



# Socioeconomic Correlates of Obesity in African-American and Caribbean-Black Men and Women

Debbie S. Barrington<sup>1</sup> · Sherman A. James<sup>2</sup> · David R. Williams<sup>3</sup>

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## Abstract

The high prevalence of obesity among Black Americans warrants additional investigation into its relationship with socioeconomic position (SEP), sex, and ethnicity. This cross-sectional study utilizes 2001–2003 data from the National Survey of American Life, a nationally representative sample of 3570 African-Americans and 1621 Caribbean-Blacks aged 18 years and older. Multivariate logistic regression models stratified by ethnicity and sex describe the independent associations between obesity and multilevel socioeconomic factors after adjustment for age, other SEP measures at the individual, family and neighborhood levels, and health behaviors such as physical activity, alcohol intake, and smoking. A positive relationship was observed between obesity and family income among African-American and Caribbean-Black men. Receipt of public assistance was a strongly associated factor for obesity in Caribbean-Black men and women. Among African-American women, inverse relationships were observed between obesity and education, occupation, and family income; residence within a neighborhood with a supermarket also decreased their odds of obesity. Residence in a neighborhood with a park decreased the odds of obesity only among African-American men, whereas residence in a neighborhood with a supermarket decreased the odds of obesity among Caribbean-Black men. The social patterning of obesity by individual, household, and neighborhood socioeconomic resources differs for African-American and Caribbean-Black men and women within these cross-sectional analyses; an appreciation of these differences may be a prerequisite for developing effective weight control interventions and policies for these two populations.

**Keywords** Adults · African American · Ethnic differences · Obesity · Socioeconomic

## Introduction

The high prevalence of obesity among non-Hispanic Black Americans (38.3%), aged 18 years and older in 2018, as

compared with 31.1% for the general US population, remains an important public health problem [1]. Obesity has a broad range of health consequences, and its higher prevalence among non-Hispanic Blacks puts them at increased risk for type 2 diabetes (Blacks = 13.0%, Whites = 8.0%), coronary heart disease (Black women = 5.2%, White women = 3.9%), asthma (Blacks = 9.2%, Whites = 8.0%), and stroke (Blacks = 4.0%, Whites = 2.7%) [1].

The important role of socioeconomic position (SEP) in the obesity epidemic has long been a focus of research [2–5]. SEP is defined as one's location in the societal structure that determines differential access to power, privilege, and desirable resources [6]. It is a multidimensional concept that can be measured at (1) the individual level, e.g., education, earnings, and occupation; (2) the household level, characterized by familial resources, e.g., poverty, family income, and wealth; and (3) the neighborhood level, described by aspects of living conditions not captured by individual or household level variables, e.g., community structural characteristics, neighborhood poverty, and crime [7, 8]. Prior research has documented

✉ Debbie S. Barrington  
debbie.barrington@georgetown.edu

Sherman A. James  
sjames@duke.edu

David R. Williams  
dwilliam@hsph.harvard.edu

<sup>1</sup> Department of Human Science, Georgetown University, 237 St. Mary's Hall, 3700 Reservoir Road NW, Washington, DC 20057-1107, USA

<sup>2</sup> Sanford School of Public Policy, Duke University, 203 Sanford Building, Durham, NC 27708-0245, USA

<sup>3</sup> Department of Social and Behavioral Sciences, Harvard T.H. Chan School of Public Health, Harvard University, 677 Huntington Ave, Room 709, Boston, MA 02115, USA

correlations between lower rates of obesity and residence in communities with beneficial structural characteristics of neighborhood SEP, including the presence of neighborhood parks and supermarkets [9–11].

Research findings on the relationship between obesity and individual and household measures of SEP, however, have been more mixed. For example, some studies have revealed a weakening of the protective effect of increasing education on obesity over the past 30 years, a consequence of the increase in obesity among the most educated [12]. The inverse association between SEP and body mass index (BMI) and obesity is stronger among women compared with men [2, 13–17]. Some studies, in fact, reported a reversal of the expected inverse SEP-obesity association among men; i.e., men of high SEP were more likely to have increased BMI and be overweight or obese than men of low SEP [14–16, 18]. Furthermore, nativity status (foreign-born vs. US-born) differentials in the association of an individual-level measure of SEP on obesity have been reported among Black Americans, with native-born Blacks being at higher risk [19].

Few studies, however, have examined sex-specific associations between obesity and multilevel measures of SEP within an ethnically diverse group of Black Americans. Hence, the present study investigates the potential differential associations between obesity and individual, household, and neighborhood-level SEP indicators among Black American men and women (African-Americans) and Blacks with Caribbean ethnicity (Caribbean-Blacks). Elucidation of the differential patterning of multidimensional measures of SEP on obesity among African-American and Caribbean-Black men and women would be beneficial for developing effective interventions to reduce obesity and obesity-related diseases within an increasingly heterogeneous US Black population.

## Methods and Procedures

This cross-sectional study utilizes data from the National Survey of American Life (NSAL). The NSAL is part of the National Institute of Mental Health (NIMH) Collaborative Psychiatric Epidemiology Surveys (CPES) initiative that also includes the National Co-morbidity Survey Replication (NCS-R) and the National Latino and Asian American Study (NLAAS) [20]. NSAL was conducted according to the guiding principles in the Declaration of Helsinki. All procedures involving human subjects, including oral and written consent from all participants 18 years of age and older, were approved by the Institutional Review Board at the University of Michigan [21]. The NSAL includes a sample of 891 non-Hispanic Whites, 3570 African-Americans, persons who identified as Black but did not have ancestral ties to the Caribbean (including 67 foreign-born Blacks), and 1621 Caribbean-Blacks, persons who identified as Black and who either were

born in Caribbean area countries (73% of the Caribbean-Black sample), had parents or grandparents who were born in the Caribbean, or had indicated that they were of Caribbean ethnicity. The NSAL survey data includes assessments of mental, emotional, and physical health and residential, environmental, and socioeconomic characteristics. Data were collected between February 2001 and June 2003 with response rates of 70.7% for African-Americans, 77.7% for Caribbean-Blacks, and 72.3% for Whites. This paper capitalizes on the growing heterogeneity of the US Black population as reflected in the NSAL sample and reports findings for African-American and Caribbean-Black men and women, aged 18 years and older within the NSAL sample.

