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Relationship between Perceptions about Neighborhood Environment and Prevalent Obesity: Data from the Dallas Heart Study

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Abstract

Although psychosocial stress can result in adverse health outcomes, little is known about how perceptions of neighborhood conditions, a measure of environment-derived stress, may impact obesity. We examined the association between perceptions of neighborhood environment and obesity [defined as body mass index (BMI) ≥ 30 kg/m^2] among 5907 participants in the Dallas Heart Study, a multi-ethnic, probability-based sample of Dallas County residents. Participants were asked to respond to 18 questions about perceptions of their neighborhood. Using factor analysis, we identified three factors associated with neighborhood perceptions: neighborhood violence, physical environment, and social cohesion. Logistic regression analyses were performed to determine the relationship between each factor (higher quintile = more unfavorable perceptions) and the odds of obesity. Decreasing age, income, and education associated with unfavorable overall neighborhood perceptions and unfavorable perceptions about specific neighborhood factors (p trend <0.05 for all). Increasing BMI was associated with unfavorable perceptions about physical environment (p trend <0.05), but not violence or social cohesion. After adjustment for race, age, sex, income, education, and length of residence, physical environment perception score

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in the highest quintile remained associated with a 25% greater odds of obesity [OR 1.25,(95% CI 1.03–1.50)]. Predictors of obesity related to environmental perceptions included heavy traffic [OR 1.39,(1.17–1.64)], trash/litter in neighborhood[OR 1.27,(1.01–1.46)], lack of recreational areas[OR 1.21,(1.01–1.46)], and lack of sidewalks[OR 1.25,(95% CI 1.04–1.51)]. Thus, unfavorable perceptions of environmental physical conditions are related to increased obesity. Efforts to improve the physical characteristics of neighborhoods, or the perceptions of those characteristics, may assist in the prevention of obesity in this community.

Introduction

An individual's neighborhood provides important context for cardiovascular disease (CVD) risk, and neighborhood characteristics as defined by census-level socioeconomic measures or the social and physical environment in which an individual lives have been associated with CVD and prevalent CV risk factors.[1–3] Obesity as a CV risk factor appears to be particularly influenced by an individual's neighborhood environment. The exponential rise in obesity prevalence over only three decades, with more than one-third of the U.S. population now having a body mass index (BMI) ≥ 30 kg/m^2, is largely consistent with behavioral and environmental rather than biological causal factors.[4] Prior work on environmental factors has also demonstrated an association between prevalent obesity and objectively measured neighborhood resources,[1, 5–6] where food environment may influence an individual's ability to engage in healthy dietary patterns[7–8] and built environment may impact physical activity.[9] Moreover, recent data suggest the prevalence of extreme obesity decreases after moving from a low-income to higher-income environment. [10] These findings further support a potential role for psychosocial and environmental factors in the development of obesity.

Little is understood about the pathways by which neighborhood characteristics are related to prevalent obesity. Psychosocial stress associated with living in one's environment likely serves as an important mechanism by which neighborhood disadvantage or limited neighborhood resources associate with prevalent obesity.[3, 11] Neighborhood environment as a potential stressor might have direct and indirect associations with obesity due to inadequate physical activity or poor dietary habits, but also through physiologic mechanisms that lead to over-activation of the hypothalamic-pituitary-adrenal (HPA) axis and sympathetic nervous system (SNS) with resultant chronic elevation of glucocorticoid and catecholamine pathways,[12–13] In fact, prior studies have demonstrated a relationship between neighborhood characteristics and higher serum cortisol levels as a measure of physiologic stress response.[14–16]

Self-reported perceptions about the quality of one's neighborhood environment may also be important in the pathway by which neighborhood characteristics are associated with prevalent obesity. An individual's perceptions of their environment may reflect physiologic stress responses to neighborhood conditions and appear to serve as a valuable proxy measure for psychosocial stress related to environment.[17] Limited prior studies assessing the association between perceptions of neighborhood environment and prevalent obesity have yielded inconsistent findings.[17–20] Furthermore, prior work is particularly limited by lack of

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racial/ethnic heterogeneity of the study population,[17, 20] utilization of surrogate neighborhood perception data,[21] and limited evaluation of environmental perceptions.[20] Individuals' perceptions of their neighborhood may also differ depending on the neighborhood's unique racial/ethnic, cultural and socioeconomic make-up, necessitating study of individual communities. Understanding the association between environmental perceptions and obesity may elucidate potential mechanisms by which the environment might impact obesity prevalence, identifying potential targets for obesity prevention and treatment and subsequent CV risk reduction.

