.8 | 2.2 | .096 |
| | (16) | (80) | | (25) | (23) | | (14) | (34) | |
| Months lived in neighborhood, mean | 78.3 | 123.9 | ns | 108.6 | 127.0 | ns | 86.0 | 127.2 | ns |
| | (16) | (80) | | (25) | (23) | | (14) | (34) | |
| Neighborhood has group(s) to deal with local issues, % | 78.6% | 60.8% | ns | 64.0% | 54.5% | ns | 91.7% | 58.8% | .037 |
| | (11) | (48) | | (16) | (12) | | (11) | (20) | |
| Number of orgs. you belong to, mean | .8 | 1.9 | ns | 2.8 | 1.0 | ns | .8 | 1.8 | ns |
| | (16) | (80) | | (25) | (23) | | (14) | (34) | |
| Age, mean | 38.7 | 40.1 | ns | 36.2 | 42.6 | .005 | 40.1 | 40.7 | ns |
| | (16) | (81) | | (26) | (23) | | (14) | (34) | |
| Education, mean | 13.3 | 13.3 | ns | 13.0 | 13.4 | ns | 13.5 | 13.4 | ns |
| | (16) | (81) | | (26) | (23) | | (14) | (34) | |
| Physical inactivity, mean | 6.4 | 6.7 | ns | 5.9 | 7.0 | .031 | 6.6 | 7.0 | ns |
| | (16) | (81) | | (26) | (23) | | (14) | (34) | |
| CESD20 scale, mean | 39.6 | 34.9 | .082 | 33.1 | 34.6 | ns | 39.7% | 36.6 | ns |
| | (16) | (78) | | (25) | (22) | | (14) | (33) | |

Source: YES Health study, 1999–2000.

*Note*. Neighborhood objective and subjective measure statistics are shown as percentages with sample sizes in parentheses for the categorical variables and as means with sample sizes in parentheses for the continuous variables. A higher scale score means less social cohesion and trust, less informal monitoring and surveillance, lower social participation, and lower perceptions of families in the neighborhood. SES is the abbreviation for socioeconomic status; CESD20 scale is the abbreviation for the Center for Epidemiologic Study of Depression 20-item survey.

**Table 2.** Descriptives of the Neighborhood Perception Measures by Neighborhood Socioeconomic Status (SES) and Racial Groups, Percentages, and Means

| Neighborhood perception measures | Total ($n = 97$) | Low SES White ($n = 24$) | Low SES Black ($n = 24$) | Middle SES White ($n = 25$) | Middle SES Black ($n = 24$) | $p$ |
|---|---|---|---|---|---|---|
| Dislike neighborhood,% | 16.5% | 25% | 41.7% | 0% | 0% | .000 |
| Social cohesion and trust scale, mean | 2.2 | 2.4 | 2.4 | 2.0 | 1.9 | .001 |
| Informal monitoring and surveillance scale, mean | 1.7 | 1.9 | 1.9 | 1.4 | 1.6 | .032 |
| Difficult noticing outsiders, % | 21.6% | 12.5% | 16.7% | 44% | 12.5% | .018 |
| Social participation scale, mean | 1.9 | 2.0 | 2.0 | 1.7 | 1.7 | ns |
| Perceptions of families scale, mean | 2.1 | 2.4 | 2.2 | 1.9 | 1.8 | .001 |
| Months lived in neighborhood, mean | 115.7 | 65.1 | 176.5 | 94.7 | 127.4 | .016 |
| Neighborhood has group(s) to deal with local issues, % | 62.8% | 16.7% | 52.2% | 91.7% | 91.3% | .000 |
| Number of orgs. you belong to, mean | 1.7 | .4 | 1.6 | 3.6 | 1.2 | ns |

Source: YES Health study, 1999–2000.
*Note*. Neighborhood objective and subjective measure statistics are shown as percentages for the categorical variables and as means for the continuous variables. A higher scale score means less social cohesion and trust, less informal monitoring and surveillance, lower social participation, and lower perceptions of families in the neighborhood.

significant association with liking versus disliking one's neighborhood ($p = .066$) and lower perceptions of families ($p = .096$) but significant associations with less informal monitoring and surveillance ($p = .023$) and perceptions that there were fewer neighborhood groups to deal with local issues ($p = .037$). No significant associations existed between men's WHR obesity and any of the neighborhood perception scales or items.