The study outcome is obesity, characterized as having a body mass index (BMI, weight (kg)/height (m)<sup>2</sup>) 30 or higher [22]. BMI is calculated within the NSAL based on self-reported weight and height. The independent variables include self-reported measures of adult SEP at the individual, family, and neighborhood levels. SEP indicators at the individual level include current education specified as < high school (HS), HS and > HS, and respondent's main occupation categorized into professional/managerial, sales/administrative, skilled blue collar, unskilled blue collar, and service. SEP measures at the family level consist of (1) a measure of wealth or "house value," specified as at or below the median, above the median, or "none," (2) quartiles of family income, and (3) "public support" described as currently receiving any public assistance for the family, and dichotomized into "any" or "none." Finally, SEP measures assessed at the neighborhood level include self-reported measures previously found to be associated with obesity within African-Americans and Caribbean-Blacks—having a supermarket within one's neighborhood (yes vs. no) and having a park within one's neighborhood (yes vs. no) [23].

Covariates utilized for statistical adjustment due to their known associations with SEP and obesity include demographic variables such as age [5], categorized into less than or equal to 29 years, 30–44 years, 45–59 years, and 60 or more years; marital status, [24] characterized as (1) married or living with a partner, (2) separated, divorced or widowed, and (3) never married; and three measures of health behaviors, (1) physical activity [22], a continuous measure based on how often the study participants worked in the garden or yard, engaged in active sports or exercise, and walked, (2) smoking status [25], specified as the participant never having smoked more than 100 cigarettes in his/her lifetime or "never smoker," having smoked more than 100 cigarettes in the past or "past smoker," and "current smoker," and (3) current alcohol consumption [22], categorized for analytical purposes into consuming no alcoholic drinks within the past year or "none," having consumed less than 12 drinks within the past year, or "infrequent drinker," and moderate-to-heavy drinkers having consumed 12 or more drinks within the past year or "regular drinker."

To minimize bias due to differentially distributed missing data on measures of SEP and BMI by ethnicity (African-American and Caribbean-Black) and sex, multiple imputation was performed prior to statistical analysis within the statistical software package IVEware [26]. IVEware uses a sequential regression imputation method to impute values for each individual, conditional on all other values observed for that individual, consequently producing complete datasets for unbiased analyses [27]. Descriptive statistics stratified by ethnicity and by sex were then calculated. Chi-square tests were performed to examine group differences in categorical variables, whereas the global *F* test within an unadjusted linear regression model was utilized to calculate ethnicity and sex differences in physical activity. Since previous studies reveal differential SEP patterning of obesity by both sex and ethnicity [4, 19], three-way interactions between measures of SEP, ethnicity, and sex were tested. Statistically significant three-way interactions were found for five out of the eight SEP indicators, *p* values ranging from 0.008 to 0.024. Therefore, all nested multivariate logistic regression models assessing the strength of the independent associations between multilevel measures of SEP and obesity after covariate adjustment are presented stratified by ethnicity and sex. Specifically, the following five models were fitted for each SEP indicator: (1) odds ratios (ORs) adjusted for age; (2) ORs additionally adjusted for individual-level SEP, i.e., education, occupation, as well as for marital status; (3) ORs additionally adjusted for family-level SEP, i.e., public support, house value, and family income; (4) ORs additionally adjusted for neighborhood-level SEP, i.e., neighborhood supermarket and neighborhood park; and (5) ORs additionally adjusted for health behaviors, i.e., physical activity, alcohol intake, and smoking.

Data management was conducted using SAS Version 9, [28] and all statistical analyses were performed using SUDAAN [29] to account for the multiple imputation and the complex sample design of the NSAL in calculating unbiased effect estimates and standard errors. Sample sizes presented within tables are un-weighted; however, all other estimates, means proportions, and standard errors, as well as ORs and 95% confidence intervals (CIs), are weighted.

## Results

Table 1 describes the general characteristics of African-American and Caribbean-Black men and women in the NSAL sample. African-American women had the highest prevalence of obesity at 41.2% followed by Caribbean-Black women at 31.1% and African-American men at 29.9%. Caribbean-Black men had the lowest prevalence of obesity at 21.6%. Caribbean-Black men and women were also younger than African-American men and women with 64.9% and 66.2% of Caribbean-Black men and women being under

the age of 45 as compared with 61.0% and 58.8% of African-American men and women, respectively.

Caribbean-Black men and women had greater educational attainment than African-American men and women, with 49.4% of Caribbean-Black men and 48.8% of Caribbean-Black women and 37.3% of African-American men and 38.4% of African-American women having > HS education. Men were more likely to be married or living with a partner than women; Caribbean-Black men had the highest prevalence at 59.9%, while African-American women had the lowest at 35.6%. In addition, men were more likely than women to be employed in the skilled and unskilled blue collar professions; unskilled blue collar employment was highest for African-American men at 33.2%. Women were more likely than men to be employed in service professions. Moreover, Caribbean-Black men and women, at 23.0% and 23.3%, respectively, were more likely to work in professional/managerial positions compared with African-American men and women at 15.4% and 17.9%, respectively.