Therefore, we utilized the Dallas Heart Study (DHS), an ethnically-diverse sample of Dallas County adults at high risk for obesity and obesity-related complications, to examine the association between measured neighborhood perceptions and prevalent obesity.

Methods

Dallas Heart Study (DHS)

The DHS is a multi-ethnic probability-based population sample of Dallas County adults ages 18–65 (N=6,101) designed to study CVD risk and outcomes. African-Americans were over-sampled to comprise 50% of the study cohort. Sample weights were calculated for each DHS participant reflecting the selection probability for the DHS based on ethnicity, age, sex, and geographic stratum to allow extrapolation of DHS prevalence data to the general population of Dallas County. Details of the DHS design and cohort have been previously reported.[22] Collection of baseline data used in this current study occurred in two visits for participants. Visit 1 for the DHS (N=6,101) involved a home visit for collection of demographic and survey data and measurement of anthropometrics. Visit 2 (N=3,398) involved collection of fasting blood and urine samples. The University of Texas Southwestern Medical Center institutional review board approved this study, and all subjects provided written informed consent.

Of the 6,101 subjects from the DHS, we excluded those subjects with race or ethnicity other than Black, white, or Hispanic (N=119) and those who refused to answer the neighborhood questionnaire (N=75), leaving a final sample size of 5,907 subjects for analysis.

Study Definitions

Demographic information, including race/ethnicity, household income, achieved education level and medical histories, were self-reported. BMI was calculated based on measured height and weight at study entry. Obesity was defined based on National Heart, Lung, and Blood Institute (NHLBI) criteria as a BMI ≥ 30 kg/m^2.23 Waist circumference (WC) was measured according to the Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults developed by the NHLBI Expert Panel.[23] WC was recorded as the circumferential distance measured at the level of the superior iliac crest. Hip circumference (HC) was recorded as the largest area around the hips when standing. Hypertension was defined as one of the following: systolic blood pressure ≥ 140 mmHg, diastolic blood pressure ≥ 90 mmHg, or the use of anti-hypertensive medication. Hypercholesterolemia was defined either by self-report accompanied by use of lipid-

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lowering medication or by a fasting low-density lipoprotein (LDL) ≥ 160 mg/dl. Diabetes mellitus was defined either by self-report accompanied by use of anti-hyperglycemic medication or by fasting serum glucose ≥ 126 mg/dl.

Neighborhood perception questions were abstracted from the 1994 Project on Human Development in Chicago Neighborhoods community survey (PHDCN-CS) and were administered during the home interview.[24] This questionnaire has been shown to have internal consistency and discriminant validity when used in prior studies of diverse populations.[24–25] Participants were asked to respond using a 5-point Likert scale to 18 questions about perceptions of their neighborhood environment (See Supplemental Table 1 for the complete list of questions). A higher score on a 1 to 5 scale for each neighborhood perception question represented a less favorable perception of that neighborhood characteristic. Participants were also surveyed about the length of time they had lived in their neighborhood.

Principal components factor analysis with varimax (orthogonal) rotation was used to define constructs or factors from the neighborhood questionnaire data. Neighborhood questions with a loading score of 0.40 or higher were used to define the theme of each factor. The eigenvalue was used as a measure of variance explained by variables comprising each factor and had to be greater than or equal to one. Cronbach's alpha coefficients were used to measure internal consistency of the variables in each factor, with values above 0.7 considered acceptable. Numeric values assigned to Likert scale answers for a factor's questions were summed to calculate a factor-related perception score; a total neighborhood perception score was the sum of factor-related perception scores. Score quintiles were calculated based on the total neighborhood and factor-related perception scores for the population. A higher score quintile represented a more unfavorable perception of the neighborhood environment.