Table 2 shows descriptives of the neighborhood perception measures by neighborhood SES and racial groups, using cross-tabulations and means (with chi-square and ANOVA tests). The perception of liking versus disliking one's neighborhood was significantly associated with neighborhood SES and race, where participants living in low SES White and Black neighborhoods were more likely to dislike their neighborhoods than their middle SES counterparts ($p = .000$). Lower

neighborhood perceptions of social cohesion and trust ($p = .001$), informal monitoring and surveillance ($p = .032$), and perceptions of families ($p = .001$) existed for those living in low SES White and Black versus middle SES White and Black neighborhoods. The perception of easily versus having difficulty noticing outsiders was significantly associated with neighborhood SES and race, where participants living in middle SES White neighborhoods had the most difficulty noticing outsiders compared to other groups ($p = .018$). Months lived in one's neighborhood was significantly associated with neighborhood SES and race ($p = .016$), where participants living in low SES White neighborhoods had the shortest tenure, followed by those living in middle SES White, middle SES Black, and low SES Black neighborhoods. The perception that there were neighborhood groups to deal with local issues was significantly associated with neighborhood SES and race ($p = .000$), which were the lowest in low SES White neighborhoods, then low SES Black neighborhoods, and were similarly high in middle SES Black and White neighborhoods.

Results from Models 1 (not shown) to 2, controlling for physical inactivity and the CESD scale in the latter model, were similar using the total and sex-stratified samples. However, adding controls to the total sample changed the relationship of WHR obesity to liking versus disliking one's neighborhood from not to marginally significant and social participation from marginally significant to significant. Adding controls changed the relationship of women's WHR obesity to informal monitoring and surveillance from marginally significant to significant; to social participation from not to marginally significant; and to perceptions of families from not to marginally significant. Adding controls also changed the relationship of men's WHR obesity to informal monitoring and surveillance from not to marginally significant.

Table 3 shows logistic regression results for the relationship between neighborhood environment and total-sample WHR obesity in Model 2. For our first hypothesis, living in low SES White and Black versus middle SES White neighborhoods was significantly related to having WHR obesity in most of the neighborhood perception models. But, stronger, significant relationships between WHR obesity and living in middle SES Black versus White neighborhoods existed across all neighborhood perception models. Thus, our first hypothesis was supported. For our second hypothesis, WHR obesity significantly related to lower informal monitoring and surveillance (OR: 45.99**, 95% CI [3.14, 674.12]); social participation (OR: 3.84*, 95% CI [1.10, 13.47]); perceptions of families (OR: 8.06*, 95% CI [1.48, 43.94]); and had a marginally significant relationship with liking one's neighborhood (OR: $0.10^{+}$, 95% CI [0.01, 1.51]). Thus, our second hypothesis was partially supported.

Table 4 shows logistic regression results for the relationship between neighborhood environment and women's WHR obesity in Model 2. Addressing our first hypothesis for women, we found similar results to the prior total-sample

**Table 3.** Logistic Regression Results for the Relationship between Neighborhood Environment and Total-Sample Waist Hip Ratio (WHR) obesity in Model 2, Odds Ratios, and 95% Confidence Intervals

| Sociodemographic measures | Model 2 (with significant neighborhood perception measures) | | | |
|---|---|---|---|---|
| Low SES White | 18.70* | 56.12* | 33.01* | 8.83 |
| | [1.27, 275.47] | [1.20, 2,630.57] | [2.21, 492.51] | [0.53, 146.00] |
| Low SES Black | 4.59 | 9.95 | 10.57* | 5.41 |
| | [0.44, 47.71] | [0.49, 201.86] | [1.15, 97.58] | [0.51, 57.21] |
| Middle SES Black | 66.75** | 313.58** | 97.01** | 147.31** |
| | [3.41, 1,307.22] | [5.44, 18,090.01] | [3.82, 2,464.24] | [4.27, 5,083.31] |
| Like or dislike neighborhood | 0.10+ | | | |
| | [0.01, 1.51] | | | |
| Informal monitoring and surveillance scale | | 45.99** | | |
| | | [3.14, 674.12] | | |
| Social participation scale | | | 3.84* | |
| | | | [1.10, 13.47] | |
| Perceptions of families scale | | | | 8.06* |
| | | | | [1.48, 43.94] |
| Age | 1.03 | 1.05 | 1.06 | 1.01 |
| | [0.94, 1.14] | [0.93, 1.18] | [0.96, 1.18] | [0.92, 1.11] |
| Sex | 15.3** | 18.94** | 23.36** | 24.46** |
| | [2.40, 97.00] | [2.32, 154.72] | [2.98, 182.85] | [3.06, 195.28] |
| Education | 1.55+ | 1.70 | 1.44 | 1.48 |
| | [0.95, 2.52] | [0.88, 3.27] | [0.89, 2.33] | [0.85, 2.58] |
| Physical inactivity | 1.10 | 1.09 | 0.92 | 1.24 |
| | [0.75, 1.61] | [0.67, 1.76] | [0.61, 1.39] | [0.80, 1.92] |
| CESD20 scale | 0.95 | 0.91+ | 0.93 | 0.95 |
| | [0.88, 1.02] | [0.82, 1.00] | [0.86, 1.02] | [0.87, 1.02] |

