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Mechanisms Linking Socioeconomic Disadvantage and BMI in Smokers

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Abstract

Objectives—To evaluate a conceptual model of the psychosocial pathways linking socioeconomic status and body mass index (BMI) among smokers.

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Human Subjects Statement

This research was approved by the Institutional Review Board of the MD Anderson Cancer Center, and informed consent was obtained from all participants.

Conflict of Interest Statement

The authors have no conflict of interests to disclose.

Methods—A latent variable modeling approach was used to evaluate the interrelationships among socioeconomic status, perceived neighborhood disadvantage, social support, negative affect, and BMI among smokers recruited from the Houston metropolitan area (N = 424).

Results—A total of 42.4% of participants were obese, with the highest prevalence of obesity among Latinos followed by African Americans. Across all racial/ethnic groups, perceived neighborhood disadvantage, social support, and negative affect functioned as pathways linking socioeconomic status and BMI.

Conclusions—Findings indicate the need for interventions that target obesity among socioeconomically disadvantaged smokers and provide potential intervention targets for the prevention and treatment of obesity.

Keywords

socioeconomic status; African American; Latino; race; smoking; BMI

Smoking and overweight/obesity are the leading causes of mortality in the United States.¹ Moreover, the combination of smoking and obesity substantially increases mortality risk above and beyond either risk factor alone² and may confer synergistic health risk.³ Researchers have hypothesized that racial/ethnic differences in the prevalence of modifiable risk factors among individuals who smoke, including obesity, may influence the likelihood of tobacco-related diseases and contribute to tobacco-related health disparities.⁴ Socioeconomic status (SES) and race/ethnicity have each been shown to be associated with obesity^{2,5–7}; however, little is known about these relationships among individuals who smoke. More research is needed to characterize the factors that influence body mass index (BMI) among smokers, so that both smoking and weight management may be effectively addressed within treatment programs for socioeconomically disadvantaged individuals and racial/ethnic minority groups.

Smoking and Obesity

The relation between smoking and obesity is complex. Recent research has indicated that smoking prevalence is positively related to BMI among overweight and obese individuals.⁸ In addition, the rates of overweight and obesity among individuals seeking smoking cessation treatment are alarmingly high.^{9–11} Smoking cessation is associated with significant weight gain,¹² and former smoking is associated with a greater likelihood of obesity.¹³ Thus, it is plausible that successful smoking cessation may result in new cases of obesity and exacerbate existing obesity.

Socioeconomic Disadvantage, Race/Ethnicity, and Obesity

SES and race/ethnicity each have an important and overlapping influence on BMI. The findings of several studies have indicated that lower SES is associated with higher BMI.^{2,5,6} In addition, SES is linked with race/ethnicity, such that African Americans and Latinos report substantially lower SES than that of whites in the United States.¹⁴ Thus, it is not surprising that obesity rates are highest among African Americans and Latinos.⁷ Initial research has suggested that behavioral factors, such as physical activity, sedentary behavior (ie, sitting), and diet may at least partially mediate the relationship between SES and BMI.¹⁵ However, additional research is needed to characterize other psychosocial mechanisms through which SES has been hypothesized to influence BMI (eg, social support, neighborhood disadvantage, negative affect) across racial/ethnic groups, especially among smokers who may be particularly vulnerable to the health effects of obesity.

Models of Socioeconomic Disadvantage and Health

Current conceptual models suggest several potential pathways that may link SES and health.^{16–18} Adler and Ostrove¹⁶ described a model in which socioeconomic disadvantage is hypothesized to influence health behavior and health outcomes through decreased access to environmental resources and increased negative affect. Negative affect is thought to adversely impact health through poor health behavior and stress-related physiological mechanisms. Similarly, Gallo and Matthews posited a model in which socioeconomic disadvantage is hypothesized to influence health behavior and health outcomes through increased probability of exposure to threat or harm, and decreased psychosocial resources, which in turn leads to increased negative affect that is believed to influence both health behavior and health.¹⁷ Consistent with these conceptual models, the findings of recent research suggest that neighborhood disadvantage, social support, and negative affect are key psychosocial mediators of the relation between SES and overweight/obesity in African American smokers.¹⁹ However, the validity of this model remains to be evaluated within other racial/ethnic groups.