Statistical Analysis

Using sample weight adjustment, baseline characteristics were compared across quintiles of total neighborhood perception score and factor-related perception score with linear trend models for continuous variables and logistic regression models for categorical variables. Multivariable logistic regression modeling was used to evaluate the odds of prevalent obesity in the population of those with a factor-related perception score in the highest quintile as compared to individuals with a score in the lowest quintile. Results from logistic models are shown as unadjusted and adjusted for age, sex, race, highest achieved education level, family income and reported length of time living in neighborhood. Multicollinearity of the variables in the logistic regression models was examined using tolerance and variance inflation factors (VIF), and independent variables (i.e. age, race, sex, income, education, length of residence, and factor score quintiles) were not found to be collinear (VIF < 2.5).

For the neighborhood perception factors found to be associated with prevalent obesity, the individual questions comprising the factor were also examined. Using logistic regression modeling, we compared odds of prevalent obesity between participants who had the least favorable perceptions of the neighborhood characteristic (Likert scale value=4 or 5) with those with the most favorable perception of the neighborhood characteristic (Likert scale

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value=1) for each question. Two-sided p-values ≤0.05 were considered statistically significant. Analyses were performed using Statistical Analysis Systems, version 9.2 (SAS Institute, Cary NC).

Results

Table 1 shows the results of principal components factor analysis pertaining to the neighborhood questions. This analysis yielded three factors with Eigenvalues greater than or equal to one that explained up to 96% of the common variance in the population's data. These three factors were: 1) neighborhood violence, 2) physical environment, and 3) social cohesion with Cronbach's alpha coefficients of 0.84, 0.82, and 0.76, respectively. As shown in the table, five questions defined the perceptions about neighborhood violence, six questions defined perceptions about physical environment, and three questions defined perceptions about social cohesion, with loading scores ranging from 0.54 to 0.78.

The total neighborhood perception score ranged from 14–69 with a median value of 28. Sample-weighted baseline characteristics for the study population across quintiles of the score are shown in Table 2. Dallas County adults with total neighborhood perception scores in the highest quintile were younger, more likely to be Black and non-smokers, have a family history of myocardial infarction, and lower socioeconomic status compared to adults with perception scores in the lower quintiles. There were no significant differences in the percentage of Dallas County adults with a history of hypertension, diabetes, or hyperlipidemia across quintiles of total neighborhood score. There was also no significant difference in the percentage of those who reported adequate levels of physical activity (≥150 met/min-wk) across quintiles, even with adjustment for age, sex, and race (data not shown).

Prevalent obesity was compared across quintiles of total neighborhood and factor-related perception scores in Table 3. Individuals with the most unfavorable perceptions of their overall neighborhood and physical environment of their neighborhood were significantly more likely to be obese as measured by BMI, and the trend remained for class II and class III obesity. The percentage of individuals with high WHR and WC was not statistically different across the quintiles; however, in sex-stratified analyses, women with unfavorable perceptions of their neighborhood physical environment were more likely to have a high WC (p-trend = 0.01, data not shown). There was no significant relationship between BMI, WC, WHR, or prevalent obesity across quintiles for neighborhood violence and social cohesion perception scores.

Individuals who reported the least favorable perceptions of the neighborhood physical environment were almost 30% more likely to have a BMI ≥ 30 kg/m^2 compared to those with the most favorable perceptions [unadjusted odds ratio (OR)=1.28, 95% confidence interval (CI)=1.08–1.53 for quintile 5 vs. quintile 1], a relationship that remained significant after adjustment for age, race, sex, education, income, and length of neighborhood residence (OR=1.25, 95% CI=1.03–1.50 for quintile 5 vs. quintile 1) (Table 4). When accounting for an observed interaction between race and education (p-interaction = 0.03) in the fully adjusted models, the association between physical environment perception and prevalent obesity was relatively unchanged (OR=1.24, 95% CI=1.03–1.50 for quintile 5 vs. quintile

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1). There was no significant interaction between race and factor score quintiles (p-interaction > 0.05 for all factors), and there was also no significant interaction between race and income (p-interaction=0.07). In addition, neither perceptions about neighborhood violence nor neighborhood social cohesion were independently associated with prevalent obesity (adjusted OR=1.14, 95% CI=0.96–1.35 for neighborhood violence score; adjusted OR=1.08, 95% CI=0.90–1.31 for social cohesion score quintile 5 vs. quintile 1).