Source: YES Health study, 1999–2000.
*Note.* $^{+}p \leq .10$; $^{*}p \leq .05$; $^{**}p \leq .01$.

analyses. Living in low SES White, low SES Black, and middle SES Black versus middle SES White neighborhoods were significantly related to having WHR obesity in almost all neighborhood perception models. Thus, our first hypothesis was supported for women. For our second hypothesis, women's WHR obesity was significantly related to lower informal monitoring and surveillance (OR: 25.74*, 95% CI [1.27, 523.17]); and had marginally significant relationships with lower social participation (OR: 3.67+, 95% CI [0.90, 15.05]) and perceptions of families (OR: 4.10+, 95% CI [0.78, 21.56]). Thus, our second hypothesis for women was partially supported.

**Table 4.** Logistic Regression Results for the Relationship between Neighborhood Environment and Women's Waist Hip Ratio (WHR) obesity in Model 2, Odds Ratios, and 95% Confidence Intervals

| Sociodemographic measures | Model 2 (with significant neighborhood perception measures) | | |
|---|---|---|---|
| Low SES White | 228.53* | 423.11** | 101.96* |
| | [2.32, 22,556.32] | [5.08, 35,268.41] | [1.47, 7,094.21] |
| Low SES Black | 32.10+ | 81.27* | 34.97* |
| | [0.63, 1,642.47] | [2.40, 2,749.64] | [1.00, 1,218.31] |
| Middle SES Black | 708.64** | 601.49** | 516.80** |
| | [7.39, 67,978.20] | [5.93, 61,042.38] | [5.41, 49,331.30] |
| Informal monitoring and surveillance scale | 25.74* | | |
| | [1.27, 523.17] | | |
| Social participation scale | | 3.67+ | |
| | | [0.90, 15.05] | |
| Perceptions of families scale | | | 4.53+ |
| | | | [0.81, 25.22] |
| Age | 1.01 | 1.06 | 0.99 |
| | [0.88, 1.16] | [0.92, 1.21] | [0.88, 1.12] |
| Education | 1.89 | 2.00+ | 2.05+ |
| | [0.86, 4.16] | [0.92, 4.31] | [0.91, 4.66] |
| Physical inactivity | 1.01 | 0.84 | 1.12 |
| | [0.59, 1.73] | [0.51, 1.40] | [0.68, 1.83] |
| CESD 20 scale | 0.92 | 0.95 | 0.97 |
| | [0.82, 1.02] | [0.87, 1.05] | [0.89, 1.06] |

Source: YES Health study, 1999–2000.
$^{+}p \leq .10$; $^{*}p \leq .05$; $^{**}p \leq .01$.

None of the neighborhood SES and racial groups or neighborhood perception measures was significantly associated with men's WHR obesity, except for the marginally significant relationship with lower informal monitoring and surveillance (OR: 3.44+, 95% CI [0.83, 14.19]). Thus, our first and second hypotheses for men were not supported.

### *Qualitative Analyses*

Twelve of 18 respondents who described how neighbors unfairly made life difficult (i.e., daily events contributing to chronic stress that are related to central obesity risk) to live in their neighborhoods came from low SES neighborhoods. Consistent with our quantitative results, our qualitative results suggest that respondents from low versus middle SES neighborhoods were more likely to perceive lower levels of social cohesion, safety, and social participation. Our analyses also

gave insight about the possible mechanisms between neighborhood perceptions and WHR obesity.