Neighborhood Disadvantage

Disadvantaged environments may influence health behavior directly via objective neighborhood characteristics that facilitate or discourage healthful behaviors (eg, parks/trails or other safe areas to pursue leisure-time activity, availability of nutritious foods, alcohol/tobacco advertising) and indirectly through increased exposure to threatening or stressful situations that increase negative affect such as crime, litter, and vandalism.^{16,17} Low SES is associated with reports of greater perceived neighborhood problems.²⁰ In turn, perceived neighborhood problems are associated with negative affect and depression,^{21–23} higher BMI, and obesity.^{24–26} Notably, one study showed that psychological distress may function as a mediator of the relationship between neighborhood problems and BMI, through poorer diet quality and irregular exercise.²⁵ However, more research is needed to characterize the interrelationships among SES, neighborhood disadvantage, negative affect, and BMI.

Social Support

Inadequate social support has been hypothesized to contribute to both negative affect and poor health behavior.^{16,17} Individuals of low SES possess fewer social resources than those of their higher SES counterparts.^{27–29} For example, Turner and Lloyd reported that socioeconomic disadvantage was associated with lower perceived support from spouses/partners, friends, relatives, and coworkers.²⁹ Similarly, Cohen et al reported that lower income and education were each associated with the perception of having less support from others.²⁸ In turn, low social support is associated with greater distress/negative affect^{29–34} and obesity.³⁵ There is some evidence that social support may function as a mediator of the relationship between SES and depression,²⁹ consistent with the hypothesis that greater social support serves as a buffer against stress and negative affect. However, more research is needed to determine whether socioeconomic disadvantage may influence BMI indirectly through both lower social support and greater negative affect.

Negative Affect

Negative affect is associated with behavioral and physiological changes that are hypothesized to play an important mediating role in the relationship between SES and health.^{17,18} Low SES is associated with increased risk for depression,^{36,37} and depression is associated with obesity.³⁸ In fact, recent research has indicated that low SES may influence obesity, in part, through its impact on negative affect.^{19,39} Possible mechanisms linking negative affect and obesity may include poor dietary quality, affect-related calorie

consumption (ie, emotional eating), low physical activity self-efficacy, and low levels of physical activity.^{39,40} However, more research is needed to characterize the pathways that link socioeconomic disadvantage and negative affect (such as social support and neighborhood disadvantage) and influence BMI.

The purpose of the present study was to evaluate a previously tested model¹⁹ of the psychosocial pathways through which SES might influence BMI in a tri-ethnic sample of smokers. Consistent with current conceptual models of SES and health,^{16–18} hypothesized psychosocial mediators included perceived neighborhood disadvantage, social support, and negative affect. The model was additionally evaluated for adequate fit within each of 3 racial/ethnic groups including African Americans, Latinos, and whites. It is hoped that the findings may illuminate the pathways through which economic disadvantage may influence BMI among individuals participating in smoking cessation treatment.

METHODS

Data used in the current study were collected as part of a longitudinal cohort study designed to examine the influence of social determinants, including SES and race/ethnicity, on the process of smoking cessation among participants recruited from the Houston, Texas, metropolitan area. All participants received a smoking cessation treatment that included nicotine patch therapy, self-help materials, and counseling. Please note that BMI was not part of the participant inclusion/exclusion criteria, and therefore individuals of any BMI were able to participate. This research was approved by the Institutional Review Board of the MD Anderson Cancer Center, and informed consent was obtained from all participants. Details of the parent study are presented elsewhere.⁴¹ All variables used in the present study were measured prior to the quit date.

Participants

Individuals were eligible to participate if they were ≥ 21 years of age, smoked ≥ 5 cigarettes per day during the previous year, were motivated to quit within 30 days, possessed a home address and a functioning home telephone number, and were able to understand English at a 6th-grade literacy level. Individuals were excluded from the study if they reported regular use of tobacco products other than cigarettes, used bupropion or nicotine replacement products other than the nicotine patches supplied by the study, had another household member enrolled in the study, participated in a smoking cessation program during the previous 90 days, or reported that the nicotine patch was medically contraindicated.

Measures

Socioeconomic status/demographic information—The Demographic Information Questionnaire is a self-report measure of demographic (eg, race/ethnicity, age, gender, and marital status) and several commonly used socioeconomic status indicators (for a review, see^{42,43}). Education was dichotomized into 2 categories: (1) high school education and (2) some college. Annual household income included 4 categories: (1) \$9,999, (2) \$10,000–\$29,999, (3) \$30,000–\$49,999, and (4) ≥ \$50,000. Employment included 2 categories: (1) not employed (60% were unemployed, 21.2% were unable to work/disabled, 9.1% were retired, 5.1% were homemakers, 4.6% were students) and (2) employed (81.1% employed full-time, 18.9% employed part-time). Insurance included 2 categories: (1) insured (ie, Medicaid, Medicare, private) or (2) uninsured.