African-American women were the most likely to receive public support, and accordingly, most likely to have had the lowest family income compared with all other ethnic/sex groups. Caribbean-Black men were least likely to receive public support and to have had the highest family income. African-American men were most likely to be homeowners relative to all other ethnic/sex groups, whereas Caribbean-Black women were least likely to be homeowners.

Caribbean-Black men and women were more likely than African-American men and women to live in neighborhoods that had a supermarket or a park. Caribbean-Black men had the highest prevalence, in that 91% lived in a neighborhood with a supermarket and 88.1% resided in a neighborhood with a park. African-American women had the lowest prevalence with approximately 71% residing in a neighborhood that had a supermarket or park.

Men reported higher rates of physical activity than women, with Caribbean-Black men having the highest average score (2.95) and African-American women having the lowest (2.56). Seventy-nine percent of Caribbean-Black women never smoked, whereas only 49.4% of African-American men never smoked. Finally, African-American women were least likely to consume alcohol in the past year where 43.5% never drank. Caribbean-Black men were most likely to drink alcohol in the past year and 55.7% were regular drinkers.

Tables 2, 3, 4, and 5 present the adjusted odds ratios (ORs) and 95% confidence intervals for the associations between obesity and individual-, family-, and neighborhood-level socioeconomic position (SEP) among African-American men, Caribbean-Black men, African-American women, and Caribbean-Black women, respectively. Unless otherwise stated, all ORs were determined from the fully adjusted models.

For African-American men, no significant associations between obesity and any individual-level measure of SEP were

**Table 1** General characteristics of African-American and Caribbean-Black men and women: the National Survey of American Life

	African-American men			Caribbean-Black men			African-American women			Caribbean-Black women			P value <sup>a</sup>
	N	Wt%	Se	N	Wt%	Se	N	Wt%	Se	N	Wt%	Se	
Obesity													< 0.0001
No	903	70.10	1.34	528	78.41	4.45	1327	58.82	1.14	677	68.94	3.96	
Yes	368	29.90	1.34	115	21.59	4.45	972	41.18	1.14	301	31.06	3.96	
Age													0.0034
≤ 29	275	24.25	1.54	189	34.42	3.89	531	24.46	1.24	247	27.57	2.21	
45–59	324	23.85	1.34	134	20.00	3.81	531	23.74	0.97	222	18.69	2.36	
60+	224	15.10	1.14	102	15.08	3.58	409	17.42	1.12	122	15.10	2.19	
30–44	448	36.79	1.25	218	30.50	2.58	828	34.37	1.20	387	38.64	2.61	
Current education													0.0013
< HS	320	23.22	1.58	134	21.43	4.45	600	24.96	1.74	172	21.02	2.12	
HS	497	39.45	1.78	194	29.16	3.59	865	36.61	1.30	287	30.15	2.80	
> HS	454	37.33	2.10	315	49.42	3.86	834	38.44	1.57	519	48.83	3.54	
Marital status													< 0.0001
Married/partner	554	49.44	1.65	337	59.88	5.56	672	35.56	1.27	356	40.08	3.09	
Separated/divorced/widowed	325	20.17	1.31	106	10.39	1.98	843	32.05	0.99	279	27.79	3.86	
Never married	392	30.39	1.60	200	29.72	4.13	784	32.39	1.50	343	32.14	1.79	
Main occupation													< 0.0001
Professional/Managerial	179	15.44	1.44	130	22.98	4.09	403	17.88	1.14	240	23.36	3.10	
Sales/administrative	193	15.61	1.47	136	23.03	5.17	694	32.25	1.19	284	28.92	2.97	
Blue Collar: skilled	203	15.69	1.62	126	15.19	2.62	76	3.19	0.46	39	4.01	0.81	
Blue Collar: unskilled	444	33.19	2.11	125	19.04	4.32	300	12.30	0.82	40	5.15	2.10	
Service	252	20.07	1.37	126	19.77	3.82	827	34.38	1.73	375	38.56	3.38	
Public support													< 0.0001
Any	579	46.78	1.94	218	39.56	4.88	1488	63.45	1.61	472	55.75	3.09	
None	692	53.22	1.94	425	60.44	4.88	811	36.55	1.61	506	44.25	3.09	
House value													0.0005
At/below median	254	19.45	1.59	59	12.98	2.75	457	19.10	1.48	75	12.52	2.84	
Above median	404	34.28	2.13	216	33.13	3.97	575	27.07	1.66	288	29.43	3.31	
None	613	46.27	2.46	368	53.89	3.90	1267	53.83	1.94	615	58.05	2.74	
Family income													< 0.0001
0–25%	277	18.45	1.52	82	13.19	3.74	777	29.61	1.42	191	17.95	2.48	
26–50%	309	22.21	1.30	145	21.24	2.87	690	28.33	1.24	275	28.20	3.08	
51–75%	374	29.97	1.38	184	24.02	3.53	474	21.76	1.00	258	24.82	2.08	
76–100%	311	29.37	2.11	232	41.55	4.73	358	20.29	1.54	254	29.02	3.50	
Supermarket in neighborhood													< 0.0001
Yes	940	75.66	1.91	586	91.04	2.37	1606	70.95	1.74	869	86.82	2.26	
No	331	24.34	1.91	57	8.96	2.37	693	29.05	1.74	109	13.18	2.26	
Park in neighborhood													< 0.0001
Yes	945	76.63	1.94	544	88.06	2.57	1560	70.57	1.59	827	85.23	2.26	
No	326	23.37	1.94	99	11.94	2.57	739	29.43	1.59	151	14.77	2.26	
Mean physical activity	1271	2.88	0.03	643	2.95	0.07	2299	2.56	0.02	978	2.64	0.05	0.0053
Smoking status													< 0.0001
Never	610	49.42	1.65	427	63.80	3.71	1439	62.46	1.44	783	79.02	3.19	
Past	253	19.09	1.20	89	16.37	3.93	312	13.72	1.10	93	8.59	1.87	
Current	408	31.49	1.77	127	19.83	3.80	548	23.82	1.22	102	12.39	3.41	
Current alcohol consumption													< 0.0001
None	374	28.70	2.09	182	21.85	4.07	1006	43.51	1.96	436	39.38	3.89	
Infrequent	236	19.27	1.13	132	22.42	2.12	559	23.64	1.56	269	29.87	2.79	
Regular	661	52.03	2.06	329	55.73	4.94	734	32.85	1.33	273	30.75	3.12	

