Published in final edited form as:

J Health Care Poor Underserved. 2020 ; 31(1): 153–170. doi:10.1353/hpu.2020.0015.

Disentangling Race, Poverty, and Place to Understand the Racial Disparity in Waist Circumference among Women

Kelly Bower, PhD, MSN/MPH, RN,

Johns Hopkins School of Nursing

Laura Samuel, PhD, CRNP,

Johns Hopkins School of Nursing

Kelly Gleason, PhD, RN,

Johns Hopkins School of Nursing

Roland J Thorpe Jr., PhD,

Johns Hopkins Bloomberg School of Public Health along with Kelly Bower and Hopkins Center for Health Disparities Solutions

Darrell Gaskin, PhD

Johns Hopkins Bloomberg School of Public Health along with Kelly Bower and Hopkins Center for Health Disparities Solutions

Abstract

In the U.S., 54.8% of non-Hispanic Black women are obese, a rate that is 1.4 times greater than in White women. The drivers of this racial disparity are not yet clearly understood. We sought to disentangle race, household poverty, neighborhood racial composition, and neighborhood poverty to better understand the racial disparity in obesity among women. We used data from the 1999–2004 National Health and Nutrition Examination Survey and the 2000 U.S. Census to examine the role of individual race, individual poverty, neighborhood racial composition, and neighborhood poverty on women's risk of obesity. We found that individual race was the primary risk factor for obesity among women. Neighborhood effects did not account for the racial disparity.

Understanding that race is a social, not a biologic construct, more work is needed to uncover what it is about race that produces racial disparities in obesity among women.

Keywords

Obesity; racial residential segregation; poverty; race; health disparities; women's health

The prevalence of obesity in the United States (U.S.) has been rising over the past two decades and is at an all-time high.¹ The obesity rates among women are especially alarming, and the racial disparity is wide. Non-Hispanic Black (hereafter referred to as Black) women

Please address all correspondence to: Kelly M Bower, Johns Hopkins School of Nursing, 525 N Wolfe Street, Baltimore, MD 21205. kbower1@jhu.edu.

For additional information about this article <https://muse.jhu.edu/article/747781>

experience the highest rate of obesity (54.8%), with rates that are 1.4 times higher than in non-Hispanic White (hereafter referred to as White) women (38.0%).² The rising obesity rate is a matter for concern, in part because of its strong association with cardiovascular disease.³ Efforts to understand the racial disparity in obesity prevalence among women have focused on primarily individual-level differences in behavior, attitudes,⁴ and socioeconomic status.^{4,5} More recently, the association between neighborhood-level characteristics and obesity has been investigated and findings have been mixed.⁶ Little work has been conducted to understand how individual- and neighborhood-level factors work together to influence disparities in obesity.

The intersections of race and poverty at both the individual and neighborhood levels make them difficult to disentangle in order to understand the independent effects of each. As individuals, Black women experience disproportionately high rates of individual poverty⁷ and are more likely than White women to live in poor neighborhoods;⁸ most Black women live in predominantly Black neighborhoods.⁹ At the community-level, the racial segregation of neighborhoods in the U.S. has resulted in predominantly Black neighborhoods experiencing high levels of concentrated poverty,¹⁰ such that neighborhood-level racial composition and poverty levels are also entangled. Further, it has been demonstrated that the typical method of addressing the confounding of race and socioeconomic status by adjusting for socioeconomic status in multiple regression models is not adequate because most studies have small numbers of Black individuals living in racially integrated or high-income neighborhoods.¹¹ While studies have examined the effects of race, individual income, neighborhood racial composition, and neighborhood poverty on obesity, to our knowledge, none has examined the nexus of these often intersecting factors to understand how each is individually associated with obesity among women.

Individual- and neighborhood-level Black race and poverty have each been associated with higher risk of obesity among women. We have long known that both Black and White women experiencing poverty have a high risk of obesity.^{12,13} A newer line of research has begun to examine the associations between obesity and neighborhood characteristics, many of which are also associated with race. For instance, there is evidence that an obesogenic environment, including the scarcity of neighborhood supermarkets^{6,14,15} and less neighborhood walkability,¹⁶ is associated with higher risk of obesity. Exposure to obesogenic environments can limit healthy behaviors, and is partly a result of racial residential segregation.⁹ Predominantly Black neighborhoods have fewer supermarkets^{17,18} and fewer traits that promote physical activity (e.g., recreational facilities and walkability).¹⁹ Further, racial residential segregation has been associated with obesity among Black women.^{20,21} Residential segregation is thought partly to act indirectly through the concentration of poverty in neighborhoods,²² and neighborhood poverty has also been associated with a heightened risk of obesity.^{23,24} As a result of these intersecting risk factors, it can be difficult to disentangle the effects of individual race, individual poverty, neighborhood poverty rates, and neighborhood racial composition.^{7,25,26}

The aim of this study is to disentangle race, household poverty, neighborhood racial composition, and neighborhood poverty to understand better how these factors, together and separately, are associated with the racial disparity in obesity among women. Use of a large,

nationally representative sample is necessary for examining the nexus of these factors. We hypothesized that (1) obesity rates are higher in predominantly Black neighborhoods and in high-poverty neighborhoods, after accounting for individual poverty status and race, and (2) these neighborhood associations will be stronger for Black than for White women and for low-income than for high-income women.