Perceived neighborhood disadvantage—The neighborhood vigilance scale^{44,45} is a 6-item self-report measure of reactive responding and vigilance for threat within an individual's neighborhood. Items are rated on a 5-point Likert scale, and total scores may

range from 6 to 30. Higher scores indicate greater vigilance for threat. The neighborhood problems scale²⁰ is a 10-item self-report measure of problems such as vandalism, litter, and traffic within a neighborhood. Total scores may range from 10 to 30, with higher scores indicating greater neighborhood problems. The social cohesion and trust scale⁴⁶ is a 5-item self-report measure of beliefs about neighbors (eg, neighbors' willingness to help, trustworthiness, values). All items are measured on a 5-point Likert scale, and scores may range from 5 to 25. Higher scores suggest greater neighborhood social cohesion and trust.

Social support—The Interpersonal Support Evaluation List (ISEL-12)⁴⁷ is a 12-item self-report measure of perceived availability of social support that contains 3 subscales. The Tangible Support subscale measures the perceived availability of material aid (eg, able to borrow money if needed), the Belonging subscale measures the perceived availability of others with whom one may engage in activities, and the Appraisal subscale measures the perceived availability of others with whom one can talk about problems. Items are rated on a 4-point scale, and scores may range from 4 to 16 on each subscale. Higher scores indicate greater social support.

Negative affect—The Center for Epidemiologic Studies Depression (CES-D)⁴⁸ questionnaire was administered to measure depressive symptoms. The measure contains 20 items rated on a 4-point scale, and total scores may range from 0 to 60. The Positive and Negative Affect Schedule (PANAS)⁴⁹ is a self-report measure on which participants rate the degree to which each of 20 adjectives reflects their mood during the past 7 days. The measure comprises separate positive affect and negative affect subscales. Items are rated on a 5-point Likert scale, and scores may range from 10 to 50 on each subscale. Higher scores indicate greater positive or negative affect. The Patient Health Questionnaire (PHQ) – Major Depressive Disorder (MDD)⁵⁰ is a self-report diagnostic screening instrument used to indicate probable MDD. Responses on the questionnaire suggest a probable diagnosis of MDD when a participant endorses 5 or more symptoms of MDD that were experienced on more than half the days during the past 2 weeks, and at least one of those symptoms includes (1) little interest or pleasure in doing things or (2) feeling down, depressed, or hopeless.

Body mass index—Weight and height were measured using a Scale-Tronix Model 5002 stand-on scale with height gauge. Body mass index (BMI; kg/m²) was calculated based on prequit height and weight measurements. Participants with a BMI ≥ 30 were considered obese.

Analytic plan—Mplus software (version 5.21) was used to evaluate a latent variable model of the hypothesized mechanisms through which SES influences BMI among smokers. The hypothesized mechanisms evaluated in the model were neighborhood disadvantage, social support, and negative affect. Four latent variables were created: (1) SES, (2) perceived neighborhood disadvantage, (3) social support, and (4) negative affect. The SES latent variable comprised 4 standard measures of SES including education, income, employment status, and insurance status. The perceived neighborhood disadvantage latent variable included the neighborhood vigilance, neighborhood problems, and social cohesion and trust measures. The social support latent variable included the 3 subscales of the ISEL-12 (ie, Tangible Support, Belonging, Appraisal). Finally, the negative affect latent variable comprised the CES-D, PANAS negative affect, and PHQ MDD. Most of the variables in the model were treated as continuous, with the exceptions of employment status (dichotomous), education (dichotomous), income (4 categories), insurance status (dichotomous), and PHQ MDD (dichotomous). Given the inclusion of these categorical variables, mean and variance adjusted weighted least squares (WLSMV) estimation was used to evaluate the model. Standardized path coefficients were reported for each pathway

in the model and may be interpreted as the standard deviation increase or decrease in the predicted variable for each 1 standard deviation increase in the predictor variable. The model was initially tested in all 3 racial/ethnic groups combined, and subsequently within each racial/ethnic group, to determine whether the model was a good fit for all groups. Unstandardized path coefficients were additionally presented when the model was evaluated within each racial/ethnic group in order to allow for direct comparisons of the coefficients between groups. Unstandardized coefficients represent the increase or decrease in the predicted variable that occurs with each 1-point increase in the predictor variable.