<sup>a</sup>P values are based on Chi-square and F-tests examining group differences by ethnicity and sex

observed (Table 2). Low SEP at the family level, however, was associated with a lower odds of obesity. Within all adjusted models for African-American men, family income within the lowest quartile was protective against obesity relative to the highest quartile, OR = 0.50, 95% CI (0.27, 0.92). Furthermore, African-American male homeowners with housing equity at or below the median had a 43% increased odds of

obesity compared with their non-home-owning counterparts, OR = 1.43, 95% CI (1.00, 2.06). Neighborhood-level SEP was also associated with obesity, with all adjusted models showing lower odds of obesity for African-American men residing in neighborhoods that contained a park compared with those who lived in neighborhoods without one (OR = 0.60, 95% CI (0.38, 0.94)).

**Table 2** Unadjusted and adjusted odds ratios for obesity among African-American men: the National Survey of American Life

SEP measure	Age adjusted		+ individual-level SEP and marital status <sup>a</sup>		+ family-level SEP <sup>b</sup>		+ neighborhood-level SEP <sup>c</sup>		+ health behaviors <sup>d</sup>	
	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI
Current education										
< HS	0.92	(0.65, 1.32)	0.99	(0.65, 1.51)	1.17	(0.73, 1.87)	1.13	(0.69, 1.83)	1.18	(0.71, 1.96)
HS	0.87	(0.65, 1.17)	0.90	(0.64, 1.28)	0.96	(0.65, 1.43)	0.94	(0.63, 1.39)	0.93	(0.62, 1.41)
> HS	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
Main occupation										
Professional/managerial	1.63	(0.93, 2.87)	1.53	(0.82, 2.85)	1.45	(0.76, 2.79)	1.42	(0.73, 2.74)	1.37	(0.71, 2.61)
Sales/Administrative	1.61	(0.95, 2.71)	1.62	(0.96, 2.73)	1.55	(0.90, 2.67)	1.53	(0.90, 2.62)	1.55	(0.92, 2.63)
Blue collar: skilled	1.43	(0.75, 2.74)	1.43	(0.74, 2.77)	1.37	(0.68, 2.76)	1.36	(0.68, 2.72)	1.49	(0.77, 2.91)
Blue collar: unskilled	1.53	(0.95, 2.47)	1.52	(0.93, 2.48)	1.51	(0.90, 2.55)	1.47	(0.87, 2.46)	1.53	(0.91, 2.56)
Service	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
Public support										
Any	0.96	(0.75, 1.22)	0.99	(0.77, 1.27)	1.04	(0.80, 1.37)	1.06	(0.81, 1.39)	1.03	(0.78, 1.37)
None	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
House value										
At/below median	1.70	(1.17, 2.46)	1.58	(1.10, 2.29)	1.46	(1.00, 2.12)	1.37	(0.95, 1.98)	1.43	(1.00, 2.06)
Above median	1.40	(0.94, 2.09)	1.29	(0.85, 1.96)	1.17	(0.76, 1.79)	1.13	(0.75, 1.72)	1.13	(0.74, 1.73)
None	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
Family income										
0–25%	0.45	(0.29, 0.71)	0.47	(0.27, 0.80)	0.51	(0.28, 0.91)	0.47	(0.26, 0.85)	0.50	(0.27, 0.92)
26–50%	0.73	(0.45, 1.18)	0.77	(0.44, 1.35)	0.82	(0.46, 1.45)	0.75	(0.41, 1.37)	0.79	(0.43, 1.46)
51–75%	0.78	(0.55, 1.11)	0.81	(0.55, 1.19)	0.86	(0.58, 1.27)	0.83	(0.56, 1.25)	0.85	(0.56, 1.30)
76–100%	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
Supermarket in neighborhood										
Yes	0.92	(0.69, 1.22)	0.89	(0.67, 1.18)	0.90	(0.67, 1.23)	1.02	(0.73, 1.43)	1.03	(0.73, 1.45)
No	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
Park in neighborhood										
Yes	0.62	(0.42, 0.92)	0.61	(0.40, 0.92)	0.59	(0.39, 0.91)	0.59	(0.38, 0.92)	0.60	(0.38, 0.94)
No	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF

<sup>a</sup> Each SEP measure additionally adjusted for marital status, education, and/or occupation

<sup>b</sup> Each SEP measure additionally adjusted for public support, house value, and/or family income

<sup>c</sup> Each SEP measure additionally adjusted for neighborhood supermarket and/or park

<sup>d</sup> Each SEP measure additionally adjusted for physical activity, smoking, and alcohol intake

As shown in Table 3, none of the individual-level measures of SEP for Caribbean-Black men was significantly associated with obesity, paralleling the findings for African-American men. Nevertheless, selected family- and neighborhood-level SEP measures were associated with obesity. For example, like African-American men, low family income was protective for Caribbean-Black men within the age-adjusted model; however, this association became non-significant ( $P > 0.05$ ) with additional covariate adjustment. Furthermore, Caribbean-Black men who received any public assistance had 3.5 times the odds (95% CI 1.30, 9.42) of obesity compared with their counterparts who did not. Finally, Caribbean-Black men residing in a neighborhood containing a supermarket experienced an 86% decreased odds of obesity compared with those in neighborhoods without this amenity, OR = 0.14, 95% CI (0.04, 0.52).