Methods

This was a cross-sectional study using the National Health and Nutrition Examination Survey (NHANES) participant data pooled from 1999 to 2004 and 2000 U.S. Census Bureau data. A repeated, semi-annual, cross-sectional survey, NHANES recruits a nationally representative sample of the non-institutionalized U.S. population using a complex, stratified multistage probability sampling design that oversamples for low-income individuals, 12 to 19-year-old adolescents, adults 70 years and older, non-Hispanic Blacks, and Mexican Americans. The NHANES data were collected during in-home interviews and a physical examination. Additional details about the NHANES survey can be found elsewhere.²⁷

The response rate for female participants who completed both the interview and physical examination in the 1999–2004 surveys were 77% (1999–2000), 80% (2001–2002), and 76% (2003–2004); sampling weights accounted for differential non-response.² We limited our analytic sample to female respondents who participated in the physical examination portion of the NHANES survey and were 24 years of age and older. We were interested in comparing Black versus White differences and, therefore, included only participants who were either non-Hispanic White (n = 4,172) or non-Hispanic Black/African American (n = 679); all other racial and ethnic groups were excluded.

We linked NHANES participant data by census tract to 2000 U.S. Census aggregate data of the race, ethnicity, and income reported by residents of each census tract.²⁸ Because we accessed participants' census tract information, the analysis was conducted at the NCHS Research Data Center to preserve the respondents' privacy, confidentiality, and anonymity. The study was approved by the Johns Hopkins Institutional Review Board.

Variables.

Dependent variable.—For women, abdominal obesity, based on waist circumference, is a stronger and more potent risk factor for cardiovascular and overall mortality than body mass index (BMI).^{29–35,36} Given that waist circumference is a better tool than BMI for discriminating cardiometabolic risk,³⁷ it is recommended for the identification of increased disease risk among adults.³⁸ Therefore, for this study, obesity was classified based on waist circumference as measured during the physical examination portion of the NHANES survey and recorded in centimeters. Waist circumference for women was categorized as elevated if it was greater than 80 cm and normal if less than 80 cm based on the International Diabetes Federation (IDF) definition of metabolic syndrome.³⁹ A sensitivity analysis used an alternative threshold of 88 cm.⁴⁰

Main independent variables.

The independent variables included individual race, individual poverty status, neighborhood poverty, and neighborhood racial composition. Self-reported individual race was categorized as either non-Hispanic Black/African American or non-Hispanic White. Self-reported individual poverty status was measured in two ways: (a) the poverty-income ratio—the ratio of household income to the federal poverty threshold limit (FPL)—was used to create a five-category variable: income below FPL, 100–199% FPL, 200–299% FPL, 300–399% FPL, and 400% FPL or more; (b) we also created a binary individual poverty variable indicating whether individuals had a household income-poverty ratio of less than 200% of the FPL (poor) or greater than or equal to 200% of the FPL (non-poor). These individual-level measures have been used in prior work.⁴¹

Neighborhood characteristics were measured using the participants' census tract, census tracts being permanent statistical subdivisions within the U.S. The census tracts are relatively small, ranging in size from 1,500 to 8,000 people. Based on prior work,⁴¹ neighborhood poverty was classified as poor if at least 20% of the residents had a household income of less than 200% of the FPL and non-poor if less than 20% of residents met this income threshold. Neighborhood racial composition was classified as predominantly Black, predominantly White, or predominantly other if the census tract comprised at least 65% Black, White, or other racial groups, and was classified as integrated if there was less than 65% of any one racial group.⁴¹

To disentangle individual- and neighborhood-level race and poverty, we generated three additional categorical variables to examine different combinations of individual and neighborhood characteristics, similar to measures used in a prior study.⁴¹ The race-place variable combined the individual race variable (Black or White) and neighborhood racial composition variable (Black, White, other, or integrated) and was categorized as White in a White neighborhood (referent), White in a Black neighborhood, White in an other-race neighborhood, White in an integrated neighborhood, Black in a White neighborhood, Black in a Black neighborhood, Black in an other-race neighborhood, and Black in an integrated neighborhood. The poverty-place variable combined the binary neighborhood poverty variable (poor or non-poor) and the binary individual poverty variable. The poverty-place variable was categorized as non-poor in a non-poor neighborhood (referent), non-poor in a poor neighborhood, poor in a non-poor neighborhood, and poor in a poor neighborhood. The race-poverty-place variable combined the individual race variable (Black or White), the individual poverty variable (poor or non-poor), and the neighborhood poverty variable (poor or non-poor). The eight categories were as follows: non-poor White in a non-poor neighborhood (referent), non-poor White in a poor neighborhood, poor White in a non-poor neighborhood, poor White in a poor neighborhood, non-poor Black in a non-poor neighborhood, non-poor Black in a poor neighborhood, poor Black in a non-poor neighborhood, and poor Black in a poor neighborhood.

Additional independent variables.

Adjusted models controlled for age and educational status. Age was categorized as 24–34 years, 35–44, 45–54, 55–64, and 65 years or older. Educational status was based on highest

educational achievement and categorized as less than 9th grade, some high school, high school graduate or GED, some college, and college degree or beyond.

Analysis.

We tested bivariate associations between abdominal obesity and each main independent variable. We used the 2-by-N χ^2 test and unadjusted modified Poisson regression models to determine proportional differences in abdominal obesity. Due to a relatively high population prevalence of abdominal obesity (78%), modified Poisson regression models with robust standard errors were used to estimate prevalence ratios.⁴² A series of regression models were built to test the hypothesized associations. The base model included individual race, individual poverty, neighborhood racial composition, and neighborhood poverty, and adjusted for age and educational status. To disentangle individual-level from neighborhood-level associations, three additional separate models were built. The race-place model included the race-place variable, age, individual poverty, neighborhood poverty, and education. The poverty-place model included the poverty-place variable, individual race, age, and education. The race-poverty-place model included the race-poverty-place variable, age, and education. None of the variables were missing data for more than 9% of the observations. Observations with missing data were excluded from the analysis and there were no differences with regard to the main exposures compared with those with complete data. Sensitivity analyses additionally adjusted for urban (vs. rural) neighborhood status and self-reported health in each regression model.