RESULTS

Participant Characteristics

A total of 434 smokers participated in the smoking cessation intervention. However, 10 participants were excluded from the current analyses because they reported a race/ethnicity other than African American, Latino, or white; and there were insufficient numbers of individuals in other racial/ethnic groups to evaluate the hypothesized model. Of the remaining 424 participants, 34.0% were African American ($N = 144$), 33.2% were Latino ($N = 141$; primarily of Mexican origin), and 32.8% were white ($N = 139$). Information about participant recruitment and enrollment in the parent study is presented elsewhere.^{10,41} Baseline participant characteristics overall and by race/ethnicity are presented in Table 1. As shown, there were numerous differences by race/ethnicity including age, gender, cigarettes smoked per day, years of smoking, education, income, unemployment, social support, BMI, and obesity prevalence. Please also note that BMI among participants ranged from underweight to obese (range 16.8–69.2).

Latent Variable Model

Correlation analyses indicated that higher BMI was significantly associated with lower income, unemployment, greater neighborhood vigilance, greater CES-D scores, and probable major depressive disorder (see Table 2 for correlations among variables included in the model). WLSMV estimation for the hypothesized model yielded the following model fit values: χ^2 ($df = 34$) = 51.693, $p = .0265$; root mean square error of approximation (RMSEA) = .035, Tucker-Lewis Index (TLI) = .979, comparative fit index (CFI) = .967, and weighted root mean square residual (WRMR) = .679. Overall, the model fit indices are consistent with good fit.^{51–53} Although the indicators of each latent variable are correlated (ie, range = .45 – .80; see Table 2), the magnitudes of the relationships do not suggest multicollinearity (eg, all correlations < .90; see ⁵⁴). Most of the pathways between variables in the model were significant. Specifically, SES was inversely associated with perceived neighborhood disadvantage, $p < .001$, and BMI, $p = .024$, and positively associated with social support, $p = .006$. Perceived neighborhood disadvantage was inversely associated with social support, $p < .001$, and positively associated with negative affect, $p < .001$. Social support was inversely associated with negative affect, $p < .001$, and positively associated with BMI, $p = .003$. Negative affect was positively associated with BMI, $p = .026$. However, the pathways between SES and negative affect and between perceived neighborhood disadvantage and BMI were not significant. Variables in the model accounted for 6.2% of the variance in BMI ($R^2 = .062$), 46.9% of the variance in negative affect ($R^2 = .469$), 13.3% of the variance in perceived neighborhood disadvantage ($R^2 = .133$), and 18.4% of the variance in social support ($R^2 = .184$). The model including standardized path estimates is presented in Figure 1.

Notably, SES had significant indirect effects on BMI through perceived neighborhood disadvantage, social support, and negative affect. Perceived neighborhood disadvantage had significant indirect effects on BMI through social support and negative affect; and social

support had significant indirect effects on BMI through negative affect. Standardized indirect effects are calculated by multiplying the standardized path coefficients for each individual path, and therefore the direction of the effects will vary depending on whether the multipliers are positive and/or negative. Thus, the standardized estimates that indicate overall directionality for each indirect pathway in the model are presented in Table 3, with the direction of the association indicated in parentheses following each individual pathway (ie, + or -).

Racial/Ethnic Differences

Analyses were conducted to determine whether the model was a good fit within each racial/ethnic group. WLSMV estimation for the model yielded acceptable model fit values for all groups: African Americans, $\chi^2(24) = 23.283$, $p = .503$, RMSEA < .001, TLI = 1.004, CFI = 1.000, and WRMR = .567; Latinos, $\chi^2(30) = 28.835$, $p = .5263$, RMSEA < .001, TLI = 1.006, CFI = 1.000, and WRMR = .548; whites, $\chi^2(26) = 40.389$, $p = .036$, RMSEA = .063, TLI = .951, CFI = .909, and WRMR = .663. A multiple group analysis was conducted, using the DIFFTEST option for WLSMV estimation,⁵⁵ to determine whether the individual paths in the final model differed significantly by racial/ethnic group. The following paths differed by race/ethnicity: (1) perceived neighborhood disadvantage → social support and (2) SES → BMI (Table 4). Specifically, the inverse relationship between perceived neighborhood disadvantage and social support was significantly stronger for African Americans and Latinos than for whites. In addition, the relationship between SES and BMI was positive for Latinos, which differed significantly from the inverse relationships found among African Americans and whites. Table 4 displays the unstandardized path estimates by race/ethnicity to allow for direct comparisons, given that standardized estimates may not be directly compared across groups.⁵¹ Overall, model fit statistics suggest that the hypothesized model is a good fit within each racial/ethnic group (eg, all RMSEA statistics < .06, all TLI statistics > .95, all CFI statistics > .90, all WRMR statistics < .90).

