The Association Between Perceived Discrimination and BMI Trajectory

A Prospective Study of African American and White Adults

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Evidence suggests that socioenvironmental stressors, such as discrimination, may serve as determinants of the ongoing obesity epidemic and persisting disparities in obesity prevalence. The objectives of these analyses were to examine whether perceived discrimination was associated with body mass index (BMI) trajectory and whether this relationship differed by race or sex. Data for these analyses came from the Healthy Aging in Neighborhoods of Diversity across the Life Span study, a prospective cohort study in Baltimore City. Mixed-effects linear regression was used in a sample of 1962 African American and white adults to test our hypotheses. We found that race was an effect modifier in the relationship between perceived discrimination and BMI trajectory ($B = 0.063$, $P = .014$). Specifically, higher baseline perceived discrimination was associated with positive BMI trajectory in African American adults ($B = 0.031$, $P = .033$) but not in white adults ($B = -0.032$ $P = .128$). In this longitudinal study of African American and white adults, the relationship between perceived discrimination and BMI trajectory differed by race. Future research should be conducted in diverse samples to understand the risk socioenvironmental stressors pose on the development and progression of overweight and obesity, in addition to how these differ in subgroups.

Key words: BMI, discrimination, disparities, obesity

MORE THAN 70% of US adults have a body mass index (BMI) that is considered overweight or obese.[1] The prevalence of overweight and obesity is significantly greater in non-Hispanic Blacks than in non-Hispanic whites, and non-Hispanic Black females compared with non-Hispanic Black males.[1] As a risk factor for cardiovascular disease and several other chronic diseases and conditions,[2] overweight and obesity burden more than two-thirds of the US population with poorer quality of life and increased medical costs.[3] To address the enduring obesity crisis, and the disparities within it, an ecological approach has been utilized to comprehensively understand the determinants.[4-8] In doing so, socioenvironmental stressors, such as discrimination, have been recognized as potential crucial components of risk for overweight and obesity.

Specifically, discrimination, or the unjust treatment of a category of people,[9] is associated positively with obesity,[10-12] increased BMI,[13-18] increased weight gain,[19,20] increased waist circumference,[14,15,18,20,21] increased central adiposity,[22] and increased amount of visceral fat.[23] However, these findings are largely limited to cross-sectional studies and therefore the effect over time is less understood.[10,11,13-17,23] Moreover, of the studies that have evaluated the longitudinal relationship between discrimination and weight or adiposity, the majority have focused on a specific type of discrimination, such as weight or race-based discrimination.[12,18-20] This limits our ability to understand how the cumulative experiences of discrimination from multiple sources, such as gender, age, disability status, and sexuality, may affect weight. Given that a 5% to 10% body weight loss/gain changes risk for several diseases despite current weight status,[24] and that discrimination can be experienced from multiple sources, understanding how perceived discrimination affects weight change overtime may help us better understand possible targets for intervention to improve health outcomes.

Provided the known disparities in overweight and obesity,[1] it is also important to understand how the discrimination and weight relationship may vary

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H.N.M. was supported by NINR T32NR012704. R.J.T. was supported by the National Institute on Aging (K02AG059140) and the National Institute on Minority Health and Health Disparities (U54MD000214). HANDLS was supported entirely by the Intramural Research Program of the National Institutes of Health, National Institute on Aging (Z01-AG000513).

The authors have no relevant disclosures to declare.

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DOI: 10.1097/FCH.0000000000000326

by demographic characteristics. However, there is a scarce literature on how perceived discrimination may contribute to weight change over time differently between men and women and between whites and African Americans. Many previous studies examined included only one sex or one race.[12,19,20,25]

The purpose of these analyses was to examine whether perceived discrimination was associated with BMI trajectory and whether this relationship differed by race or sex. We hypothesized that perceived discrimination was associated with BMI trajectory and that these relationships would differ by race and sex.