We developed sample weights to account for sampling design and differential response rates and to produce nationally representative estimates and appropriate standard errors. Following the algorithm described by the NCHS,⁴³ we created a six-year sample weight variable by assigning two thirds of the four-year weight for 1999–2002 if the person was sampled in 1999–2002 or assigning one-third of the two-year weight for 2003–2004 if the person was sampled in 2003–2004. We applied sampling weights to all analyses in Stata version 15 (StataCorp LP, College Station, TX). We adjusted parameter estimates and standard errors for the multistage sampling design with Taylor linearization methods.

Results

Table 1 includes unadjusted modified Poisson regression models of the risk of abdominal obesity across independent variables and covariates. The rate of abdominal obesity in the full sample was 78%, and Black women had a higher risk of obesity than White women (PR 1.13, 95% CI: 1.08, 1.17). Women with incomes either 100%–199% (PR=1.11, 95% CI: 1.05, 1.16) or 200%–299% (PR=1.10, 95% CI: 1.04, 1.16)—but not less than the FPL—had a significantly higher risk of obesity than women with incomes of 400% of the FPL or more. Women in Black neighborhoods had a significantly higher risk of obesity than those in predominantly White neighborhoods (PR 1.11, 95% CI 1.05, 1.18). Black women living in Black neighborhoods (PR 1.14, 95% CI .08, 1.20), Black women living in integrated neighborhoods (PR 1.10, 95% CI 1.04, 1.16), and Black women living in White neighborhoods (PR 1.11, 95% CI 1.04, 1.19) had a significantly higher risk of obesity than White women in White neighborhoods (race-place). Poor women in poor neighborhoods

(PR 1.06, 95% CI 1.01, 1.12) and poor women in non-poor neighborhoods (PR 1.04, 95% CI 1–1.09), but not non-poor women in poor neighborhoods, had a significantly higher risk of obesity than non-poor women in non-poor neighborhoods (poverty-place). Black women have higher risk of obesity than White women regardless of their individual poverty or neighborhood poverty status. Non-poor Whites in poor neighborhoods and poor Whites in non-poor and poor neighborhoods did not have significantly higher risk of obesity than non-poor Whites in non-poor neighborhoods, indicating that there was not an individual-based socioeconomic gradient for poor Whites (race-poverty-place). Finally, there was a significantly higher risk of obesity among non-poor Blacks in non-poor neighborhoods (PR 1.08, 95% CI 1.02, 1.14) and poor neighborhoods (PR 1.19, 95% CI 1.13, 1.25), and among poor Blacks in non-poor neighborhoods (PR 1.14, 95% CI 1.08, 1.20) and poor neighborhoods (PR 1.15, 95% CI 1.09, 1.22) than non-poor Whites in non-poor neighborhoods (race-poverty-place).

The results of multivariate Poisson regressions for each model are reported in Table 2. The base model determined whether, after adjusting for age and education, individual race, individual poverty status, neighborhood racial composition, and neighborhood poverty were independently associated with the risk of abdominal obesity. Individual race and individual poverty were significantly associated with higher risk of obesity, whereas neighborhood racial composition and neighborhood poverty were not associated with obesity. Black women were 14% more likely to be obese than White women. Compared with women with a household income of 400% of FPL or more, the risk of obesity was 6% (95% CI= 1% to 13%) greater for women living at 100% to 199% of FPL; there were no differences for women below the FPL or above 200% of the FPL.

The race-place model tested whether the risk of obesity differed relative to an individual's race and the racial composition of their neighborhood, adjusting for neighborhood poverty, individual poverty, education, and age (Table 2). In this multivariate model, Black women in Black neighborhoods (PR 1.14, 95% CI 1.07, 1.22), White neighborhoods (PR 1.14, 95% CI 1.08, 1.21), and integrated neighborhoods (PR 1.14, 95% CI 1.07, 1.22) each had significantly higher risk of obesity than White women in White neighborhoods. The poverty-place model tested whether the risk of obesity differed relative to women's individual poverty status and neighborhood poverty adjusting for education, age, and individual race (Table 2). We found that poverty status relative to neighborhood poverty concentration was not a significant predictor of risk of obesity after accounting for race, age, and education. The race-poverty-place model tested whether the risk of obesity differed relative to women's individual race, individual poverty, and neighborhood poverty, adjusting for age and education (Table 2). Compared with non-poor White women in non-poor neighborhoods, non-poor Black women in non-poor (PR 1.11, 95% CI 1.04, 1.17) and poor neighborhoods (PR 1.16, 95% CI 1.10, 1.22), and poor Black women in non-poor (PR 1.19, 95% CI 1.13, 1.26) and poor neighborhoods (PR 1.13, 95% CI 1.07, 1.20), each had significantly higher risk of obesity. The inferences for all models remained unchanged comparing the results of the present study to using an alternate waist circumference cut point of 88, and including living in an urban neighborhood in the models and self-reported health status in the models.

Discussion

This study leveraged data from a large, nationally representative sample of U.S. women to isolate the effects of individual and neighborhood factors to examine their roles related to the racial disparity in obesity. Our findings suggest that neither individual income, neighborhood poverty, nor neighborhood racial composition are drivers of the racial disparity. While studies have found that neighborhood place-based factors explain other racial disparities in health, such as diabetes,⁴¹ we found that individual race had the strongest effect on the racial disparity in abdominal obesity among women. Black women were more likely to be obese than their White peers, regardless of individual poverty, neighborhood poverty, or neighborhood racial composition.