DISCUSSION

The prevalence of obesity in this sample of treatment-seeking smokers was alarmingly high (42.4%) and differed by race/ethnicity. Rates of obesity were highest among Latinos (52.4%), followed by African Americans (43.1%), and whites (32.3%). Lower SES, particularly lower income and unemployment, was linked with higher BMI in this sample. Social support, perceived neighborhood disadvantage, and negative affect at least partially mediated the relationship between SES and BMI. Consistent with previous research, SES was inversely associated with perceived neighborhood disadvantage and BMI, and positively associated with social support. Perceived neighborhood disadvantage was positively associated with negative affect and inversely associated with social support. Social support was inversely associated with negative affect, and negative affect was positively associated with BMI. The hypothesized conceptual model demonstrated good fit across 3 racial/ethnic groups. These findings suggest the need for interventions that target obesity among smokers seeking treatment, and provide several potential intervention targets for the prevention and treatment of overweight/obesity.

Although most of the hypothesized pathways in the model were significant (Figure 1), the direct effects of SES on negative affect and of perceived neighborhood disadvantage on BMI were not significant. Thus, it appears that SES has only an indirect effect on negative affect through social support and perceived neighborhood disadvantage. For example, limited income may necessitate living in a disadvantaged neighborhood due to the lower costs of housing; and resulting perceptions of neighborhood problems may lead to greater negative affect. Similarly, socioeconomically disadvantaged individuals may have fewer social resources, which may also contribute to greater negative affect.

Perceived neighborhood disadvantage had only an indirect effect on BMI through social support and negative affect. Although it is possible that objective measures of neighborhood disadvantage may have a more direct influence on BMI due to physical limitations on an individual's ability to engage in physical activity (eg, absence of sidewalks for walking, etc) or to purchase healthy foods (eg, few grocery stores), perceived neighborhood disadvantage (eg, low neighborhood social cohesion, perceived neighborhood problems) may be more associated with psychosocial mechanisms such as low social support and negative affect. For example, individuals may experience negative affect as a result of problems in their neighborhoods (eg, vandalism and other crime) and have less social support to cope with stressors. Notably, social support was positively related to BMI, which is consistent with previous findings among African American smokers.¹⁹ Plausibly, the increasingly high prevalence of overweight and obesity may disproportionately influence food preferences, physical activity habits, and perceptions of healthy body size in those with large social networks. That is, individuals with larger social networks may have a greater number of contacts who are overweight or obese, which may influence habits and perceptions related to obesity.

Although the hypothesized model demonstrated good fit overall across racial/ethnic groups, 2 pathways differed between groups. Specifically, the paths between perceived neighborhood disadvantage and social support and between SES and BMI differed by race/ethnicity. The inverse relationship between perceived neighborhood disadvantage and social support was significantly stronger for African Americans and Latinos than for whites. One possible hypothesis might be that African Americans and Latinos are more likely than whites to depend on neighbors for social support, and opportunities to develop these relationships may be more limited in disadvantaged neighborhoods due to safety and other concerns. Consistent with this hypothesis, neighborhood social cohesion and trust were significantly correlated with all 3 subscales of the ISEL social support measure (ie, Tangible Support, Belonging, Appraisal) for both African Americans and Latinos, but only with Tangible Support among whites (analyses not presented). Thus, overall social support may be reduced among racial/ethnic minority groups living in particularly disadvantaged neighborhoods. Conversely, overall social support among whites might be less influenced by residence in disadvantaged neighborhoods if, in fact, they are less likely to rely on neighbors for social support.

Surprisingly, the relationship between SES and BMI was positive for Latinos, which differed significantly from the inverse relationship found among African Americans and whites. Perhaps these findings may be understood in the context of the "Hispanic paradox" (for a review, see Gallo et al⁵⁶). Specifically, foreign-born Latinos, especially those of Mexican origin, seem to be initially protected from many of the negative health outcomes typically associated with low SES when they arrive in the United States. Unfortunately, health becomes poorer with increasing SES and acculturation among Mexican adults in the United States.⁵⁷ Similarly, birth in the United States as well as greater length of US residence are each associated with greater BMI.⁵⁸ In the current study, most Latino participants were not recent immigrants (ie, 74.4% of Latino participants reported that they were born in the United States), suggesting the possibility that greater acculturation may have contributed to the positive association between SES and BMI among Latino participants. Additional post hoc analyses indicated that there were significant differences in the prevalence of overweight and obesity by immigrant status ($p = .039$), such that Latinos born in the United States were more likely than Latino immigrants to be overweight (29.0% vs 25.0%) or obese (57.0% vs 40.6%). Although these findings are intriguing, a larger sample of Latino immigrants and nonimmigrants will be needed to thoroughly explore this question. In addition, future studies are needed to evaluate the role of acculturation within models of SES and BMI and/or other modifiable risk factors.