In contrast to men, Table 4 shows statistically significant associations between measures of individual-level SEP and obesity for African-American women. African-American

women with < HS education had 1.47 times the odds (95% CI (1.04, 2.09)) of obesity than those with > HS education. Though only borderline significant in fully adjusted models, African-American women with a HS education had 1.40 times the odds (95% CI (0.96, 2.05)) of obesity compared with those with > HS education. African-American women employed in the sales/administrative occupations had 27% lower odds of obesity compared with African-American women employed in service employment, OR = 0.73, 95% CI (0.57, 0.94).

In contrast to African-American men, higher family SEP was protective against obesity for African-American women. Though of borderline significance, African-American women who received public support had a 27% greater odds of obesity compared with those not receiving such support, OR = 1.27, 95% CI (0.98, 1.63). Though not statistically significant, African-American women with family income in the third quartile were associated with a 35% increased odds of obesity compared with women in the highest quartile, OR = 1.35, 95% CI (0.97, 1.89). African-American females with housing



**Table 3** Unadjusted and adjusted odds ratios for obesity among Caribbean-Black men: the National Survey of American Life

SEP measure	Age adjusted		+ individual-level SEP and marital status <sup>a</sup>		+ family-level SEP <sup>b</sup>		+ neighborhood-level SEP <sup>c</sup>		+ health behaviors <sup>d</sup>	
	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI
<b>Current education</b>										
< HS	0.28	(0.07, 1.16)	0.30	(0.08, 1.15)	0.45	(0.13, 1.53)	0.49	(0.13, 1.83)	0.58	(0.16, 2.12)
HS	0.69	(0.20, 2.32)	0.80	(0.19, 3.28)	0.78	(0.23, 2.63)	0.84	(0.20, 3.47)	0.84	(0.28, 2.50)
> HS	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
<b>Main occupation</b>										
Professional/managerial	2.24	(0.56, 8.87)	1.82	(0.38, 8.64)	1.88	(0.60, 5.85)	1.66	(0.54, 5.18)	1.70	(0.67, 4.31)
Sales/administrative	1.08	(0.36, 3.19)	0.89	(0.32, 2.49)	0.95	(0.42, 2.14)	1.04	(0.47, 2.27)	0.84	(0.34, 2.07)
Blue collar: skilled	0.55	(0.15, 2.09)	0.54	(0.16, 1.78)	0.46	(0.15, 1.47)	0.47	(0.14, 1.56)	0.54	(0.20, 1.45)
Blue collar: unskilled	1.45	(0.37, 5.72)	1.99	(0.66, 6.04)	1.92	(0.66, 5.56)	1.48	(0.58, 3.79)	1.45	(0.57, 3.72)
Service	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
<b>Public support</b>										
Any	2.15	(0.77, 5.99)	2.78	(1.00, 7.76)	2.65	(1.00, 7.03)	3.18	(1.19, 8.50)	3.50	(1.30, 9.42)
None	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
<b>House value</b>										
At/below median	2.17	(0.33, 14.35)	1.41	(0.37, 5.34)	1.23	(0.34, 4.45)	1.26	(0.39, 4.05)	0.90	(0.34, 2.38)
Above median	1.12	(0.60, 2.08)	0.97	(0.57, 1.65)	0.85	(0.47, 1.53)	0.86	(0.46, 1.62)	0.60	(0.26, 1.39)
None	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
<b>Family income</b>										
0–25%	0.19	(0.04, 0.94)	0.27	(0.05, 1.36)	0.24	(0.04, 1.30)	0.29	(0.05, 1.72)	0.24	(0.04, 1.39)
26–50%	0.44	(0.12, 1.55)	0.56	(0.20, 1.57)	0.53	(0.17, 1.62)	0.55	(0.17, 1.82)	0.47	(0.13, 1.76)
51–75%	0.92	(0.40, 2.10)	1.09	(0.54, 2.23)	1.00	(0.46, 2.17)	0.96	(0.44, 2.11)	0.87	(0.37, 2.06)
76–100%	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
<b>Supermarket in neighborhood</b>										
Yes	0.19	(0.07, 0.51)	0.16	(0.05, 0.52)	0.14	(0.04, 0.50)	0.14	(0.04, 0.48)	0.14	(0.04, 0.52)
No	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
<b>Park in neighborhood</b>										
Yes	0.83	(0.35, 1.95)	0.69	(0.22, 2.17)	0.63	(0.17, 2.23)	1.00	(0.44, 2.25)	0.91	(0.34, 2.40)
No	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF

<sup>a</sup> Each SEP measure additionally adjusted for marital status, education, and/or occupation

<sup>b</sup> Each SEP measure additionally adjusted for public support, house value, and/or family income

<sup>c</sup> Each SEP measure additionally adjusted for neighborhood supermarket and/or park

<sup>d</sup> Each SEP measure additionally adjusted for physical activity, smoking, and alcohol intake

equity above the median had 22% lower odds of obesity compared with their non-home-owning counterparts, though borderline significant, OR = 0.78, 95% CI (0.59, 1.03). Finally, at the neighborhood level, African-American women residing in neighborhoods containing a supermarket had a 26% decreased odds of obesity compared with those without this amenity, OR = 0.74, 95% CI (0.56, 0.96).