Of the components of the physical environment perception score, unfavorable perceptions about heavy traffic in the neighborhood were most associated with prevalent obesity (Figure). Those who believed that heavy traffic was a “somewhat serious problem” (Likert scale score=4) or a “very serious problem” (Likert scale score=5) were 20 and 39% more likely, respectively, to be obese compared to those who believed that it was “not really a problem” (Likert scale score=1). Perceptions regarding excessive trash or litter in the neighborhood, lack of recreation areas, lack of sidewalks, and excessive noise in the neighborhood were also significantly associated with prevalent obesity (Figure). In contrast, perceptions of inadequate access to food shops did not independently associate with prevalent obesity.

Discussion

In summary, these data from a large, multi-ethnic, population-based sample of Dallas County residents identify perceptions about neighborhood violence, physical environment, and social cohesion as psychosocial factors associated with neighborhood environment for Dallas County adults. Blacks and individuals of lower socioeconomic status reported less favorable perceptions of environment, particularly in relation to neighborhood violence and physical environment. To explore a possible mechanistic pathway between neighborhood characteristics and prevalent obesity, we examined the association between perceptions of neighborhood environment and prevalent obesity for Dallas County adults. In this population, unfavorable perceptions of the physical environment portend an increased likelihood of prevalent obesity; perceived aesthetics of the neighborhood environment and access to safe recreational areas appear to play a key role in this relationship. Thus, targeting physical conditions of neighborhoods in Dallas County may aid in preventing obesity for this population.

Our findings highlight several important issues. First, consistent with previous work, unfavorable perceptions of a neighborhood environment, particularly the physical environment of the neighborhood, are associated with obesity. In a prior study of individuals in two urban communities in the U.S., those who perceived a lack of sidewalks or poor aesthetics in their community were more than twice as likely to be obese as compared to those who perceived adequate sidewalks and aesthetics.[19] The odds of prevalent obesity in relation to perceived lack of sidewalks was higher in this population (adjusted OR = 2.2, 95% CI = 1.1–4.3) compared to our present study; however, we additionally adjusted logistic regression models for potential confounders including race, family income, and reported length of residence in neighborhood, which may explain these differences. Moreover, our findings related to physical environment perception and prevalent obesity are similar in magnitude to results from a large, population-based sample of British adults

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(adjusted OR = 1.2, 95% CI = 1.0–1.3).[18] Other work from the Multiethnic Study of Atherosclerosis (MESA) demonstrated that favorable physical environment characteristics, such as availability of walking paths and healthy foods, were associated with lower body mass index. However, this study used a community survey for non-MESA participants as a proxy measure of physical environment for the study population, thereby making it difficult to decipher how perceptions of the physical environment is related to obesity in this population.[21]

Second, our results demonstrate no significant association between perceptions about food store availability and prevalent obesity in the DHS population. In addition, there was little difference in reported physical activity with worsening perception of neighborhood environment. Intriguingly, these findings suggest that an ability to comply with beneficial health behaviors, like healthy eating and physical activity, may not mediate the relationship between perceptions about the neighborhood environment and obesity for Dallas County adults. Data from prior studies support these findings. For instance, Poortinga et al. showed that physical activity did not mediate the relationship between perceived access to recreation amenities in the local environment and obesity, suggesting other undefined mechanisms through which perceptions of environment may lead to obesity.[18] The lack of a relationship between perceived food store access and obesity may also reflect variability in what stressors activate the biological pathways between psychosocial stress related to neighborhood environment and obesity.[26] Emerging data suggest the possibility that differential neural mechanisms for processing acute stressors may be related to the environment in which an individual was raised or currently lives, a hypothesis that could reflect the aforementioned variability noted.[27]

Third, unlike other cardiovascular risk factors like hypertension and hyperlipidemia, obesity prevalence increased in the DHS population with less favorable perceptions of the neighborhood environment, suggesting that perceptions about one's neighborhood may represent a unique pathway by which neighborhood characteristics are associated with cardiovascular risk. Perceptions may denote an individual's psychological response to their neighborhood environment. At a macro-level, prior work supports psychological stress as a mediator of perceptions about neighborhood environment and obesity.[17, 29] For instance, in a probability sample of over 1,500 Texas adults, Burdette and colleagues demonstrated an association between prevalent obesity and perceptions about crime, noise, and cleanliness in participants' neighborhood environment. Perceptions of greater neighborhood disorder were associated with a greater odds of obesity, after accounting for age, sex, race, and SES in this population; however, the odds of obesity was reduced by 3% and no longer statistically significant when psychological distress, as measured by reported sensations of anxiety or restlessness, was added to the regression model.[17] At a molecular level, individual-level SES, a potential surrogate for neighborhood deprivation, in childhood has been shown to influence release of stress-induced hormones such as cortisol and interleukin-6 (IL-6) that may promote obesity in adulthood.[28] Recent data support a relationship between neighborhood-level characteristics, such as census-measured neighborhood disorder, neighborhood deprivation, or poorer neighborhood aesthetics and higher levels of cortisol or inflammatory biomarkers associated with obesity.[14, 16] Future studies should explore the