Overall, findings suggest the need to address obesity among those attempting smoking cessation and highlight the importance of addressing neighborhood disadvantage, social support, and negative affect. Policy-level strategies that address socioeconomic factors such as unemployment, low education, poverty, and neighborhood problems may have a beneficial indirect influence on BMI. Dow et al⁵⁹ suggest several broad strategies that could be implemented to reduce the SES gradient in health including (1) raising the SES of the lowest SES groups, (2) redistributing resources away from the highest SES, (3) reducing population-wide risk exposures, and (4) buffering the negative health consequences of low SES. For example, socioeconomic disadvantage may be targeted directly through programs that provide assistance with education planning (eg, providing information about obtaining financial aid, GED programs, or local colleges/universities/trade schools) and obtaining employment (eg, resume preparation, searches for appropriate positions). In addition, financial incentives have been shown short-term success for the promotion of behavior change^{60,61} and may be particularly appealing to economically disadvantaged individuals. Such incentives may be provided through government programs, such as Medicaid, where smoking- and obesity-attributable expenditures are high.^{62,63}

Community-based participatory research (CBPR) is another approach to addressing SES disparities, in which academic institutions partner with the community to address the determinants of health (for a review of the CBPR approach, see Horowitz et al⁶⁴). For example, Minkler et al⁶⁵ described a partnership between a local university and a committee of community representatives that resulted in changes to city smoking and land use policies aimed at reducing indoor smoking and promoting physical activity. Such community groups may be uniquely positioned to address neighborhood disadvantage, and other problems, through the facilitation and planning of a variety of activities such as neighborhood watch programs and neighborhood social activities.

Finally, existing smoking cessation and other health behavior interventions for low SES populations may be modified to target existing obesity or to prevent future weight gain. Some initial work has been done in the area of postcessation weight gain prevention with equivocal results.^{66,67} Promising approaches to longer-term weight gain prevention following smoking cessation may include individualized programs, cognitive behavioral treatments, very low calorie diets, and exercise interventions.⁶⁷ In addition, multiple behavior-change interventions have shown promise for secondary prevention among individuals with cardiovascular disease or diabetes.⁶⁸ With regard to the current findings, positive social support may be facilitated through multiple behavior-change interventions that involve family, social networks, or others attempting to make similar behavior changes. Further, negative affect may be targeted through adjunctive treatment for depression or via stress management/coping skills training. Similarly, the stress associated with residence in a disadvantaged neighborhood or other related stressors (eg, financial strain) may be addressed within such treatments.

The current study has several strengths and limitations. Using a structural equation modeling approach, the findings provide additional support for a theoretical model previously evaluated in an African American sample of smokers.¹⁹ Further, the current sample included roughly equal proportions of African American, Latino, and white participants, which allowed for the evaluation of the model within 3 racial/ethnic groups. Unfortunately, the cross-sectional design of the study limits the ability to draw conclusions about causality, and important behavioral variables such as diet and physical activity were not available and therefore are not included in the model. Nevertheless, the findings provide additional support for a conceptual model with which researchers may attempt to understand psychosocial factors that mediate the relationship between SES and BMI. It is unclear the extent to which the current model may be applied to community samples that include both

smokers and nonsmokers, and it is possible that the model may apply only to treatment-seeking smokers. However, obesity among smokers may warrant specific attention, as this combination of modifiable risk factors increases the likelihood of disease and mortality. Future studies are needed to evaluate the model using prospective designs within community samples and in other racial/ethnic groups and to continue to identify additional mediators of the relation between SES and BMI. Research aimed at gaining a better understanding of the mechanisms through which SES and race/ethnicity influence BMI may facilitate the development of effective interventions and ultimately contribute to the elimination of health disparities.

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Figure 1.