Table 5 summarizes associations between SEP and obesity among Caribbean-Black women. Occupation is the only individual-level SEP measure that was associated with obesity in this group. Being employed within professional/managerial occupations was associated with a decreased odds of obesity compared with employment in service occupations, after adjusting for age, marital status, and other individual-level, family-level, and neighborhood-level SEP measures, OR = 0.55, 95% CI (0.30, 0.99). This association became statistically

insignificant, however, after adjusting for physical activity, smoking, and alcohol consumption, OR = 0.61, 95% CI (0.35, 1.07).

Similar to African-American women, receipt of public assistance increased the odds of obesity for Caribbean-Black women; however, the magnitude of the association was stronger for the latter. Caribbean-Black women receiving public support had 1.74 times the odds of obesity compared with Caribbean-Black women not on public assistance, 95% CI (1.08, 2.82). Yet, unlike African-American women, in age-adjusted and individual-level SEP adjusted models, Caribbean-Black women with family income in the third quartile had a decreased odds of obesity compared with those with family income in the fourth quartile. In fully adjusted models, this relationship became statistically insignificant, OR = 0.56, 95% CI (0.28, 1.14). No association was observed between

**Table 4** Unadjusted and adjusted odds ratios for obesity among African-American women: the National Survey of American Life

SEP Measure	Age adjusted		+ individual-level SEP and marital status <sup>a</sup>		+ family-level SEP <sup>b</sup>		+ neighborhood-level SEP <sup>c</sup>		+ health behaviors <sup>d</sup>	
	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI
<b>Current education</b>										
< HS	1.81	(1.39, 2.36)	1.62	(1.19, 2.20)	1.49	(1.05, 2.09)	1.42	(1.01, 2.00)	1.47	(1.04, 2.09)
HS	1.59	(1.17, 2.15)	1.51	(1.08, 2.13)	1.44	(1.00, 2.07)	1.42	(0.98, 2.05)	1.40	(0.96, 2.05)
> HS	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
<b>Main occupation</b>										
Professional/managerial	0.61	(0.44, 0.86)	0.76	(0.53, 1.09)	0.81	(0.57, 1.17)	0.82	(0.57, 1.19)	0.80	(0.55, 1.18)
Sales/administrative	0.65	(0.51, 0.83)	0.72	(0.57, 0.92)	0.73	(0.58, 0.93)	0.74	(0.59, 0.94)	0.73	(0.57, 0.94)
Blue collar: skilled	0.66	(0.36, 1.23)	0.76	(0.41, 1.40)	0.82	(0.43, 1.55)	0.83	(0.44, 1.56)	0.81	(0.42, 1.58)
Blue collar: unskilled	0.92	(0.68, 1.25)	0.91	(0.66, 1.23)	0.92	(0.67, 1.26)	0.90	(0.66, 1.24)	0.98	(0.71, 1.35)
Service	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
<b>Public support</b>										
Any	1.38	(1.07, 1.78)	1.28	(0.99, 1.67)	1.27	(0.99, 1.63)	1.25	(0.98, 1.61)	1.27	(0.98, 1.63)
None	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
<b>House value</b>										
At/below median	1.01	(0.81, 1.27)	1.04	(0.83, 1.28)	1.08	(0.86, 1.35)	1.00	(0.81, 1.24)	1.01	(0.79, 1.28)
Above median	0.73	(0.57, 0.94)	0.79	(0.61, 1.02)	0.82	(0.63, 1.08)	0.78	(0.60, 1.03)	0.78	(0.59, 1.03)
None	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
<b>Family income</b>										
0–25%	1.58	(1.15, 2.16)	1.30	(0.87, 1.96)	1.15	(0.76, 1.75)	1.12	(0.74, 1.69)	1.19	(0.77, 1.84)
26–50%	1.51	(1.09, 2.09)	1.33	(0.90, 1.98)	1.26	(0.83, 1.89)	1.22	(0.81, 1.83)	1.24	(0.80, 1.90)
51–75%	1.47	(1.07, 2.01)	1.38	(0.98, 1.94)	1.31	(0.93, 1.85)	1.30	(0.93, 1.81)	1.35	(0.97, 1.89)
76–100%	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
<b>Supermarket in neighborhood</b>										
Yes	0.68	(0.54, 0.86)	0.73	(0.57, 0.93)	0.72	(0.57, 0.92)	0.73	(0.56, 0.94)	0.74	(0.56, 0.96)
No	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
<b>Park in neighborhood</b>										
Yes	0.80	(0.66, 0.98)	0.88	(0.72, 1.07)	0.90	(0.75, 1.08)	0.94	(0.77, 1.14)	1.00	(0.82, 1.23)
No	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF

<sup>a</sup> Each SEP measure additionally adjusted for marital status, education, and/or occupation

<sup>b</sup> Each SEP measure additionally adjusted for public support, house value, and/or family income

<sup>c</sup> Each SEP measure additionally adjusted for neighborhood supermarket and/or park

<sup>d</sup> Each SEP measure additionally adjusted for physical activity, smoking, and alcohol intake

obesity and neighborhood-level SEP variables for Caribbean-Black women, in contrast to findings for both groups of men.