Content analysis of respondents' interviews regarding their worst and most recent housing experiences revealed three major themes. Our first theme was that neighborhood disorders made respondents' lives difficult on a daily basis. Respondents' statements revealed causes of perceived neighborhood disorder including: kids hanging out and littering, stealing, false accusations such as being accused of selling drugs out of one's house, gangs, prostitution, parking in a reserved spot, not maintaining clean yards, neighbors drink/are drunks, and having neighbors with disruptive friends. A low SES neighborhood White mother described her frustration with prostitutes being in the neighborhood.

> And we moved to a very, very bad neighborhood . . . And there was prostitutes in our neighborhood, walking the streets, around the block every day. I asked them to stay off of our side of the street, we have kids here . . . And we fought, yes we did, and the police came, and I went to the hospital in the ambulance . . . I mean, just a terrible neighborhood! I won't ever live back down there again.

The second theme was that respondents were very concerned for their safety living in a low SES neighborhood because they or their family members were hurt by neighbors, threatened by guns, harassed by neighborhood gangs, or someone broke in their homes. Sometimes, respondents chose to move out of a neighborhood because they were too worried about their safety. People who perceived disorderly and unsafe neighborhoods also reported experiencing chronic stress, with daily worries about bad influences on their kids and their safety. When a low SES neighborhood White mother described an incident of a person throwing a bottle and it hitting her daughter in the face, she said:

> I will NEVER forget that, and I know she won't either. And I wanted REVENGE, so bad, it's not so much as far as hurtin' them myself, but I never forget nobody actually SAY who did it . . . Yeah, but it just shouldn't have happened . . . I kept crying for her . . . Like I said, I try to block it out, the only thing is every Mother's Day, it comes back. Yeah, it's been seven years now . . . God, was I angry that night!

Chronic stress reported by respondents also suggests a low level of social cohesion and informal monitoring and surveillance in neighborhoods. Burdett and Hill (2008) found that the relationship of perceived neighborhood disorder and obesity was mediated by psychological distress. Based on our findings, neighborhood-related stress might mediate the association between perceived neighborhood disorder and safety and central obesity.

The third theme is that particular neighbors, rather than the neighborhood in general, made daily life difficult. People in neighborhoods seemed biased toward those who had any or multiple children living in one home and unmarried couples moving in together. In some reports, neighbors were racially biased. Their neighbors were unfriendly to them and made their lives inconvenient. Usually, altercations with neighbors became chronic stressors via long-term worrying and

harassment. A low SES neighborhood White woman complained about her neighbor running a car washing business on the estate. Her neighbors harassed her family after she reported their business to the township ordinance officer.

> . . . And these people . . . called in their family from everywhere . . . they got out in the street, and started cursin' at my next door neighbors. And they were calling 'em filthy names, and saying that they seen the wife in a bar, and she was picking up men, and I mean screaming this in the street! And, my one son was going to elementary school, he was in second grade, and they had five of their grandkids went to the same school, and every time my son would go out for recess they would corner him and try to beat him up.

The importance of particular neighbors in participants' narratives about their neighborhood perceptions denotes the role of close relationships in influencing behaviors as indicated in the social ecological model. The social networks among adults and children in a neighborhood are important in fostering the collective capacity for supervision and creating the constraint on deviant behaviors (Sampson, 1995). Although trivial at times, some neighbors' behaviors became daily harassments and affected participants' neighborhood perceptions. A low SES neighborhood White man complained about neighbors parking in his spot.

> The only thing that bothers me . . . is they got these neighbors, and they just like to park in our spot . . . They're a totally a pain in the rear gear . . . You feel like rippin' their head off.

Overall, our qualitative results partially corroborate our quantitative results that low SES neighborhood adults were more likely to experience neighborhood disorders and safety issues. Qualitative findings revealed that many factors were involved in the perceptions of difficult life in a neighborhood, including: gangs, prostitutes, gun-related incidents, and fights with neighbors. Moreover, these factors were reported to cause chronic stress, which might be a possible link between low neighborhood SES, perceptions, and WHR, found in our quantitative analyses.