It is possible that there are neighborhood characteristics not measured in this study that are responsible for the racial disparity in obesity status among women. In the Exploring Health Disparities in Integrated Communities (EHDIC) study, poor urban Black and White women living in the same racially integrated neighborhoods had similar rates of obesity.⁴⁴ This suggests that there is something about the physical or social environment that contributes to obesity, regardless of race. For instance, the physical characteristics of a neighborhood that create an obesogenic environment have been associated with obesity,^{6,14–16} and studies suggest that characteristics of the social environment, including social capital, collective efficacy, and crime, should be further examined.⁴⁵ For instance, discriminatory policing has been associated with the Black-White disparity in waist circumference for women.⁴⁶ These or other neighborhood-level characteristics may be responsible for the racial disparity in obesity; however, research has not adequately explored how various neighborhood exposures may have differential impacts on Black versus White women. Additionally, since Black race is clustered regionally in the U.S., these results highlight the important role that race may play in shaping regional disparities in obesity.

There may also be elements unique to the lived experience of Black women that account for the racial disparity in obesity and explain why, in our study, race had the strongest association with obesity. The *differential exposure hypothesis* suggests that Black individuals are faced with higher levels of stress and explains why racial disparities exist and persist.^{47,48} Black women likely experience excess stress due to their race in the form of racial discrimination.⁴⁹ The accumulation of excess stress over the life course can result in physiologic alterations, or increased allostatic load.⁵⁰ There is evidence that psychosocial stress is associated with increased central adiposity over time and that cumulative stress mediates the association between neighborhood poverty and central adiposity;^{23,51} however, more work is needed to examine the relationship between stress and obesity, especially for Black women and as a driver of the racial disparity.

Cultural beliefs and practices are other unmeasured variables that may have a stronger influence on obesity than neighborhood factors. These include norms and attitudes related to body size and shape, traditions of how food relates to health, and eating and feeding patterns, which vary among racial/ethnic groups. As a group, Black women have been found to be more satisfied with their body size than White women^{52,53} and have been found to be less likely than White women to perceive overweight or obese bodies as being too fat.⁵⁴ The

influence of these and other cultural attitudes and norms on obesity—over and above neighborhood effects and as a driver of racial disparities—should be examined further.

While this study drew from a large, multi-year, nationally representative sample, it has some limitations. While we were attempting to study the effect of neighborhood racial composition, the extreme racial residential segregation found across the U.S. made it difficult,^{7,10} even when using a national dataset and applying advanced statistical techniques.¹¹ Only 6.6% of the sample lived in a predominantly Black neighborhood and only 0.56% of White women lived in a predominantly Black neighborhood, which prevented us from being able to detect the effect of neighborhood segregation on obesity. Additionally, our findings are only generalizable to Black and White women. Future work should consider women of other racial and ethnic backgrounds, in particular Hispanic women, who also have a high prevalence of obesity compared with White women.⁵⁵ Our use of the 2000 U.S. Census data to measure neighborhood poverty and racial composition assumes that these measures remained stable through the study period. Finally, there are limitations to the use of census tract as a proxy for neighborhood. A census tract may not be an accurate reflection of the area a person considers to be their neighborhood, nor the area where they spend most of their time. The size and number of residents in a census tract also varies widely depending on the population density of the area.

Race is *not* a biologic construct. Race *is* a social construct. We must examine social determinants as the drivers of the racial disparities in health, including obesity. Neighborhood poverty and income, each examined independently, were not drivers of obesity among Black women in this study. However, neighborhood factors have been found to exert a powerful influence on a variety of health outcomes and there may be other neighborhood characteristics not measured in this study that more strongly influence obesity. Additionally, the lived experiences of being Black must be further examined and understood and considered as a potential driver of racial disparities in Black women.

Acknowledgments

This research was supported by the National Heart, Lung and Blood Institute (grant R01HL092846-02). The analysis was conducted at the Research Data Center of the National Center for Health Statistics. The findings and conclusions are those of the authors and do not necessarily represent the views of the National Center for Health Statistics or the Centers for Disease Control and Prevention. This research was also supported by the Johns Hopkins Institute for Clinical and Translational Research (ICTR), which is funded in part by Grant Number KL2TR001077 from the National Center for Advancing Translational Sciences (NCATS), a component of the National Institutes of Health (NIH), and the NIH Roadmap for Medical Research. Its contents are solely the responsibility of the authors and do not necessarily represent the official view of the Johns Hopkins ICTR, NCATS or NIH.

References

1. Flegal KM, Kruszon-Moran D, Carroll MD, et al. Trends in obesity among adults in the United States, 2005 to 2014. *JAMA*. 2016 6 7;315(21):2284–91. 10.1001/jama.2016.6458 [PubMed: 27272580]
2. National Center for Health Statistics. Health, United States, 2015: with special feature on racial and ethnic health disparities. Hyattsville, MD: National Center for Health Statistics, 2016.
3. Centers for Disease Control and Prevention (CDC). Leading causes of death—females—2016. Atlanta, GA: CDC, 2018 Available at: <https://www.cdc.gov/women/lcod/2015/all-females/index.htm>.