## Discussion

This study of the association between multiple dimensions of SEP (individual, family, and neighborhood) and obesity in a sample of US Blacks found that associations varied by ethnicity and by sex. Among African-American men, no statistically significant associations between SEP and obesity were observed at the individual level, but a positive relationship was observed for family SEP; namely, African-American men in the bottom quartile of family income and who had no housing equity had the lowest odds of obesity. Similar to African-American men, there was no association between adulthood SEP at the individual level among Caribbean-Black men. For Caribbean-Black men, more complex SEP patterns for family

income were observed, wherein (1) obesity increased among those receiving public assistance and (2), similar to African-American men, a positive association was observed between family income and obesity.

The association between public assistance and the increasing odds of obesity among Caribbean-Black men is consistent with a previous report showing that participation in public assistance programs increased the risk of adult obesity [30]. In this particular study, the association was stronger among men than women and was mediated by dietary quality as assessed by higher soda consumption. Moreover, in the current study, our finding of a positive association between obesity and SEP at the family level among Black men is also in line with previous reports [5, 14, 31, 32]. African-American elementary school boys with low SEP have been reported to engage in more vigorous physical activity than high SEP boys through participation in team sports such as football and basketball [33]. This engagement in vigorous team sports, if it

**Table 5** Unadjusted and adjusted odds ratios for obesity among Caribbean-Black women: the National Survey of American Life

SEP measure	Age adjusted		+ individual-level SEP and marital status <sup>a</sup>		+ family-level SEP <sup>b</sup>		+ neighborhood-level SEP <sup>c</sup>		+ health behaviors <sup>d</sup>	
	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI
<b>Current education</b>										
< HS	1.02	(0.42, 2.45)	0.84	(0.37, 1.88)	0.84	(0.44, 1.61)	0.80	(0.42, 1.53)	0.78	(0.41, 1.49)
HS	1.00	(0.48, 2.07)	0.83	(0.40, 1.75)	0.86	(0.49, 1.51)	0.84	(0.49, 1.42)	0.84	(0.47, 1.52)
> HS	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
<b>Main occupation</b>										
Professional/managerial	0.65	(0.32, 1.31)	0.55	(0.29, 1.05)	0.54	(0.30, 0.97)	0.55	(0.30, 0.99)	0.61	(0.35, 1.07)
Sales/administrative	0.79	(0.37, 1.69)	0.72	(0.33, 1.53)	0.70	(0.35, 1.39)	0.70	(0.35, 1.40)	0.66	(0.33, 1.32)
Blue collar: skilled	0.49	(0.13, 1.93)	0.46	(0.12, 1.78)	0.42	(0.10, 1.75)	0.42	(0.10, 1.76)	0.36	(0.10, 1.25)
Blue collar: unskilled	0.35	(0.11, 1.16)	0.38	(0.12, 1.26)	0.35	(0.10, 1.20)	0.34	(0.10, 1.17)	0.41	(0.11, 1.50)
Service	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
<b>Public support</b>										
Any	1.91	(1.18, 3.09)	2.09	(1.32, 3.32)	1.91	(1.27, 2.87)	1.91	(1.25, 2.89)	1.74	(1.08, 2.82)
None	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
<b>House value</b>										
At/below median	1.31	(0.33, 5.28)	1.31	(0.40, 4.34)	1.22	(0.38, 3.87)	1.26	(0.39, 4.08)	1.51	(0.51, 4.50)
Above median	0.93	(0.52, 1.65)	0.92	(0.55, 1.55)	0.91	(0.51, 1.61)	0.90	(0.51, 1.62)	1.17	(0.62, 2.22)
None	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
<b>Family income</b>										
0–25%	0.99	(0.30, 3.24)	1.04	(0.33, 3.26)	0.87	(0.25, 3.01)	0.87	(0.25, 3.02)	0.88	(0.27, 2.86)
26–50%	0.75	(0.26, 2.19)	0.79	(0.30, 2.11)	0.72	(0.27, 1.97)	0.73	(0.28, 1.92)	0.77	(0.30, 1.96)
51–75%	0.52	(0.26, 1.02)	0.51	(0.27, 0.97)	0.56	(0.30, 1.06)	0.56	(0.29, 1.08)	0.56	(0.28, 1.14)
76–100%	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
<b>Supermarket in neighborhood</b>										
Yes	0.73	(0.34, 1.44)	0.71	(0.39, 1.26)	0.68	(0.37, 1.24)	0.68	(0.37, 1.25)	0.70	(0.36, 1.36)
No	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
<b>Park in neighborhood</b>										
Yes	0.90	(0.44, 1.82)	0.89	(0.46, 1.70)	0.88	(0.50, 1.56)	0.91	(0.51, 1.63)	1.03	(0.60, 1.78)
No	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF

<sup>a</sup> Each SEP measure additionally adjusted for marital status, education, and/or occupation

<sup>b</sup> Each SEP measure additionally adjusted for public support, house value, and/or family income

<sup>c</sup> Each SEP measure additionally adjusted for neighborhood supermarket and/or park

<sup>d</sup> Each SEP measure additionally adjusted for physical activity, smoking, and alcohol intake

continues throughout adulthood [34], is a possible contributing factor in lowering the risk of obesity among low SEP African-American and Caribbean-Black men. This is a hypothesis that should be tested in prospective research. Moreover, the higher obesity rate among high SEP men has been postulated to be due to the positive effect increased body weight has on higher earned income and social prestige among men [35]. Future longitudinal investigations should determine whether perceived and actual positive economic consequences for increasing body size drive the positive relationship between SEP and obesity among men.

For African-American women, the expected inverse relationship between individual-level SEP and obesity was seen for education [15]; however, educational attainment was not associated with obesity among Caribbean-Black women. In line with previous research [36], our study also reveals that higher status occupations, i.e., sales and administrative jobs

among African-American women and professional and managerial jobs among Caribbean-Black women, are associated with lower odds for obesity than lesser status service professions. Finally, our results at family-level SEP show that similar to Caribbean-Black men, receipt of public assistance increased odds for obesity among women, with a stronger association for Caribbean-Black women.