## Discussion

This study examined the relationship between neighborhood environment and WHR obesity, using quantitative and qualitative data to apply the social ecological model. Our first hypothesis was supported, where living in low SES Black and White and middle SES Black compared to middle SES White neighborhoods had significant relationships with total-sample and women's obesity, across almost all of the neighborhood perception models. Our second hypothesis was partially supported with significant relationships between: disliking one's neighborhood and total-sample obesity; lower informal monitoring and surveillance and total-sample and women's obesity; lower social participation and total-sample and women's obesity; and lower perceptions of families and total-sample and women's obesity. Our hypotheses were not supported for men. Our qualitative results partially corroborated our quantitative results that low SES neighborhood adults were more

likely to experience neighborhood disorders and safety issues. These results indicated that relationships with neighbors may play an important role in an individual's perceptions about his/her quality of life in a neighborhood. Our quantitative and qualitative findings support using the social ecological model, highlighting the importance of examining central obesity from multiple levels, and suggesting specific targets for neighborhood intervention programs to reduce long-term risks of CVD and type II diabetes.

Although there was no discussion on obesity in respondents' interviews, their descriptions indicate two possible pathways linking neighborhood perceptions to WHR obesity risk. First, perceived neighborhood disorders may make residents feel they lack opportunity structures for health promoting activities, such as exercise, due to safety concerns. Poortinga (2006) observed that physical activity modified the association between the perception of the environment and obesity. Second, chronic stress at home caused by perceptions of neighborhood disorder and low collective efficacy could be linked to obesity risk. Beydoun et al. (2009) found that depression, which could be related to neighborhood chronic stress and subsequent feelings of helplessness, was associated with poorer diet, which, in turn, was associated with high WHR. Among women of different ethnicities in a national study, Beatty, Bromberger, & Matthews (in press) show a relationship between chronic stress, measured as unfair treatment or discrimination, and inflammation over time using C-reactive protein. Unfair treatment and inflammation are risk factors for CVDs that illustrate possible pathways connecting neighborhood environment to WHR. Thus, people in deprived neighborhoods experience built and/or social environment barriers, potentially leading to chronic stress, followed by risky health behaviors, which then result in higher obesity risk. Although we do not have data to test these mechanisms, our qualitative results show directions for future research.

Our results also revealed other interesting observations. First, objective neighborhood measures had a stronger significant relationship to WHR obesity than the subjective neighborhood measures. This was true in analyses for the total and women only samples. In the only study examining observed and perceived neighborhood indicators, Boehmer et al. (2007) found significant relationships between both types of indicators and BMI obesity. Their research found that perceived and observed neighborhood land use (e.g., perceived residential and nonresidential destinations close to home vs. a count of nonresidential destinations) and aesthetics (e.g., perceived community ratings as active and well maintained places vs. an average count of physical disorder, garbage, and less attractive or comfortable features of neighborhoods) were the most robust indicators associated with obesity.

Second, the lack of significant neighborhood environment measures related to WHR obesity in men suggests potentially gendered social ecological related pathways for obesity. Stronger or significant findings for women only were

consistent with prior research (Boehmer et al., 2007; Chang et al., 2009; Robert & Reither, 2004). This research suggests that the link between a negative neighborhood environment and women's WHR obesity may be positively mediated by their greater likelihood of experiencing psychological stress, using overeating as a coping tool, and lower likelihood of engaging in exercise. But, men are more likely to cope with stressors through exercise and substance use that may reduce the impact of a negative neighborhood environment on their WHR obesity. This research also suggests that more nuanced measures of physical activity, including exercise related to leisure, work, and housekeeping, and nutrition may help us better understand gender differences in the relationship between neighborhood environment and WHR obesity.

Third, the neighborhood perception scales were better measures than the neighborhood perception single items related to WHR obesity. These single items may have contributed to a lack of association with WHR obesity in our analyses. However, we found a marginal relationship between like or dislike neighborhood and total WHR obesity. Moreover, Fish et al. (2010) used a single question item for perception of neighborhood safety and found a significant relationship between higher BMI in unsafe versus safe neighborhoods. Perhaps two of our single items, neighborhood has groups to deal with local issues and number of organizations you belong to, needed further clarification for participants. Perhaps, some participants interpreted the first single item as the number of neighborhood groups to deal with local "safety" issues, but it was not specific enough in asking respondents what local issues they wanted a neighborhood group to deal with. Perhaps, some participants interpreted the second single item as the number of organizations you belong to "that help enhance or protect your neighborhood," but the question did not specifically ask participants about their organizational memberships that benefited their neighborhoods. As validity issues, these items' vagueness may have led to varied respondent interpretations and may explain their lack of association with central obesity.