4. Seo DC, Torabi MR. Racial/ethnic differences in body mass index, morbidity and attitudes toward obesity among U.S. adults. *J Natl Med Assoc.* 2006 8;98(8):1300–8. [PubMed: 16916128]
5. Bruce MP, Sims MP, Miller SPM, Elliott VP, Ladipo MM. One size fits all? Race, gender and body mass index among U.S. Adults. *J Natl Med Assoc.* 2007 10;99(10):1152–8. [PubMed: 17987919]
6. Black JL, Macinko J, Dixon LB, et al. Neighborhoods and obesity in New York City. *Health Place.* 2010 5;16(3):489–99. Epub 2010 Jan 7. 10.1016/j.healthplace.2009.12.007 [PubMed: 20106710]
7. LaVeist TA. Disentangling race and socioeconomic status: a key to understanding health inequalities. *J Urban Health.* 2005 6;82(2 Suppl 3):iii26–34. 10.1093/jurban/jti061 [PubMed: 15933328]
8. Reardon SF, Fox L, Townsend J. Neighborhood income composition by household race and income, 1990–2009. *Ann Am Acad Pol Soc Sci.* 2015 7 1;660(1):78–97. Epub 2019 Jun 9. 10.1177/0002716215576104
9. Williams DR, Collins C. Racial residential segregation: a fundamental cause of racial disparities in health. *Public Health Rep.* 2001 Sep-Oct;116(5):404–16. 10.1093/phr/116.5.404 [PubMed: 12042604]
10. Massey DS. Residential segregation and neighborhood conditions in U.S. metropolitan areas. In: National Research Council. *America becoming: racial trends and their consequences* (vol.1). Washington, DC: The National Academies Press, 2001:391–434. Available at: <https://www.nap.edu/read/9599/chapter/14>.
11. LaVeist TA, Thorpe RJ Jr, Mance GA, et al. Overcoming confounding of race with socio-economic status and segregation to explore race disparities in smoking. *Addiction.* 2007 10;102 Suppl 2:65–70. 10.1111/j.1360-0443.2007.01956.x [PubMed: 17850615]
12. Boykin S, Diez-Roux A, Carnethon M, et al. Racial/ethnic heterogeneity in the socioeconomic patterning of CVD risk factors: in the United States: the multi-ethnic study of atherosclerosis. *J Health Care Poor Underserved.* 2011 2;22(1):111–27. [PubMed: 21317510]
13. Braveman PA, Cubbin C, Egerter S, et al. Socioeconomic disparities in health in the United States: what the patterns tell us. *Am J Public Health.* 2010 4; 100 Suppl 1:S186–96. Epub 2010 Feb 10. 10.2105/AJPH.2009.166082 [PubMed: 20147693]
14. Lopez RP. Neighborhood risk factors for obesity. *Obesity (Silver Spring).* 2007 8;15(8):2111–9. 10.1038/oby.2007.251 [PubMed: 17712130]
15. Morland K, Diez Roux AV, Wing S. Supermarkets, other food stores, and obesity: the atherosclerosis risk in communities study. *Am J Prev Med.* 2006 4;30(4):333–9. 10.1016/j.amepre.2005.11.003 [PubMed: 16530621]
16. Rundle A, Neckerman KM, Freeman L, et al. Neighborhood food environment and walkability predict obesity in New York City. *Environ Health Perspect.* 2009 3;117(3):442–7. Epub 2008 Oct 2. 10.1289/ehp.11590 [PubMed: 19337520]
17. Bower KM, Thorpe RJ, Rohde C, et al. The intersection of neighborhood racial segregation, poverty, and urbanicity and its impact on food store availability in the United States. *Prev Med.* 2014 1;58:33–9. 10.1016/j.ypmed.2013.10.010 [PubMed: 24161713]
18. Powell LM, Slater S, Mirtcheva D, et al. Food store availability and neighborhood characteristics in the United States. *Prev Med.* 2007 3;44(3):189–95. Epub 2006 Sep 25. 10.1016/j.ypmed.2006.08.008 [PubMed: 16997358]
19. Moore LV, Diez Roux AV, Evenson KR, et al. Availability of recreational resources in minority and low socioeconomic status areas. *Am J Prev Med.* 2008 1;34(1):16–22. 10.1016/j.amepre.2007.09.021 [PubMed: 18083446]
20. Bower KM, Thorpe RJ, Yenokyan G, et al. Racial residential segregation and disparities in obesity among women. *J Urban Heal.* 2015 10;92(5):843–52. 10.1007/s11524-015-9974-z
21. Chang VW. Racial residential segregation and weight status among US adults. *Soc Sci Med.* 2006 9;63(5):1289–303. 10.1016/j.socscimed.2006.03.049 [PubMed: 16707199]
22. Williams DR, Collins C. U. S. socioeconomic and racial differences in health: patterns and explanations. *Annu Rev Sociol.* 1995;21:349–86. 10.1146/annurev.so.21.080195.002025
23. Kwarteng JL, Schulz AJ, Mentz GB, et al. Independent effects of neighborhood poverty and psychosocial stress on obesity over time. *J Urban Health.* 2017 12;94(6): 791–802. 10.1007/s11524-017-0193-7 [PubMed: 28895036]