METHODS

Sample

Data for these analyses came from the Healthy Aging in Neighborhoods of Diversity across the Life Span (HANDLS) study.[26] The HANDLS study is an ongoing prospective cohort study examining the effects of race and socioeconomic-based disparities on cardiovascular and cognitive health in African American and white adults living in Baltimore City. Area probability sampling, based on the 2000 census data, was utilized in 13 predetermined neighborhoods in Baltimore City to obtain a socioeconomically diverse sample of African American and white adults aged 30 to 64 years. Details of the HANDLS recruitment and sampling strategies were reported previously.[26] In brief, trained research staff went door to door to randomly selected households between 2004 and 2009 to determine eligibility and invite residents to participate in the study. Individuals were excluded from the study if they were pregnant at the time of recruitment or received cancer treatment (eg, chemotherapy, radiation therapy) in the 6 months prior to recruitment. If eligible and interested, informed consent was obtained, and participants were administered a household and nutritional survey (phase 1 of data collection at baseline). The second phase of baseline data collection occurred in mobile research vehicles parked in participants' neighborhoods, in which medical history was collected and physical examinations took place. A total of 2802 participants completed both phases of baseline recruitment. The current analysis utilized data collected over 13 years from baseline (2004-2009) and follow-up periods that occurred between 2009 and 2013 (time 2) and 2013 and 2017 (time 3). Follow-ups did not occur in the same order that baseline assessments occurred and therefore time between follow-ups varies by individual and time. For example, participant A could have had his or her baseline visit in 2004 and first follow-up (time 2) visit in 2013, while participant B could have had his or her baseline visit in 2008 and first follow-up (time 2) visit in 2011. To more accurately estimate the BMI trajectory, we required individuals to have a BMI at both the baseline visit and final time point (time 3), resulting in an analytic sample of 1962 adults. There were no additional inclusion or exclusion criteria for this analysis.

Measurement

BMI

Height and weight were measured at baseline and each follow-up by trained research staff. BMI was derived by dividing weight in kilograms by height in meters squared (kg/m^2).

Perceived discrimination

Perceived discrimination was measured at baseline using a 9-item instrument with Likert-style responses.[27] Individuals were asked the following: (1) How often are you treated with less courtesy than others? (2) How often are you treated with less respect than others? (3) How often do you receive poorer service than others in restaurants or stores? (4) How often do people act like you are not smart? (5) How often do people act as they are better than you? (6) How often do you people act as they are afraid of you? (7) How often do people act as you are dishonest? (8) How often do people call you names or insult you? (9) How often do people threaten or harass you? The instrument did not ask the participant to identify the source of discrimination, such as race, sex, disability, or age. The Likert-style responses were as follows: almost every day (1), at least once a week than (2), a few times a month (3), a few times a year (4), once a year (5), and never (6). The responses were reverse scored and averaged to obtain a perceived discrimination score ranging from 1 to 6, with a higher score indicating greater frequency of discrimination. The total score was computed if at least 7 of the 9 items were complete (N = 1913; 98%). The scale demonstrated strong internal consistency reliability in this sample, with a Cronbach α of 0.84.

Time

Time was calculated on the basis of the number of years between data collection visits. The baseline visit was coded as 0 years. The possible range of times was 0 to 13 years.

Sociodemographic and health-related characteristics

We examined several self-reported sociodemographic and health-related characteristics that have previously been found to be associated with BMI as potential covariates. These included race, sex, age,

poverty status, education, alcohol use, cigarette use, and depression.

Sex and race were documented at a person's baseline visit for which binary variables were created (sex: 0 = women, 1 = men; race: 0 = white, 1 = African American). Poverty status (0 = above, 1 = below) was determined on the basis of the household income and the 125% poverty threshold. Education level (0 = high school or more, 1 = less than high school) was determined by asking the participant the number of years of school he or she had completed. Alcohol use and cigarette use were treated as binary variables (0 = never/former, 1 = current). Depression symptomatology level was scored using the 20-item Center for Epidemiologic Studies Depression Scale (CES-D).[28] Responses were Likert style, ranging from rarely or none of the time (0) to most or all of the time (3). The responses across items were averaged and then multiplied by 20 to obtain a depression symptomatology score ranging from 0 to 60, with a higher score indicating greater depressive symptoms. A cutoff of 16 was used to indicate the presence of clinically significant depression.[28] In order for the score to be computed, we required individuals to have a response documented for at least 15 of the 20 items (N = 1903; 96%).