Model of the relationship between socioeconomic status and body mass index in smokers. Most standardized path coefficients in the model are statistically significant ($p < .05$) with the exceptions of the following: (1) SES → Negative Affect, (2) Perceived Neighborhood Disadvantage → BMI.

Note: PHQ-MDD = Patient Health Questionnaire, Major Depressive Disorder; CES-D = Center for Epidemiologic Studies – Depression; PANAS NA = Positive and Negative Affect Schedule, Negative Affect Scale

Table 1

Baseline Participant Characteristics by Race/Ethnicity

	All Participants	African Americans	Latinos	Whites	p
Age	41.2 (11.2)	44.8 (9.8) ^e	36.0 (10.2) ^{e,g}	42.8 (11.6) ^g	<.001
Gender (% female)	53.5	59.7 ^e	44.7 ^e	56.1	.03
Cigarettes Smoked per Day	21.1 (10.3)	20.9 (12.0) ^f	19.0 (8.9) ^g	23.5 (9.3) ^{f,g}	.001
Years of Smoking	21.6 (11.1)	23.5 (11.3) ^e	18.0 (9.3) ^{e,g}	23.1 (11.7) ^g	<.001
Education (% High School)	42.4	46.2 ^f	49.6 ^g	31.2 ^{f,g}	.004
Annual Household Income (%)					<.001
\$9,999	29.3	42.1 ^{e,f}	15.0 ^{e,g}	29.5 ^{f,g}	
\$10,000-\$29,999	24.0	24.8	27.5	19.7	
\$30,000-\$49,999	24.0	23.3	30.0 ^g	18.9 ^g	
\$50,000	22.7	9.8 ^{e,f}	27.5 ^e	32.0 ^f	
Employment (% unemployed)	41.9	51.4 ^e	26.2 ^{e,g}	46.0 ^g	<.001
Insurance (% uninsured)	39.3	35.0	46.8	36.2	.086
Neighborhood Problems	14.9 (4.0)	15.1 (4.1)	15.0 (4.0)	14.4 (3.9)	.298
Social Cohesion and Trust	16.4 (3.7)	16.2 (3.6)	16.4 (3.8)	16.6 (3.8)	.656
Neighborhood Vigilance	16.4 (4.5)	16.7 (4.1)	16.8 (4.4)	15.7 (4.9)	.076
ISEL Tangible Support ^a	12.6 (2.8)	12.2 (2.9)	12.8 (2.7)	12.8 (2.8)	.140
ISEL Belonging ^a	12.6 (2.7)	12.4 (2.8) ^e	13.1 (2.5) ^{e,g}	12.2 (2.7) ^g	.016
ISEL Appraisal ^a	12.7 (3.0)	12.6 (2.8)	12.4 (3.1)	13.1 (3.0)	.147
CES-D ^b	14.8 (11.3)	16.3 (11.5)	15.0 (10.7)	13.0 (11.5)	.064
PANAS Negative Affect ^c	19.8 (8.3)	20.0 (8.5)	20.2 (8.3)	19.3 (8.1)	.642
PHQ Major Depressive Disorder ^d (%)	11.1	13.2	10.6	9.4	.576
Body Mass Index (1 week prequit)	29.9 (7.7)	30.3 (7.9) ^f	31.3 (7.0) ^g	28.2 (8.0) ^{f,g}	.003
Obesity (% BMI ≥ 30; 1 week prequit)	42.4	43.1	52.4 ^g	32.3 ^g	.001

^a Interpersonal Support Evaluation List (ISEL)

^bCenter for Epidemiologic Studies – Depression (CES-D)

^cPositive and Negative Affect Schedule (PANAS)

^dPatient Health Questionnaire (PHQ)

^eAfrican Americans significantly differ from Latinos

^fAfrican Americans significantly differ from whites

^gLatinos significantly differ from whites.