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connection between perceptions of the neighborhood environment and specific stress-related biomarkers that promote obesity and thus, cardiovascular risk.

Fourth, in contrast to our findings, other studies have found associations between neighborhood violence and obesity. For instance, a random sample of adult Los Angeles residents who perceived their neighborhood as unsafe had significantly higher BMI than those who described their neighborhoods as safe.[20] Built environment measures, such as walkability and street connectivity, and perceived overall safety or safety from crime have also been shown to have an independent association with lower BMI.[30] Our findings might differ from some previous work due to differences in the racial/ethnic makeup and population sampling of our participants. Additionally, our study includes comprehensive measurement of perceptions about neighborhood environment in Dallas County which facilitated examination of relative associations between multiple facets of the neighborhood environment and prevalent obesity.

Important strengths of our study include the multi-ethnic, urban nature of the cohort, and measurement of height and weight as opposed to the use of self-reported measures to estimate BMI.[17, 19–20] However, limitations of the present study must also be considered. These data are cross-sectional and, therefore, we cannot infer causality. We are also unable to evaluate the bi-directional relationship between one's living environment and weight status. Healthier, more financially secure individuals may self-select neighborhoods they perceive as providing adequate resources for healthy foods and physical activity just as one's neighborhood may impact perceptions about one's environment, health beliefs, and behaviors.[2] Additionally, physical activity was self-reported, making it subject to misclassification bias. Finally, given that the DHS represents an urban and geographically localized population in the U.S., findings may not be applicable to populations in other settings.