The first limitation of this pilot study was our small sample size, and results should be examined in a larger, representative, national sample. Second, results were based on cross-sectional data, and we could not examine the direction of causality between neighborhood environment and WHR obesity. Third, we do not know the timing of onset for participants' WHR obesity or if it was associated with a specific neighborhood environment at one time in their lives, given survey and qualitative responses reflected respondents' lifetime neighborhood experiences. Fourth, the degree of bias in respondents' perceptions of their neighborhoods is unknown. Respondents' preferences, self-selection into neighborhoods, or others' biases in excluding them from certain neighborhoods (as mentioned in the qualitative data) could influence their neighborhood perceptions. Additionally, neighborhood perceptions and their relationship to WHR obesity could vary if

we had sampled low and middle SES Black adults living in predominantly low and middle SES White neighborhoods, respectively. Low and middle SES Black adults in integrated neighborhoods may experience better access to resources and services than their counterparts from the more segregated neighborhoods we sampled, possibly related to lower WHR obesity risk. But, low and middle SES Black adults in integrated neighborhoods might also experience more bias and chronic stress from relative comparisons of amenities and/or racial isolation, possibly related to higher WHR obesity risk.

Fifth, while research shows that physical inactivity is related to obesity and neighborhood environment as a potential mediator or confounder (Eugeni et al., 2011), our results do not support this assertion. Perhaps, a more stringent measure of physical inactivity based on the American Heart Association's guidelines for ideal cardiovascular health, specifically measuring respondents' inability to meet $\geq$150 minutes a week of moderate intensity, $\geq$75 minutes a week of vigorous intensity, or a combination of these amounts of physical activity, might have produced significant results (Lloyd-Jones et al., 2010). Another possible mediator or confounder, nutrition, such as eating a balanced diet, the appropriate daily calorie intake, and low fat and salt intake, is related to neighborhood environment and obesity measured using WHR and BMI (Beydoun et al., 2009; Diez-Roux & Mair, 2010). However, the YES Health study did not collect extensive physical activity or nutrition measures.

The literature supports two other potential mediators or confounders, smoking and alcohol intake (Duncan et al., 1995; Stafford, Brunner, Head, & Ross, 2010); however, we did not include these health behaviors after some preliminary analysis. We ran Pearson correlations for smoking and alcohol intake with total-sample and sex-stratified WHR obesity, but results showed no significant correlations with either outcome. Thus, with a small sample size limiting the number of added variables, we included only physical inactivity, a widely cited health behavior related to neighborhood environment and obesity (Diez-Roux & Mair, 2010).

Our multivariate results showed significant relationships between neighborhood SES and race, informal monitoring and surveillance, social participation, and perceptions of families and central obesity. Qualitative results partially supported our quantitative results, finding: low SES neighborhood adults were more likely to experience neighborhood disorders; and participants experienced daily neighborhood stressors, lower perceived safety, and relationship difficulties with neighbors. Our contributions to the literature on neighborhood environment and central obesity include examining: 1) objective and subjective neighborhood environments from the neighborhood and individual levels; 2) multiple subjective neighborhood perception scales and items in our quantitative analyses; and 3) qualitative data to elaborate on our quantitative results.

*Implications for Public Health Policy*

Many of the behavioral risk factors associated with reducing central obesity are difficult to change. But neighborhood environment interventions may improve relationships with neighbors, neighborhood perceptions, and health behaviors, while reducing chronic stress and WHR obesity risk with potentially longer lasting effects than individual-level interventions (Edwards, Clarke, Ransley, & Cade, 2010; Sallis & Glanz, 2006). Perhaps, a two-level intervention approach, including community-based and local policy actions, is needed to increase collective efficacy and residents' overall neighborhood appreciation. Community-based neighborhood interventions might include: implementing community association and neighborhood watch groups, community appreciation days with events and activities for residents, and/or community gardens (Garofalo & McLeod, 1989; Johnson & Smith, 2006). Local policy interventions might include scheduling neighborhood town hall meetings with local politicians, police departments, researchers, and media, giving residents consistent forums to discuss neighborhood grievances and law enforcement while holding locally elected politicians accountable to their constituents (Lukensmeyer & Brigham, 2003). Our findings confirm that these interventions should be tailored based on racial and neighborhood SES composition and gender differences related to WHR obesity. With some investments from residents and local politicians, neighborhood interventions could create protective pathways between the neighborhood environment and lower WHR obesity risk.

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