Table 2

Correlations Among Variables in the Model

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Education	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. Income	.18***	-	-	-	-	-	-	-	-	-	-	-	-	-
3. Employment ^a	.07	.45***	-	-	-	-	-	-	-	-	-	-	-	-
4. Insurance ^b	.06	.23***	.10*	-	-	-	-	-	-	-	-	-	-	-
5. Neighborhood Problems	-.15**	-.27***	-.09	-.10*	-	-	-	-	-	-	-	-	-	-
6. Social Cohesion and Trust	.07	.25***	.05	.12*	-.50***	-	-	-	-	-	-	-	-	-
7. Neighborhood Vigilance	-.17***	-.22***	-.07	-.04	.47***	-.56***	-	-	-	-	-	-	-	-
8. Tangible Support (ISEL)	.03	.22***	.18***	.10*	-.22***	.31***	-.28***	-	-	-	-	-	-	-
9. Belonging (ISEL)	.01	.21***	.18***	.05	-.14**	.20***	-.16***	.66***	-	-	-	-	-	-
10. Appraisal (ISEL)	.04	.17***	.10*	.10*	-.22***	.24***	-.27***	.66***	.63***	-	-	-	-	-
11. Depression (CES-D)	-.09	-.33***	-.19***	-.02	.34***	-.33***	.36***	-.49***	-.38***	-.47***	-	-	-	-
12. Negative Affect (PANAS)	.03	-.20***	-.09	-.01	.24***	-.24***	.28***	-.39***	-.31***	-.38***	.80***	-	-	-
13. Major Depressive Disorder (PHQ) ^c	-.02	-.19***	-.13***	-.02	.21***	-.20***	.23***	-.31***	-.24***	-.30***	.50***	.45***	-	-
14. Body Mass Index	-.03	-.12*	-.14**	.01	.06	-.06	.13**	.00	.06	.06	.10*	.07	.13**	-

Note.

ISEL = Interpersonal Support Evaluation List; CES-D = Center for Epidemiologic Studies Depression; PANAS = Positive and Negative Affect Schedule

^aUnemployed = 0, Employed = 1^bUninsured = 0, Insured = 1^cNondepressed = 0, Probable Major Depressive Disorder = 1*
p .05**
p .01***
p .001

Table 3

Specific Indirect Effects of SES, Perceived Neighborhood Disadvantage, and Social Support on Body Mass Index.

Indirect Pathway	Standardized Estimate	p
SES → BMI		
SES → Perceived Neighborhood Disadvantage (–) → Social Support (–) → BMI (+)	.026	.01
SES → Perceived Neighborhood Disadvantage (–) → Social Support (–) → Negative Affect (–) → BMI (+)	–.010	.05
SES → Social Support (+) → BMI (+)	.039	.05
SES → Perceived Neighborhood Disadvantage (–) → Negative Affect (+) → BMI (+)	–.019	.06
SES → Social Support (+) → Negative Affect (–) → BMI (+)	–.015	.09
SES → Negative Affect (–) → BMI (+)	–.018	.19
SES → Perceived Neighborhood Disadvantage (–) → BMI (+)	–.023	.37
Perceived Neighborhood Disadvantage → BMI		
Perceived Neighborhood Disadvantage → Social Support (–) → BMI (+)	–.071	.01
Perceived Neighborhood Disadvantage → Social Support (–) → Negative Affect (–) → BMI (+)	.027	.04
Perceived Neighborhood Disadvantage → Negative Affect (+) → BMI (+)	.051	.05
Social Support → BMI		
Social Support → Negative Affect (–) → BMI (+)	–.082	.04

Note.

The direction of the association is indicated in parentheses following each pathway (ie, + or –).

Table 4

Unstandardized Path Estimates by Race/Ethnicity

Path	African Americans		Latinos		Whites		Diff test χ^2 (2)
	Unstandardized Estimate	SE	Unstandardized Estimate	SE	Unstandardized Estimate	SE	
SES → Social Support	1.904	.931	.737	1.096	2.227	.938	1.318
SES → Perceived Neighborhood Disadvantage	-2.118	1.328	-4.993	2.093	-3.981	1.372	2.378
SES → Negative Affect	-0.312	0.325	-0.120	0.348	-0.342	.294	0.265
Perceived Neighborhood Disadvantage → Social Support	0.402	.084	0.264	0.086	-.060	0.065	12.397 a,b
Perceived Neighborhood Disadvantage → Negative Affect	0.100	0.038	0.057	0.031	0.060	0.021	0.991
Social Support → Negative Affect	-0.153	0.041	-0.146	0.036	-0.172	0.034	0.386
Negative Affect → Body Mass Index	2.356	1.702	0.434	1.495	0.862	0.779	0.794
Perceived Neighborhood Disadvantage → Body Mass Index	0.034	0.396	0.162	0.297	0.212	0.198	0.156
Social Support → Body Mass Index	1.161	0.512	0.429	0.366	0.275	0.381	2.055
SES → Body Mass Index	7.540	3.687	2.901	2.833	4.857	3.276	6.339 b,c

^aPath for whites is significantly different (p .05) from that for African Americans.

^bPath for whites is significantly different (p .05) from that for Latinos.

^cPath for African Americans is significantly different (p .05) from that for Latinos.