Lastly, our results show important ethnic and sex differences in the association between community SEP characteristics and obesity. The lower odds of obesity among Caribbean-Black male and African-American female residents in neighborhoods containing a supermarket is consistent with prior research [23, 37]. In addition, the lower odds of obesity for residence within a neighborhood containing a supermarket found among Caribbean-Black women suggests that this relationship may hold for them as well despite the lack of statistical significance most



likely due to low statistical power. The absence of any relationship between obesity and residence within a neighborhood containing a supermarket among African-American men warrants further investigation.

It is important to highlight the substantial decrease in the odds of obesity exclusively among African-American men who live in neighborhoods containing a park. Research has shown that increased access to parks is associated with increased moderate-to-vigorous physical activity in boys but not among girls aged 8 to 12 years [38]. For many Black men, these childhood patterns of engaging in vigorous competitive team sports (e.g., basketball) in neighborhood parks extend into early adulthood, a pattern not seen historically among Black women [39, 40]. Additional research is needed to determine whether elevated energy expenditure due to increased access to recreational parks across the life course explains the lower prevalence of obesity among African-American men living in neighborhoods with community parks. Previous research documenting a lack of association between SEP and exercise frequency in Black women may explain the absence of a relationship between neighborhood parks and obesity among African-American and Caribbean women within our findings [41]. Further theoretical and empirical investigations are needed to uncover additional mechanisms through which measures of SEP at the neighborhood level independently operate to increase obesity within the various ethnic and sex groups.

To our knowledge, this is the first study to document associations between multilevel and multidimensional measures of SEP and obesity in a sample of US self-identified and Caribbean self-identified Black Americans, while using an intersectionality approach centered on both within-race ethnic and sex differentiation. Methodological strengths also include the employment of multiple imputation of missing data. This study has several limitations, however. Multiple imputation was not performed on measures with over 40% of missing data, such as individual-level income, and so, this variable was not included within the analysis in order to minimize bias [42, 43]. Furthermore, the lower sample size of Caribbean-Blacks within the NSAL dataset limited statistical power to examine any additional variation in the SEP-obesity associations by nativity status, i.e., foreign-born vs. US-born.

The public-use NSAL questionnaire utilized for analysis included only self-reported measures of neighborhood physical characteristics and did not allow for geocoding addresses to include census tract measures, i.e., percentages of families below the poverty, unemployed and/or low-educated adults, and homeowners within a neighborhood, for multilevel modeling. Although the inability to examine objective assessments of neighborhood SEP within hierarchical models is a disadvantage, perceived measures of neighborhood resources have been found in previous studies to be equally robust correlates of obesity as observed neighborhood indicators [44].

The cross-sectional nature of the NSAL study design does not establish a clear, unbiased temporal relationship between multilevel SEP indicators and adult obesity; therefore, neither causality nor direction of the SEP-obesity associations can be ascertained with certainty. The NSAL, one of the few studies that allow for an examination of the socioeconomic correlates of cardio-metabolic health by ethnicity and sex within Black Americans, was conducted in 2001–2003 and hence is an established dataset. Notwithstanding, the stability of SEP indicators over time for Black Americans, including median income, which was \$40,573 in 2003 and \$41,361 in 2018, supports the present-day relevancy of our findings [45].

The use of self-reported weight and height to estimate obesity prevalence is also a potential bias. Studies have found that these self-reported measures are reasonably valid and reliable indicators of actual weight and height, although obese individuals tend to underestimate their weight [46–48]. A dilution rather than an exaggeration of the magnitude of our associations is expected however if a systematic underreporting of weight is similar across SEP categories. Statistical adjustment for additional health behaviors related to obesity such as dietary quality could not be made within the analyses since this information is not assessed in the NSAL. In addition, physical activity, crudely assessed within the NSAL as a continuous measure of reported leisure time activity, is a less reliable measure of activity level than other methods which directly monitor the intensity of physical activity such as the use of double isotopically labeled water ( $D_2O^{18}$ ) methodology and measurement by a pedometer or tachometer [49]. The extent to which the inclusion of dietary intake and a more reliable indicator of the intensity of physical activity would explain the associations between multilevel indicators of SEP and obesity cannot be determined.

Our study findings highlight that adulthood SEP at the individual, family, and neighborhood levels plays an important role in obesity in the US Black population, and this varies by ethnicity and sex. The opposite SEP-obesity relationships between Black men and women suggest the need for further empirical investigation into the sex-specific mechanisms of obesity, particularly among low SEP families where the disparity between young adult Black women and men is the largest [50]. Moreover, the lower odds of obesity associated with residence in neighborhoods with a supermarket for African-American women and Caribbean-Black men, and with residence in neighborhoods containing a park for African-American men, suggests that continued public policy attention to increasing access to food and recreational facilities within Black American communities, as was undertaken in the national “Let us Move!” comprehensive initiative for preventing childhood obesity [51], is likely to be an important endeavor. Evidence from this study also suggests that the development of targeted, multilevel, cultural, and sex-specific societal interventions could be vital to

not only curtailing the US obesity epidemic but to reducing racial inequities in survival from emerging infectious diseases such as COVID-19, for which obesity has arisen as a strong risk and prognostic factor in its severity [52–54].

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## Compliance with Ethical Standards

**Conflict of Interest** The authors declare that they have no conflicts of interest.

**Ethical Approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

**Informed Consent** Informed consent was obtained from all individual participants included in the study.

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