Analytic strategy

Baseline characteristics between individuals included and excluded from the final analytic sample were compared using chi-square tests for categorical variables and *t* tests for continuous variables. In addition, baseline characteristics for African American and white individuals included in the final analytic sample were compared using chi-square tests for categorical variables and *t* tests for continuous variables. Missing data were handled via multiple imputation. A total of 20 imputed data sets were estimated. All variables, including the outcome variable, were utilized in the multiple imputation. To examine the relationship between perceived discrimination and BMI trajectory, and whether this relationship differed by race or sex, linear mixed-effects regression was utilized. A total of 6 mixed-effects models were estimated, with BMI as the outcome of interest. To establish whether a significant change in BMI was present in this sample, model 1 examined the relationship between time (in years) and BMI trajectory, controlling for relevant covariates. Model 2 expanded model 1 by including perceived discrimination and the time (in years) by perceived discrimination interaction. The time and perceived discrimination interaction tested whether BMI trajectory varied across levels of baseline perceived discrimination. Models 3 and 4 tested sex and race as moderators in the relationship between perceived discrimination and BMI trajectory, respectively. This was done by including a 3-way interaction term in each model. Model 3 included the time × perceived discrimination × sex interaction term, and model 4 included the time × perceived discrimination × race interaction term. Both models also included all relevant covariates. To facilitate the interpretation, we stratified the analyses by race because the time × perceived discrimination × race interaction was significant. These models, model 5 and 6, were model 2 stratified by white and African American adults, respectively.

Covariates were included in the models if they were significantly associated with BMI trajectory in bivariate analyses. These included age, alcohol use, and cigarette use, which were treated as time-varying covariates, and sex and poverty status at baseline, which were treated as fixed covariates.

All analyses were performed using STATA statistical software, version 15. *P* values of less than .05 were considered statistically significant and all tests were 2 tailed.

RESULTS

The individuals from the original HANDLS study meeting the inclusion criteria for this analysis (N = 1962) did not differ from those of individuals excluded from the final analytic sample (N = 840) in terms of baseline BMI, discrimination, race, or alcohol use. They did differ, however, in sex, age, poverty status, education level, cigarette use, and depression. Compared with those excluded, the analytic sample included more women (59% vs 50%, $P < .000$), had a lower baseline mean age (48 years vs 50 years, $P < .001$), had fewer individuals below poverty status (39% vs 45%, $P = .002$), had fewer individuals with less than high school education (32% vs 35%, $P = .039$), had fewer current cigarette users (47% vs 53%, $P = .002$), and had lower depression symptomatology scores (14.81 vs 15.16, $P = .019$).

Table 1 details the sample's baseline characteristics by race. The average age at baseline was 48.01 (SD = 9.01) years. The majority of the sample was female (59%) and African American (59%). The average BMI at baseline was 30.17 (SD = 7.70). The average discrimination score was 2.28 (SD = 0.92), indicating that individuals felt discriminated against less than once a year to a few times a year. In the total sample, 39% of individuals were below poverty status, and 32% of individuals had less than a high school education. In addition, 59% of the sample comprised current alcohol users, and 47% of the sample included current cigarette users. Finally, the average depression score was 14.81 (SD = 11.39), indicating no presence of clinically significant

TABLE 1. Select Baseline Demographic Characteristics of 1962 White and African American Adults in the HANDLS Cohort

Characteristic	Total (N = 1962)	White (N = 800)	African American (N = 1162)
BMI, $M \pm$ SD	30.17 ± 7.70	30.18 ± 7.57	30.16 ± 7.8
Discrimination score, $M \pm$ SD	2.28 ± 0.92	2.18 ± 0.89	2.34 ± 0.94*
Demographic			
Female, %	59	59	59
Age, $M \pm$ SD	48.01 ± 9.01	48.40 ± 8.92	47.73 ± 9.07
Socioeconomic			
Below poverty status, %	39	32	44*
Less than HS education, %	32	33	31
Health related			
Current alcohol use, %	59	60	58
Current cigarette use, %	47	44	49
Depression, $M \pm$ SD	14.81 ± 11.39	15.20 ± 11.69	14.53 ± 11.17

Abbreviations: BMI, body mass index; HANDLS, Healthy Aging in Neighborhoods of Diversity across the Life Span; HS, high school.
*$P < .05$.

depression. Whites and African Americans in this sample did not differ on baseline BMI, sex, age, education level, current alcohol use, current cigarette use, or depression. However, African Americans had a significantly higher amount of perceived discrimination than their white counterparts ($P < .001$). In addition, there were significantly more African Americans below poverty status at baseline than whites in this sample ($P < .001$).