In conclusion, perceptions of neighborhood environment, particularly relative to the physical environment, are associated with an increased prevalence of obesity among Dallas County residents. Our results are hypothesis-generating and suggest that public policy efforts that focus on improvement of the county's physical environment, or perceptions of that environment, might be an important element in reducing the obesity epidemic in this community. Also, specific research is needed that directly evaluates the potential interplay between neighborhood environment, psychosocial stress and health conditions. Since longitudinal evidence suggests that psychosocial stress is associated with obesity,[31] identification of specific stressors related to the neighborhood may help in the development of targeted interventions to prevent and reduce obesity.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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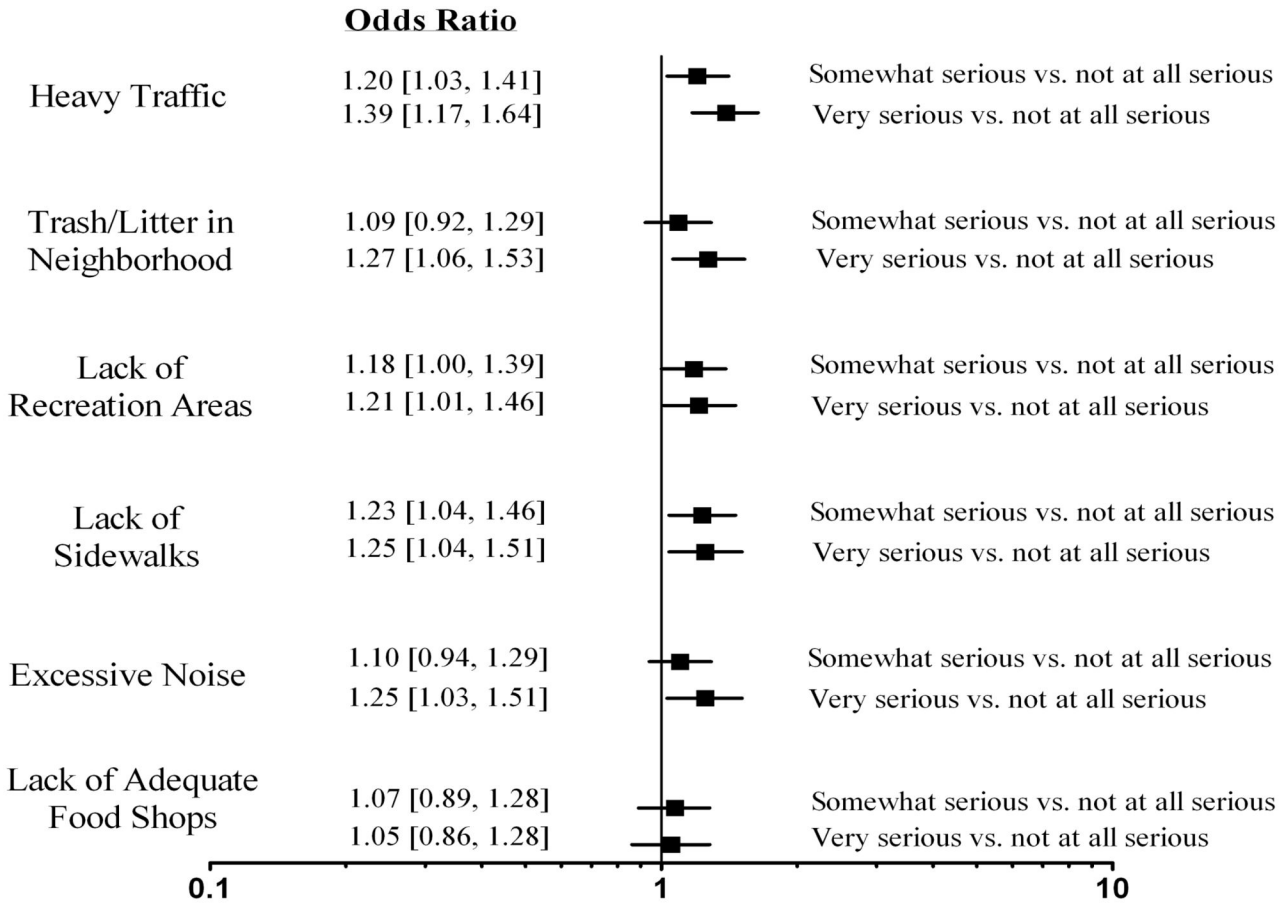

Figure.

Adjusted odds ratios for prevalent obesity (BMI ≥ 30 kg/m^2) for DHS participants with second highest level of perceived stress (belief that physical environment issue a “somewhat serious problem” - Likert Scale answer value = 4) and highest level of perceived stress (belief that physical environment issue a “very serious problem” - Likert Scale answer value = 5). Referent group are those who felt physical environment factor “not really a problem” (Likert Scale answer value = 1). All odds ratios are adjusted for age (continuous), race (Black, White, Hispanic), sex, education (< high school, high school, some college, college grad or higher), income (<$16,000,$16,000-$29,999, $30,000-$49,999, $50,000 or higher), length of neighborhood residence (continuous).

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Table 1

Factor Analysis for Creation of Neighborhood-Related Factors in the Dallas Heart Study (DHS)

Component	Question pertaining to:	Mean (SD)	Factor 1	Factor 2	Factor 3
Violence (Factor 1)	Gang violence	1.53 (1.04)	0.75	0.17	0.08
	Fights with weapons	2 (1.35)	0.74	0.25	0.15
	Violent arguments	2.02 (1.34)	0.67	0.28	0.19
	Sexual assault	1.46 (0.92)	0.67	0.12	0.06
	Robbery	2.16 (1.35)	0.62	0.15	0.20
Physical Environment (Factor 2)	Trash and litter	2.12 (1.45)	0.22	0.74	0.12
	Lack of recreation areas	2.08 (1.45)	0.10	0.66	0.06
	Food shops	1.88 (1.36)	0.14	0.64	0.01
	Sidewalks	2.02 (1.42)	0.11	0.63	0.05
	Excessive noise	2.23 (1.43)	0.25	0.56	0.21
	Heavy traffic	2.5 (1.52)	0.21	0.54	0.19
Social Cohesion (Factor 3)	Willingness to help neighbors	2.4 (1.26)	0.17	0.09	0.78
	Close knit neighborhood	2.75 (1.39)	0.07	0.06	0.70
	People trusted	2.68 (1.33)	0.27	0.18	0.61
		Eigenvalue	10.52	2.39	1.84
		Common variance explained by each component	0.76	0.17	0.13
		Cronbach's alpha coefficient	0.84	0.82	0.76