24. Boardman JD, Saint Onge JM, Rogers RG, et al. Race differentials in obesity: the impact of place. *J Health Soc Behav.* 2005 9;46(3):229–43. 10.1177/002214650504600302 [PubMed: 16259146]
25. Navarro V Race or class versus race and class: mortality differentials in the United States. *Lancet.* 1990 11 17;336(8725):1238–40. 10.1016/0140-6736(90)92846-A [PubMed: 1978083]
26. Kaufman JS, Cooper RS, McGee DL. Socioeconomic status and health in Blacks and Whites: the problem of residual confounding and the resiliency of race. *Epidemiology.* 1997 11;8(6):621–8. 10.1097/00001648-199711000-00006 [PubMed: 9345660]
27. National Centers for Health Statistics. National Health and Nutrition Examination Survey. Atlanta, GA: Center for Disease Control and Prevention, 2019 Available at: <https://www.cdc.gov/nchs/nhanes/index.htm>.
28. United States Census Bureau. Census 2000: summary file 1. Washington, DC: U.S. Census Bureau, 2018 Available at: <https://www.census.gov/census2000/sumfile1.html>.
29. Yusuf PS, Hawken S, Ounpuu S, et al. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. *Lancet.* 2004 9 11–17;364(99438):937–52. 10.1016/S0140-6736(04)17018-9 [PubMed: 15364185]
30. Lofgren I, Herron K, Zern T, et al. Waist circumference is a better predictor than body mass index of coronary heart disease risk in overweight premenopausal women. *J Nutr.* 2004 5;134(5):1071–6. 10.1093/jn/134.5.1071 [PubMed: 15113947]
31. Suk SH, Sacco RL, Boden-Albala B, et al. Abdominal obesity and risk of ischemic stroke: The Northern Manhattan Stroke Study. *Stroke.* 2003 7;34(7):1586–92. Epub 2003 May 29. 10.1161/01.STR.0000075294.98582.2F [PubMed: 12775882]
32. Folsom AR, Kushi LH, Anderson KE, et al. Associations of general and abdominal obesity with multiple health outcomes in older women: the Iowa Women's Health Study. *Arch Intern Med.* 2000 7 24;160(14):2117–28. 10.1001/archinte.160.14.2117 [PubMed: 10904454]
33. Warren T, Wilcox S, Dowda M, et al. Independent association of waist circumference with hypertension and diabetes in African American women, South Carolina, 2007–2009. *Prev Chronic Dis.* 2012;9:E105 Epub 2012 May 24. 10.5888/pcd9.110170 [PubMed: 22632742]
34. Katzmarzyk PT, Craig CL. Independent effects of waist circumference and physical activity on all-cause mortality in Canadian women. *Appl Physiol Nutr Metab.* 2006 6;31(3):271–6. 10.1139/h05-038 [PubMed: 16770355]
35. Koster A, Leitzmann MF, Schatzkin A, et al. Waist circumference and mortality. *Am J Epidemiol.* 2008 6 15;167(12):1465–75. Epub 2008 Apr 15. 10.1093/aje/kwn079 [PubMed: 18417494]
36. Hu FB. Adiposity as compared with physical activity in predicting mortality among women. *N Engl J Med.* 2004 12 23;351(26):2694–703. 10.1056/NEJMoa042135 [PubMed: 15616204]
37. Ashwell M, Gunn P, Gibson S. Waist-to-height ratio is a better screening tool than waist circumference and BMI for adult cardiometabolic risk factors: systematic review and meta-analysis. *Obes Rev.* 2012 3;13(3):275–86. 10.1111/j.1467-789X.2011.00952.x [PubMed: 22106927]
38. National Institutes of Health (NIH), National Heart, Lung and Blood Institute (NHLBI). Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults—The Evidence Report. *Obes Res.* 1998 9;6 Suppl 2:51S–209S. [PubMed: 9813653]
39. Rennie D Consensus statements. *N Engl J Med.* 1981 3 12;304:665–6. 10.1056/NEJM198103123041110 [PubMed: 6969852]
40. National Institute of Health (NIH). Guidelines on overweight and obesity:electronic textbook. Bethesda, MD: National Heart, Lung, and Blood Institute, 2006 Available at: https://www.nhlbi.nih.gov/health-pro/guidelines/current/obesity-guidelines/e_textbook/txgd/4142.htm.
41. Gaskin DJ, Thorpe RJ, McGinty EE, et al. Disparities in diabetes: the nexus of race, poverty, and place. *Am J Public Health.* 2014 11;104(11):2147–55. Epub 2013 Nov 14. 10.2105/AJPH.2013.301420 [PubMed: 24228660]
42. Zou G A modified poisson regression approach to prospective studies with binary data. *Am J Epidemiol.* 2004 4 1;159(7):706–6. 10.1093/aje/kwh090
43. National Center for Health Statistics. NHANES Survey Methods and Analytic Guidelines. Atlanta, GA: CDC, 2018 Available at: <https://www.cdc.gov/nchs/nhanes/analyticguidelines.aspx>.