The mixed linear regression model results are displayed in Table 2. Controlling for relevant covariates, there was a significant effect of time on BMI in model 1 ($B = .063$, $P = .003$), indicating that BMI significantly increased over time in this sample. The main hypotheses were tested in models 2 to 4, where model 2 tested the relationship between perceived discrimination and BMI trajectory and models 3 and 4 tested whether this relationship differed by sex or race. In model 2, the perceived discrimination × time interaction was not significant, indicating that baseline levels of perceived discrimination were not associated with BMI trajectory in the full sample. The 3-way interaction term between sex, discrimination, and time tested in model 3 was not significant ($B = -0.009$, $P = .717$), indicating the relationship between perceived discrimination and BMI trajectory did not differ by sex. However, the 3-way interaction term between race, discrimination, and time tested in model 4 was significant ($B = 0.063$, $P = .014$), suggesting that the relationship between perceived discrimination and BMI trajectory differed by race. To further explore these differences, the association between discrimination and BMI trajectory was stratified by race in Table 3. The discrimination × time interaction was significantly associated with BMI in African Americans ($B = 0.031$, $P = .033$). Specifically, increased levels of discrimination at baseline were associated with an increase in BMI trajectory in African Americans. This finding was not significant for white individuals ($B = -0.033$, $P = .128$).

DISCUSSION

Understanding socioenvironmental determinants of weight gain is crucial in establishing meaningful interventions to combat the current obesity epidemic and decrease the risk of subsequent poor health outcomes earlier on in disease progression. The objective of this article was to examine the relationship between perceived discrimination and BMI trajectory and whether and how this relationship differed by race and sex. In this analysis of Baltimore City adults, we found that the relationship between perceived discrimination and BMI trajectory differed by race. Specifically, we found a positive association between baseline perceived discrimination and BMI trajectory in African American adults but not in white adults. Contrary to our hypotheses, we did not find that the relationship between perceived discrimination and BMI trajectory differed by sex. These results demonstrate the importance of understanding how socioenvironmental stressors, namely, discrimination, contribute to obesity, in addition to the disparities observed in obesity prevalence.

For African Americans, reporting a higher baseline perceived discrimination was associated with a

TABLE 2. Association Between Discrimination and BMI Trajectory in the HANDLS Cohort (N = 1962)[a]

	Model 1	Model 2	Model 3	Model 4
Time	0.063 (.003)	0.112 (.067)	0.149 (.072)	– 0.093 (.376)
Discrimination	. . .	0.214 (.243)	0.165 (.508)	0.933 (.002)
Time × Discrimination	. . .	0.011 (.384)	0.016 (.336)	– 0.031 (.134)
Time × Discrimination × Race				
African American	. . .	. . .	. . .	0.063 (.014)
Time × Discrimination × Sex				
Male	. . .	. . .	– 0.009 (.717)	. . .
Sex				
Male	– 3.114 (.000)	– 3.155 (.000)	– 2.624 (.133)	– 3.110 (.000)
Age	0.015 (.397)	0.019 (.296)	0.019 (.295)	0.020 (.271)
Poverty status				
Below	– 0.708 (.037)	– 0.729 (.032)	– 0.729 (.032)	– 0.727 (.033)
Alcohol use				
Current user	– 0.266 (.038)	– 0.282 (.029)	– 0.283 (.028)	– 0.271 (.036)
Cigarette use				
Current user	– 1.302 (.000)	– 1.327 (.000)	– 1.325 (.000)	– 1.334 (.000)

Abbreviations: BMI, body mass index; HANDLS, Healthy Aging in Neighborhoods of Diversity across the Life Span.
[a]The values given are *B* (*P* value).

greater increase in BMI over the follow-up period (an average of 9 years). This finding is consistent with previous literature that has reported a significant, positive relationship between major lifetime discrimination and obesity in African American men[11] and perceived discrimination and BMI in African American adults.[14] It is also consistent with previous literature that has demonstrated associations between everyday and lifetime racism and increased weight change, waist circumference, and incidence of obesity in African American women.[12,19] These studies did not include white

TABLE 3. Association Between Discrimination and BMI Trajectory by Race in the HANDLS Cohort (N = 1962)[a]

	White (Model 5)	African American (Model 6)
Time	– 0.150 (.168)	0.249 (.001)
Discrimination	0.961 (.001)	– 0.186 (.416)
Time × Discrimination	– 0.032 (.128)	0.031 (.033)
Sex		
Male	– 1.634 (.002)	– 4.132 (.000)
Age	0.075 (.012)	– 0.021 (.360)
Poverty status		
Below	0.858 (.122)	– 1.795 (.000)
Alcohol use		
Current user	– 0.372 (.039)	– 0.179 (.300)
Cigarette use		
Current user	– 0.996 (.000)	– 1.521 (.000)

Abbreviations: BMI, body mass index; HANDLS, Healthy Aging in Neighborhoods of Diversity across the Life Span.
[a]The values given are *B* (*P* value).

adults in their samples and therefore we are unable to compare our finding that the relationship between discrimination and BMI trajectory differed by race. One reason for this finding might be due to difference in stress response; previous literature has indicated that relationship between a stressor, such as discrimination, and a person's neuroendocrine and physiological stress response may be moderated by race.[29-31] Moreover, our results indicated that African American adults experienced significantly more discrimination than white adults at baseline.