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Table 2

Demographics, Socioeconomic Status and Cardiovascular Risk Factors Across Quintiles of Total Neighborhood Perception Score for Dallas County Adults[a]

	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5[b]	p-trend
Unweighted Sample Size (N)	1071	1197	1282	1180	1177	
Score range	14–19	20–24	25–30	31–38	39–69	
Demographics						
Age, years	40.3 (0.6)	38.8 (0.5)	37.7 (0.6)	35.8 (0.6)	34.1 (0.6)	<0.001
Male,%	50% (2.4)	53% (2.2)	52% (2.3)	48% (2.4)	48% (2.5)	0.2
Black, %	19% (1.4)	17% (1.2)	20% (1.5)	20% (1.4)	30% (1.8)	<0.001
White, %	46% (2.4)	52% (2.1)	47% (2.4)	40% (2.4)	33% (2.4)	<0.001
Hispanic, %	35% (2.3)	31% (2.0)	33% (2.4)	40% (2.3)	37% (2.5)	0.1
Cardiovascular Risk Factors						
History of Hypertension, %	22% (1.9)	17% (1.5)	21% (1.6)	19% (1.9)	18% (1.6)	0.5
History of Diabetes, %	9% (1.7)	7% (1.2)	7% (1.2)	9% (1.6)	12% (2.0)	0.2
History of High Cholesterol, %	12% (1.7)	12% (1.5)	14% (1.8)	12% (1.8)	8% (1.6)	0.4
Family History of Premature Myocardial Infarction, %	6% (1.0)	7% (1.1)	8% (1.3)	6% (1.0)	11% (1.6)	0.03
Physical Activity ≥150 met/min-wk, %	49% (2.5)	58% (2.2)	54% (2.4)	49% (2.4)	47% (2.6)	0.2
Current Smoker, %	62% (2.3)	60% (2.1)	57% (2.5)	60% (2.3)	52% (2.5)	0.02
Socioeconomic Status						
Achieved Education						
Less than High School, %	25% (2.1)	21% (1.8)	23% (1.8)	29% (2.1)	30% (2.3)	0.02
High School, %	24% (2.0)	26% (1.8)	25% (2.3)	30% (2.1)	36% (2.4)	<0.001
Some College, %	24% (1.9)	27% (1.9)	24% (1.9)	24% (2.0)	23% (1.9)	0.3
College Grad or higher, %	26% (2.2)	26% (1.9)	28% (2.3)	17% (1.9)	11% (1.4)	<0.001
Yearly Income						
<$16,000, %	13% (1.5)	11% (1.4)	15% (1.5)	16% (1.6)	26% (2.1)	<0.001
$16,000-$29,999, %	17% (1.6)	17% (1.6)	19% (1.7)	23% (1.9)	26% (2.2)	<0.001
$30,000-$49,999, %	15% (1.6)	21% (1.6)	23% (2.2)	25% (2.1)	20% (1.8)	0.003
$50,000 or higher, %	40% (2.4)	39% (2.1)	34% (2.3)	22% (2.2)	14% (1.8)	<0.001

[a] Data are presented as mean (SEM) or percentage (SE).

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[b] Quintile 5 represents most unfavorable perceptions of neighborhood environment.

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Table 3

Obesity Prevalence by BMI, Waist Circumference, and Waist-to-Hip Ratio Across Quintiles of Neighborhood Perception Scores for Dallas County Adults[a]