44. Bleich SN, Thorpe RJ Jr, Sharif-Harris H, et al. Social context explains race disparities in obesity among women. *J Epidemiol Community Health*. 2010 5;64(5):465–9. 10.1136/jech.2009.096297
45. Suglia SF, Shelton RC, Hsiao A, et al. Why the neighborhood social environment is critical in obesity prevention. *J Urban Health*. 2016 2;93(1):206–12. 10.1007/s11524-015-0017-6 [PubMed: 26780582]
46. McFarland MJ, Taylor J, McFarland CAS. Weighed down by discriminatory policing: perceived unfair treatment and black-white disparities in waist circumference. *SSM Popul Health*. 2018 7 21;5:210–17. 10.1016/j.ssmph.2018.07.002 [PubMed: 30094316]
47. Hummer RA. Black-White differences in health and mortality: a review and conceptual model. *Sociol Q*. 1996 Winter;37(1):105–25. 10.1111/j.1533-8525.1996.tb02333.x
48. Adler NE, Boyce WT, Chesney MA, et al. Socioeconomic inequalities in health. No easy solution. *JAMA*. 1993 6 23–30;269(24):3140–5. 10.1001/jama.269.24.3140 [PubMed: 8505817]
49. Prather C, Fuller TR, Jeffries WL 4th, et al. Racism, African American women, and their sexual and reproductive health: a review of historical and contemporary evidence and implications for health equity. *Health Equity*. 2018 9 24;2(1):249–59. 10.1089/heq.2017.0045 [PubMed: 30283874]
50. McEwen BS. Stress, adaptation, and disease. Allostasis and allostatic load. *Ann N Y Acad Sci*. 1998 5 1;840:33–44. 10.1111/j.1749-6632.1998.tb09546.x [PubMed: 9629234]
51. Wardle J, Chida Y, Gibson EL, et al. Stress and adiposity: a meta-analysis of longitudinal studies. *Obesity (Silver Spring)*. 2011 4;19(4):771–8. Epub 2010 Oct 14. 10.1038/oby.2010.241 [PubMed: 20948519]
52. Schuler PB, Vinci D, Isoaari RM, et al. Body-shape perceptions and body mass index of older African American and European American women. *J Cross Cult Gerontol*. 2008 9;23(3):255–64. Epub 2008 Apr 1. 10.1007/s10823-008-9061-y [PubMed: 18379865]
53. Smith DE, Thompson JK, Raczyński JM, et al. Body image among men and women in a biracial cohort: the CARDIA Study. *Int J Eat Disord*. 1999 1;25(1):71–82. 10.1002/(SICI)1098-108X(199901)25:1<71::AID-EAT9>3.3.CO;2-V [PubMed: 9924655]
54. Lynch EB, Kane J. Body size perception among African American women. *J Nutr Educ Behav*. 2014 Sep-Oct;46(5):412–7. 10.1016/j.jneb.2014.03.002 [PubMed: 25220776]
55. Ogden CL, Carroll MD, Fryar CD, et al. Prevalence of obesity among adults and youth: United States, 2011–2014. *NCHS Data Brief*. 2015 11;(219):1–8.

Table 1.

SELECTED POPULATION CHARACTERISTICS BY RACE AND UNADJUSTED RISK RATIOS OF ABDOMINAL OBESITY AMONG NON-HISPANIC BLACK AND WHITE WOMEN AGED 24 YEARS AND OLDER: 1999–2004 NATIONAL HEALTH AND NUTRITION EXAMINATION SURVEY AND 2000 U.S. CENSUS^a

	Total	Black Women	White Women	Poisson Regression Coefficient (95% CI) ²
Unweighted N	4,851	679	4,172	
Waist Circumference ^b				
Normal	22%	14%	23%	
Obese	78%	86%	77%	
Race				
Black	14%			1.13 (1.08, 1.17)
White	86%			Ref
Age				
24–34	19%	24%	18%	Ref
35–44	23%	27%	22%	1.09 (1.01, 1.17)
45–54	22%	21%	22%	1.16 (1.07, 1.25)
55–64	14%	13%	14%	1.26 (1.16, 1.36)
65+	22%	15%	23%	1.30 (1.20, 1.40)
Education				
<9 th grade	27%	24%	28%	1.08 (1.03, 1.14)
9 th –12 th grade, no diploma	13%	26%	11%	1.08 (1.03, 1.13)
High school graduate	38%	6.2%	3.8%	Ref
Some college	32%	30%	32%	.99 (.95, 1.04)
college graduate	24%	13%	26%	.86 (.81, 0.91)
Individual poverty ^c				
400% FPL	36%	17%	39%	Ref
300%–399%	13%	9.9%	14%	1.05 (.98, 1.12)
200%–299%	16%	16%	16%	1.10 (1.04, 1.16)
100%–199% FPL	21%	28%	20%	1.11 (1.05, 1.16)
Below FPL	13%	29%	11%	1.05 (.98, 1.11)
Neighborhood poverty ^d				
Non-poor neighborhood	83%	46%	89%	Ref
Poor neighborhood	16%	53%	11%	1.04 (1.00, 1.09)
Neighborhood racial composition ^e				
White neighborhood	76%	21%	85%	Ref
Black neighborhood	6.7%	44%	0.56%	1.11 (1.05, 1.18)
Other race neighborhood	1.9%	2.5%	1.8%	.97 (.86, 1.08)
Integrated neighborhood	15%	32%	12%	.99 (.93, 1.05)
Race-place ^f				

	Total	Black Women	White Women	Poisson Regression Coefficient (95% CI) ²
White in White neighborhood	73%			Ref
White in Black neighborhood	.47%			.90 (.60, 1.35)
White in other race neighborhood	2%			.94 (.82, 1.07)
White in integrated neighborhood	11%			.95 (.88, 1.02)
Black in Black neighborhood	6%			1.14 (1.08, 1.20)
Black in White Neighborhood	3%			1.11 (1.04, 1.19)
Black in other race neighborhood	.34%			1.12 (.94, 1.34)
Black in integrated neighborhood	4%			1.10 (1.04, 1.16)
Poverty-Place ^g				
Non-poor in non-poor neighborhood	60%	26%	65%	Ref
Poor in non-poor neighborhood	24%	21%	24%	1.04 (1.00, 1.09)
Non-poor in poor neighborhood	6%	17%	4%	1.04 (.97, 1.12)
Poor in poor neighborhood	10%	36%	6%	1.06 (1.01, 1.12)
Race-Poverty-Place ^h				
Non-poor White in non-poor neighborhood	56%			Ref
Non-poor White in poor neighborhood	3.7%			.96 (.87, 1.06)
Poor White in non-poor neighborhood	21%			1.04 (.99, 1.08)
Poor White in poor neighborhood	5.3%			1.00 (.90, 1.20)
Non-poor Black in non-poor neighborhood	3.6%			1.08 (1.02, 1.14)
Non-poor Black in poor neighborhood	2.3%			1.19 (1.13, 1.25)
Poor Black in non-poor neighborhood	2.8%			1.14 (1.08, 1.20)
Poor Black in poor neighborhood	4.8%			1.15 (1.09, 1.22)