In studies that have examined the moderating role of race in the relationship between perceived discrimination and obesity, results have varied. In one recent study, authors found that at average levels of perceived discrimination, US-born non-Hispanic Blacks had a decreased risk of being obese compared with US-born non-Hispanic whites.[32] A separate study found that perceived discrimination was associated with high-risk waist circumference in ethnic whites (Jewish, Polish, Irish, and Italian) but not in other whites or African Americans.[10] Finally, a study investigating the relationships between racial/ethnic discrimination and changes in waist circumference and BMI found that an increase in self-reported racial/ethnic discrimination was associated with increases in waist circumference and BMI overtime in Black women but in not Black men or white women or men.[18]

These differences in findings could be due to several factors. First, among the studies discussed earlier, adiposity and/or obesity were operationalized differently. Specifically, 3 studies discussed earlier included continuous BMI or weight as an outcome,[10,18,19] while the others studied discrimination in relation to BMI category or waist circumference.[11,12,14,32] Second, several of these studies were cross-sectional, rather than longitudinal, limiting their ability to capture the physiological effects of recent experiences of discrimination or establish temporality in the relationship.[10,11,14,32] Third, the manner in which discrimination is conceptualized and operationalized is important and may influence study results.[33] In our study, we utilized a measurement tool that aims to capture routine, chronic exposure to discrimination. Importantly, the operationalization of this scale did not identify from which source (ie, race, age, sex, disability) the discrimination was perceived. These characteristics may have played a role in our finding that perceived discrimination was associated with increased BMI trajectory in African American but not in white adults. For example, measuring a specific source of discrimination, such as race or sex, may fail to capture the compound effects of unfair treatment that can be encountered in individuals who experience discrimination due to several sources, such as African American females. Although we were unable to test whether not specifying a source made a difference in our analysis, there are studies that have demonstrated the importance of including a comprehensive measure. For instance, Stepanikova and colleagues[14] found that race-related discrimination did not relate to weight status in African Americans, but overall levels of perceived discrimination did. Understanding how multiple sources of discrimination affect weight status over time, and how these relationships differ among various populations, continues to be an important area of focus for future research.[30]

This study had limitations that should be considered in the interpretation and application of these results. First, this analysis did not consider several underrepresented groups that could be differently impacted by discrimination, such as individuals who identify as Latino and therefore these results cannot be generalized to those populations. Similarly, this sample only included individuals residing in Baltimore City, limiting the generalizability of these findings to adults living in similar urban or rural areas. Third, these analyses only included a baseline measure of perceived discrimination. Because discrimination can be lifelong and repetitive, capturing the effect of repeated experiences of discrimination on weight is important in future research.[34] Finally, as expected in most prospective longitudinal studies, HANDLS experienced attrition of their sample from baseline to each follow-up. However, as highlighted in the results, racial and ethnic those who were excluded because of attrition did not differ on baseline perceived discrimination or BMI, limiting the amount of bias introduced by this concern.

Despite these limitations, our study had several strengths. To our knowledge, it is among the first studies to explore the longitudinal relationships between unsourced perceived discrimination and BMI trajectory in an urban sample of white and African American adults. Second, HANDLS utilized anthropometric measures of BMI, rather than self-report, increasing the reliability of these results. Finally, these analyses included a large sample of both upper- and lower-socioeconomic African American and white adults, diversifying the sample and increasing the generalizability of these findings.

CONCLUSION

In this longitudinal study of African American and white adults, we found results that supported our hypothesis that the relationship between perceived discrimination and BMI trajectory differed by race. This finding underscores the critical

importance to address the obesity epidemic uniquely for diverse groups. In addition, it highlights the need to consider the social determinants of obesity when developing weight-related interventions for diverse populations and informing policy in urban communities. Additional longitudinal studies are warranted to further understand whether and how different types of discrimination impact adiposity and risk of overweight and obesity overtime.

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