	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5[b]	p-trend
Unweighted Sample Size (N)	1071	1197	1282	1180	1177	
Total Neighborhood Score						
Score Range	14–19	20–24	25–30	31–38	39–69	
BMI ≥ 30 kg/m^2	29% (2.2)	31% (2.0)	32% (2.2)	29% (2.0)	39% (2.4)	0.03
BMI ≥ 35 kg/m^2	11% (1.6)	11% (1.2)	14% (1.8)	12% (1.3)	18% (1.8)	0.002
BMI ≥ 40 kg/m^2	5% (0.9)	4% (0.8)	5% (0.7)	6% (0.9)	8% (1.2)	0.02
High Waist Circumference[c]	53% (3.2)	56% (2.8)	52% (3.2)	52% (3.6)	58% (3.4)	0.8
High Waist-to-Hip Ratio[d]	64% (3.0)	67% (2.6)	68% (3.3)	66% (3.5)	74% (2.9)	0.1
Neighborhood Violence Score						
Score Range	5	6	7–8	9–13	14–25	
BMI ≥ 30 kg/m^2	30% (1.6)	35% (2.9)	32% (2.6)	31% (2.0)	32% (2.4)	0.8
BMI ≥ 35 kg/m^2	11% (1.0)	16% (2.4)	13% (2.1)	13% (1.3)	14% (1.7)	0.2
BMI ≥ 40 kg/m^2	5% (0.7)	4% (0.8)	5% (0.9)	5% (0.8)	6% (0.9)	0.8
High Waist Circumference[b]	53% (2.4)	54% (3.5)	59% (3.8)	51% (3.3)	55% (4.2)	0.9
High Waist-to-Hip Ratio[c]	67% (2.3)	62% (3.4)	73% (3.4)	65% (3.3)	73% (3.7)	0.4
Physical Environment Score						
Score Range	6	7–9	10–12	13–18	19–30	
BMI ≥ 30 kg/m^2	27% (2.1)	30% (2.1)	32% (2.2)	33% (2.0)	37% (2.4)	0.002
BMI ≥ 35 kg/m^2	9% (1.1)	11% (1.5)	13% (1.8)	16% (1.5)	16% (1.6)	<0.001
BMI ≥ 40 kg/m^2	3% (0.7)	5% (0.9)	4% (0.8)	7% (1.0)	7% (1.0)	0.002
High Waist Circumference[b]	52% (3.7)	55% (2.8)	57% (3.2)	51% (3.6)	52% (3.1)	0.6
High Waist-to-Hip Ratio[c]	70% (3.4)	64% (2.8)	68% (3.0)	69% (3.5)	70% (2.9)	0.5
Social Cohesion Score						
Score Range	3–4	5–6	7–8	9–10	11–15	
BMI ≥ 30 kg/m^2	30% (2.5)	31% (1.8)	31% (2.3)	31% (2.4)	34% (2.1)	0.3
BMI ≥ 35 kg/m^2	12% (2.0)	12% (1.1)	15% (1.9)	11% (1.4)	14% (1.5)	0.7

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	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5[b]	p-trend
BMI ≥ 40 kg/m^2	5% (0.2)	5% (0.2)	5% (0.2)	4% (0.1)	6% (0.2)	0.5
High Waist Circumference[b]	52% (3.7)	55% (2.8)	57% (3.2)	51% (3.6)	52% (3.1)	0.6
High Waist-to-Hip Ratio[c]	70% (3.4)	64% (2.8)	68% (3.0)	69% (3.5)	70% (2.9)	0.5

[a] Data are presented as percentage (SE).

[b] Quintile 5 represents most unfavorable perceptions of neighborhood environment.

[c] High Waist circumference defined as ≥ 102 cm for men and ≥ 88 cm for women.

[d] High Waist-to-Hip ratio defined as ≥ 0.95 for men and ≥ 0.80 for women.

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Table 4

Odds of Prevalent Obesity (BMI ≥ 30 kg/m^2) for DHS Participants at Highest Quintile of Factor-Related Neighborhood Stress Score

Model	Odds Ratio[a]	95% Confidence Interval
Neighborhood Violence (Factor 1)		
Unadjusted Model	1.09	0.93 – 1.27
Adjusted Model[b]	1.14	0.96 – 1.35
Physical Environment (Factor 2)		
Unadjusted Model	1.28	1.08 – 1.53
Adjusted Model[b]	1.25	1.03 – 1.50
Social Cohesion (Factor 3)		
Unadjusted Model	0.99	0.83 – 1.18
Adjusted Model[b]	1.08	0.90 – 1.30

[a] Referent – lowest quintile of factor-related neighborhood stress score (Quintile 1). Quintile 5 represents most unfavorable perceptions of neighborhood conditions.

[b] Adjusted Model – adjusted for age (continuous), race (Black, White, Hispanic), sex, education (< high school, high school, some college, college grad or higher), income (<$16,000,$16,000–$29,999, $30,000–$49,999, $50,000 or higher), length of neighborhood residence (continuous)