Notes:

^aSampling weights were used to represent the non-institutionalized United States Population. Data are presented as weighted %

^bWaist circumference = 0 if less than or equal to 80 cm; =1 if greater than 80 cm

^cMeasured as household income to poverty ratio

^dNeighborhood poverty was classified as poor if at least 20% of the residents had a household income of less than 200% of the FPL and non-poor if fewer than 20% of residents met this income threshold

^eNeighborhood racial composition was classified as predominantly Black, predominantly White, or predominantly other if the census tract was comprised of at least 65% Black, White or other racial groups, respectively, and classified as integrated if there were less than 65% of any one racial group

^fThe race-place variable combined the individual race variable (Black or White) and neighborhood racial composition variable (Black, White, other or integrated)

^gThe poverty-place variable combined the binary neighborhood poverty variable (poor or non-poor) and the binary individual poverty variable

^hThe race-poverty-place variable combined the individual race variable (Black or White), the individual poverty variable (poor or non-poor), and the neighborhood poverty variable (poor or non-poor).

FPL= federal poverty threshold limit

Table 2.

ESTIMATED POISSON REGRESSION COEFFICIENT OF ABDOMINAL OBESITY BY RACE, CONCENTRATED POVERTY, AND RACIAL COMPOSITION OF NEIGHBORHOOD: 1999–2004 NATIONAL HEALTH AND NUTRITION EXAMINATION SURVEY AND 2000 U.S. CENSUS, SUBPOPULATION OF NON-HISPANIC BLACK AND WHITE WOMEN AGED 24 YEARS AND OLDER, N=4025^a

	Base Model Poisson Regression Coefficient ^b (95% CI)	Race-Place Model Poisson Regression Coefficient ^b (95% CI)	Poverty-Place Model Poisson Regression Coefficient ^b (95% CI)	Race-Poverty-Place Model Poisson Regression Coefficient ^b (95% CI)
Individual race				
White	Ref		Ref	
Black	1.14 (1.08, 1.20)		1.14 (1.09, 1.20)	
Individual poverty ^c				
400% FPL	Ref	Ref		
300%–399%	1.02 (.95, 1.10)	1.02 (.95, 1.10)		
200%–299%	1.06 (.99, 1.12)	1.06 (1.00, 1.12)		
100%–199% FPL	1.06 (1.01, 1.13)	1.07 (1.01, 1.13)		
Below FPL	1.03 (.96, 1.10)	1.03 (.96, 1.10)		
Neighborhood poverty ^d				
Non-poor neighborhood	Ref	Ref		
Poor neighborhood	.97 (.90, 1.04)	.97 (.91–1.04)		
Neighborhood racial composition ^e				
White neighborhood	Ref			
Black neighborhood	1.01 (.94, 1.08)			
Other race neighborhood	.96 (.84, 1.08)			
Integrated neighborhood	1.00 (.93, 1.07)			
Race-Place ^f				
White in White neighborhood		Ref		
White in Black neighborhood		1.14 (.99, 1.31)		
White in other neighborhood		.96 (.83, 1.11)		
White in integrated neighborhood		.99 (.92, 1.08)		
Black in Black neighborhood		1.14 (1.07, 1.22)		

	Base Model Poisson Regression Coefficient ^b (95% CI)	Race-Place Model Poisson Regression Coefficient ^b (95% CI)	Poverty-Place Model Poisson Regression Coefficient ^b (95% CI)	Race-Poverty-Place Model Poisson Regression Coefficient ^b (95% CI)
Black in White neighborhood		1.14 (1.08, 1.21)		
Black in other race neighborhood		1.07 (.90, 1.28)		
Black in integrated neighborhood		1.14 (1.07, 1.22)		
Poverty-Place ^g		1.14 (1.07, 1.22)		
Non-poor (>200% FPL) in non-poor neighborhood			Ref	
Poor (0–199%) in non-poor neighborhood			1.03 (.99, 1.07)	
Non-poor (>200% FPL) in poor neighborhood			.97 (.90, 1.05)	
Poor (0–199% of FPL) in poor neighborhood			1.00 (.93, 1.07)	
Race-Poverty-Place ^h				Ref
Non-poor White in non-poor neighborhood				.93 (.84, 1.04)
Non-poor White in poor neighborhood				1.02 (.98, 1.07)
Poor White in non-poor neighborhood				1.01 (.91, 1.11)
Poor White in poor neighborhood				1.11 (1.04, 1.17)
Non-poor Black in non-poor neighborhood				1.16 (1.10, 1.22)
Non-poor Black in poor neighborhood				1.19 (1.13, 1.26)
Poor Black in non-poor neighborhood				1.13 (1.07, 1.20)

Notes:

^aSampling weights were used to represent the non-institutionalized U.S. population.^bAll regression models controlled for age and education level^cMeasured as household income to poverty ratio^dNeighborhood poverty was classified as poor if at least 20% of the residents had a household income of less than 200% of the FPL and non-poor if fewer than 20% of residents met this income threshold^eNeighborhood racial composition was classified as predominantly Black, predominantly White, or predominantly other if the census tract was comprised of at least 65% Black, White or other racial groups, respectively, and classified as integrated if there were less than 65% of any one racial group^fThe race-place variable combined the individual race variable (Black or White) and neighborhood racial composition variable (Black, White, other or integrated)^gThe poverty-place variable combined the binary neighborhood poverty variable (poor or non-poor) and the binary individual poverty variable^hThe race-poverty-place variable combined the individual race variable (Black or White), the individual poverty variable (poor or non-poor), and the neighborhood poverty variable (poor or non-poor).

FPL = federal poverty threshold limit

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript