Association Between Socioeconomic Status Mobility and Inflammation Markers Among White and Black Adults in the United States: A Latent Class Analysis

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ABSTRACT

Objective: This article examines whether multidimensional indicators of objective and subjective socioeconomic status (SES) across the life course can be categorized into latent classes of SES mobility and tests the associations of these categories with inflammation markers among white and black adults.

Methods: Data are from 592 non-Hispanic white and 158 non-Hispanic black participants who completed both the baseline survey and biomarkers assessment of the Midlife in the United States Refresher study. Groups of different SES mobility were examined using latent class analysis.

Results: White and black participants showed different patterns of SES mobility. Among blacks, the latent classes were as follows: 1) objectively always high (24.71%; high objective SES across the life course), 2) subjectively always high (6.48%; high subjective and low objective SES across the life course), 3) downwardly mobile (35.84%; high childhood SES, low adult SES), and 4) always low (32.97%; low childhood SES, education, and adult SES). Among whites, the latent classes were as follows: 1) always high (52.17%; high childhood SES, high education, high adult SES), 2) upwardly mobile (18.14%; low childhood SES, high education, high adult SES), 3) subjectively downward (27.74%; high childhood SES, high education, high objective adult SES, low subjective adult SES), and 4) always low (1.95%; low childhood SES, education, and adult SES). SES mobility was associated with inflammation in white (Wald χ^2 values (3) = 12.89–17.44, p values < .050), but not in black adults (Wald χ^2 values (3) = 2.79–7.22, p values > .050).

Conclusion: The lack of SES mobility differentiation on inflammation is an indication of diminished return for the most affluent class among black participants.

Key words: health disparities, inflammation, latent class analysis, life course, race/ethnicity, socioeconomic status (SES), social mobility, United States.

INTRODUCTION

Persistent racial inequalities in health, especially between whites and blacks, have been a long-standing public health concern in the United States (1). A substantial proportion of racial disparities in health are explained by socioeconomic status (SES) differences between races (2). SES variation creates health disparities through complex pathways involving psychological and biological mediators (3). Inflammatory processes have been hypothesized to mediate the pathways through which SES links to the development and progression of chronic diseases, such as cardiovascular disease (4). However, findings regarding the interaction between SES and race/ethnicity on affecting inflammatory burden are mixed. A study found consistent SES-inflammation associations in both black and white adults (5). However, other studies (6–8) found a less consistent association between SES and inflammation among black compared with white adults.

Gaining more attention is understanding the role of life-course SES and its association with inflammation (4,6,9). Life-course analysis of SES focuses on understanding the effect of *accumulation* of socioeconomic disadvantage on health, *sensitive periods* in which SES conditions might have a greater effect on health during the life course, and the impact of socioeconomic *mobility* on health (9–11). Previous studies have examined the association between accumulation of socioeconomic adversity across the life course (4,6,9) and tested the influence of childhood as a sensitive period for the inflammatory burden in adulthood (12). However, only few studies have examined the linkage between SES mobility

a-BIC = sample size–adjusted BIC, **BIC** = Bayesian information criterion, **BLRT** = bootstrapped likelihood ratio test, **CRP** = C-reactive protein, **CV** = coefficient of variability, **IL-6** = interleukin-6, **LCA** = latent class analysis, **MIDUS** = Midlife in the United States, **SAQ** = self-administered questionnaire, **SES** = socioeconomic status, **sICAM-1** = soluble intracellular adhesive molecule 1

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and inflammation across adulthood. Thus, examining the association between SES mobility, race/ethnicity, and inflammation is important to better understand the physiological pathways through which social factor impacts health in different racial groups.

The Lack of Subjective Measures in SES Mobility Research

Previous studies of SES mobility have used comparison of a single or composite score of objective childhood SES (i.e., parental education level) to a single or composite score of objective adult SES (i.e., individual's education level). However, past studies have not considered the role of subjective SES. Subjective SES refers to individual's appraisal regarding social status and ability to access resources. Most individuals refer to their financial situation when considering their subjective SES (13). Thus, in this study, we used multiple indicators of subjective financial condition and strains across the life course to asses one's subjective SES.

Studies have shown consistent findings that subjective SES is a unique construct, independent of objective SES, on its ability to predict health (13–16). Studies have also shown that subjective SES is significantly associated with multiple mediators of SES-health association, such as stress, perceived control, and diurnal cortisol (14,17,18). It is important to understand the interconnectedness between objective and subjective SES across the life course on forming one's SES mobility. Furthermore, multidimensionality of SES measures is critical to examine SES mobility among white and black adults. For example, compared with whites, blacks have lower levels of income across different levels of education (19). On the other hand, blacks, in general, have shown higher subjective SES compared with whites (20). Thus, whites and blacks may have different patterns of SES mobility when both objective and subjective SES measures are being used.

The Association Between SES Mobility and Health Among White and Black Adults

Studies have shown black-white differences in terms of the relationship between SES mobility and health (21,22). There are several theories that might explain how SES mobility affects health differently between black and white. The *minority poverty* hypothesis posits that blacks who experience constant socioeconomic adversity across their life course would have worse health outcomes compared with whites with similar socioeconomic conditions because of a double jeopardy of socioeconomic deprivation and racial discrimination, (21,23). Similarly, the *diminishing return* hypothesis specifies that blacks with constantly high levels of SES across their life course would have fewer health benefits compared with their white counterparts, also because of racial discrimination (21). Finally, the *skin-deep resilience* hypothesis posits that for blacks to achieve socioeconomic mobility amid great stressors due to childhood socioeconomic deprivation and racial discrimination may cost them physiologically because of physical wear and tear (24).

It is unclear how socioeconomic mobility across the life course relates to inflammation. Life-course analysis on early life adversity provides a clue that childhood may be a sensitive period for the development of inflammatory burden across adulthood (12). Studies have found that childhood SES is associated with markers of inflammation across adulthood (25,26). A study found that those who experience upward mobility show higher levels of inflammatory markers compared with those in the stable high SES (27), further supporting the assertion that childhood is a sensitive period for the development of inflammatory burden in adulthood. However, other studies have shown that adult SES was more strongly related to inflammation in adulthood (7,9). Less is known regarding the association between SES mobility and markers of inflammation among white and black adults.

In summary, the goal of this study is twofold: a) to model socioeconomic mobility across the life course among white and black adults based on objective and subjective indicators of SES using latent class analysis (LCA), and (b) to examine the association between SES mobility and inflammation markers among white and black adults. LCA is a suitable approach on modeling heterogeneity of SES mobility based on multiple indicators of objective and subjective SES by providing an intuitive and parsimonious solution (28).

METHODS

Participants and Procedures

This study used data from the Midlife in the United States (MIDUS) study (midus.wisc.edu). The first wave of MIDUS study was conducted from 1995 to 1996, followed by the second wave in 2004. In 2011, the MIDUS Refresher study was conducted to investigate the impact of the Great Recession in the late 2000s on health and to refresh and expand the MIDUS study by recruiting a new set of participants (29). Recruitment of participants, data collection process, and study protocols in MIDUS Refresher were similar to the main study of MIDUS. The MIDUS Refresher study recruited 3577 new participants (response rate, 59%) through random dial digit who completed baseline telephone interview. Among them, 2600 participants (73% of the phone interview participants) also completed self-administered questionnaires (SAQs). The main sample of MIDUS Refreshers comprised 82.5% white and 9.7% black participants. To oversample the black participants, a supplemental sample was drawn from Milwaukee County, Wisconsin. The supplemental sample included 508 participants who completed in-person interviews (response rate, 47.7%). Among them, 299 participants (59% of the in-person interview participants) also completed the SAQ. The Milwaukee supplemental sample comprised 3.9% white and 90.9% black participants. Those who completed both the baseline survey and SAQ were eligible to participate in the biomarker assessment.

The biomarker assessment of the MIDUS Refresher (n = 863) was conducted in 2013 to 2016. Participants were invited to stay overnight at one of the three regional clinical research units, whichever imposed the least travel burden. Data for this analysis were from 750 biomarkers study participants (mean [SD] age = 50.84 [13.41] years; 52.1% were female; 86.4% MIDUS Refresher main sample, 13.6% MIDUS Refresher Milwaukee supplemental survey) who self-identified as non-Hispanic white (592; 99% from the main sample) and non-Hispanic black participants (158; 34.8% from the main sample). Participants signed an informed consent to participate in both the baseline survey and the biomarker study. Sociodemographic characteristics of the participants were presented in Table 1.

Measures

Life-Course SES

There are eight measures used as the indicators of life-course SES, including the following: 1) father's (or mother if data were missing) highest level of education (1, < high school; 2, high school/general educational development and above), 2) whether family of origin received welfare (1, yes; 2, never), 3) perception of financial level growing up (1, a lot/somewhat/a little worse off than average families; 2, same/a little/somewhat/a lot better off than average families), 4) participants' level of education (1, high school/

TABLE 1. Descriptive Statistics for Demographic Characteristics, Class Indicators, and Outcomes

Variable	White (n = 592)	Black (n = 158)
Study		
MIDUS main survey, *n* (%)	586 (99)	55 (34.8)
MIDUS Milwaukee supplemental sample, *n* (%)	6 (1)	103 (65.2)
Demographic characteristics		
Female, *n* (%)	281 (47.5)	107 (67.7)
Age, M (SD), y	52.5 (13.4)	46.8 (11.8)
Indicators of life-course SES		
Childhood SES, *n* (%)		
Parent graduated from HS/GED or higher	454 (76.7)	90 (57.0)
Family of origin never received welfare	549 (92.7)	97 (61.4)
High financial level growing up	403 (68.1)	102 (64.6)
Adult SES, *n* (%)		
Some college or higher	513 (86.7)	105 (66.5)
High income-to-poverty ratio	513 (86.7)	88 (55.7)
High current financial status	411 (69.4)	60 (38.0)
Enough money to fulfill basic needs	454 (76.7)	67 (42.4)
Not difficult paying bills	393 (66.4)	52 (32.9)
Inflammation, M (SD)		
IL-6, pg/ml	2.6 (2.3)	3.4 (2.5)
CRP, μg/ml	2.6 (5.2)	4.1 (4.9)
sICAM-1, ng/ml	268.8 (194.7)	252.6 (147.5)

MIDUS = Midlife in the United States; M = mean; SES = socioeconomic status; HS = high school; GED = general educational development; IL-6 = interleukin-6; CRP = C-reactive protein; sICAM-1 = soluble intracellular adhesive molecule 1.

general educational development or less; 2, some college or above), 5) household-sized adjusted income-to-poverty ratio (1, <150%, ≥150%), 6) perception of current financial level (0, worst; 10, best; recoded into 1, responded 0–5 on the original scale; 2, responded 6–10 on the original scale), 7) perception of the availability of money (1, not enough money; 2, enough money or more money than you need), and 8) perception of hardship on paying bills (1, very/somewhat difficult; 2, not very difficult/not at all difficult).

Parental education and welfare status are considered as objective indicators of childhood SES, whereas perceived financial level growing up is considered as the subjective indicator. Education and the income-to-poverty ratio are considered as the objective indicators of adult SES, and the rest of adult SES measures are considered as the subjective indicators of adult SES. This set of life-course SES measures has been previously used as a composite measure of childhood SES, adult SES, or life-course SES and was a significant predictor of various health outcomes across adulthood, including daily stress and daily negative affect (29), allostatic load (30), diabetes (31), and reported chronic disease (32).

Markers of Inflammation

Three markers of low-grade inflammation were used in this analysis: C-reactive protein (CRP), interleukin 6 (IL-6), and soluble intracellular adhesive molecule 1 (sICAM-1). Blood CRP was measured using a particle-enhanced immunonephelometric assay (BNII nephelometer; Dade Behring Inc, Deerfield, Illinois). The assay range is 0.164 to 800 μg/ml, intra-assay coefficients of variability (CVs) range from 2.3% to 4.4%, and interassay CVs range from 4.72% to 5.16%. Blood serum IL-6 was measured using an ultrasensitive enzyme-linked immunosorbent assay (R&D Systems, Minneapolis, Minnesota). The assay range is 0.156 to 10 pg/ml, intra-assay CV was 3.73%, and interassay CV was 15.66%. sICAM-1 was measured by sandwich enzyme-linked immunosorbent assay Quantikine kit (R&D Systems). The assay range is 31 to 1000 ng/ml, intra-assay CVs range from 3.7% to 5.2%, and interassay CVs range from 7.49% to 8.16%. IL-6 was assayed in the MIDUS Biocore Laboratory at the University of Wisconsin, Madison, Wisconsin. CRP and sICAM-1 were assayed at the Laboratory for Clinical Biochemistry Research at the University of Vermont, Burlington, Vermont. Natural log-transformed data for CRP, IL-6, and sICAM-1 were used for further analysis.

Statistical Analysis

LCA was used to identify unique groups of SES mobility based on eight observed, binary indicators of life-course SES (Table 1). LCA progressed in two steps. The first step identified and described latent classes of life-course SES using LCA. The second step assessed whether class membership was associated with inflammation markers. Selection of the optimally fitting model was based on model fit statistics and selection criteria, parsimony principle, and theoretical interpretability. Extensive explanations about technical aspects of model selection in LCA have been disseminated somewhere else (33). The model with one to six classes was considered (using 1000 sets of random starting values) before selecting the best-fitting model. All models were estimated using PROC LCA on SAS version 9.4 (33).

The second phase of the analysis used the latent classes of SES mobility to predict inflammation markers, using the BCH approach (34). The BCH approach uses posterior probabilities of class membership based on the latent class model to compute a special weighting variable. The mean of outcome variables for each class was then calculated based on this weighting variable. Finally, pairwise comparisons of the expected values of the distal outcomes were conducted using Wald tests. To compensate for multiple comparisons, Bonferroni correction was applied. Distal outcome analysis was conducted using LCA_Distal_BCH SAS Macro (35).

RESULTS

We initially analyzed data by combining both white and black participants (n = 750) to test whether latent classes of life-course SES have equal meaning across racial groups. Information on model fit statistics and selection criteria is shown in Table 2. The four-class model showed the best fit, indicated by lower sample size–adjusted BIC (a-BIC), and it was the last class with a significant bootstrapped likelihood ratio test (BLRT; indicated that the five-class model did not have significantly better model fit compared with the four-class model). Measurement invariance test of the four-class model based on race showed that there were severe measurement differences between white and black ($\chi^2(32) = 65.16$, $p < .001$), indicating that latent class structures of life-course SES between white and black participants were different. Further analysis was conducted by developing separate latent class models of SES mobility separately for white and black participants. The results from the separate LCA analyses are presented hereinafter.

SES Mobility Among White Participants

Table 2 provides model fit statistics and selection criteria for the white sample. The model with one to six classes was considered. The a-BIC was reduced for the four-class model; however, the Akaike information criterion and BIC for the four-class model were slightly higher than those for other class models. The BLRT was not significant for the six-class model, suggesting the five-class model as a favored

TABLE 2. Model Fit Information for Latent Class Analysis

No. Classes	Log Likelihood	No. Parameters Estimated	AIC	BIC	a-BIC	Entropy	BLRT
White and black combined (n = 750)							
1	−3309.38	8	1201.57	1238.53	1213.12	—	—
2	−2889.25	17	379.31	457.85	403.87	0.85	$p < .010$
3	−2852.65	26	324.10	444.23	361.67	0.82	$p < .010$
4	**−2823.85**	**35**	**284.51**	**446.21**	**335.07**	**0.68**	***p* < .010**
5	−2808.45	44	271.72	475.00	335.29	0.71	$p < .050$
6	−2797.51	53	267.82	512.69	344.39	0.74	$p > .050$
White (n = 592)							
1	−2300.80	8	821.49	856.56	831.16	—	—
2	−2033.14	17	304.16	378.68	324.71	0.87	$p < .010$
3	−2000.96	26	257.79	371.76	289.22	0.74	$p < .010$
4	**−1979.41**	**35**	**232.71**	**386.13**	**275.02**	**0.78**	***p* < .010**
5	−1966.96	44	225.81	418.68	279.00	0.77	$p < .050$
6	−1958.84	53	227.57	459.89	291.63	0.84	$p > .050$
Black (n = 158)							
1	−819.25	8	358.62	383.12	357.80	—	—
2	−753.58	17	245.29	297.35	243.54	0.84	$p < .010$
3	−739.41	26	234.94	314.57	232.26	0.82	$p < .050$
4	**−728.34**	**35**	**230.80**	**337.99**	**227.20**	**0.81**	***p* > .050**
5	−721.07	44	234.26	369.01	229.73	0.80	$p > .050$
6	−713.87	53	237.85	400.17	232.40	0.84	$p > .050$

AIC = Akaike information criterion; BIC = Bayesian information criterion; a-BIC = sample size–adjusted BIC; BLRT = bootstrapped likelihood ratio test.
Dashes indicate that the criterion was not applicable; boldface type indicates selected model.

model. Based on the model selection criteria, the best-fitting model for white participants was between the four-class and five-class models. Upon closer inspection, the five-class model was characterized by two redundant classes that were grouped into one class in the four-class model. Thus, the four-class model was selected as the best-fit model for theoretical explanation and further analysis.

Information on latent class membership probabilities and item-response probabilities for the four-class model of life-course SES among white is presented in Table 3. Class 1 (1.95% prevalence) was characterized by low levels of SES, both objective and subjective, across the life course. This class was labeled as the *always low* class. Class 2 (18.4%) was characterized by low objective and subjective childhood SES, high education, and high objective and subjective adult SES. Class 2 was identified as *upwardly mobile*. Class 3 (27.74%) was named *subjectively downward* class, as it was characterized by high objective and subjective childhood SES, high education, and high objective adult SES (i.e., income-to-poverty ratio), but low across all indicators of subjective adult SES. The last class, class 4 (52.17%), was characterized by high levels of SES, both objective and subjective, across the life course. Class 4 was labeled *always high*.

SES Mobility and Inflammation Markers Among White Participants

The omnibus test showed that expected means of log IL-6 ($\chi^2(3) = 17.44$, $p < .001$), log CRP ($\chi^2(3) = 15.08$, $p < .010$), and log sICAM-1 ($\chi^2(3) = 12.89$, $p < .010$) differed significantly by class membership. The expected mean levels of log IL-6 and log CRP for each class are presented in the top part of Table 3. Figure 1 shows that the expected mean of log IL-6 for the always low class was significantly lower than the always high ($\chi^2(1) = 15.52$, $p < .050$) and subjectively downward ($\chi^2(1) = 9.72$, $p < .050$). The expected mean of log CRP for the always low class was significantly lower than the always high class ($\chi^2(1) = 9.77$, $p < .050$; Figure 1). Finally, the expected mean of log sICAM-1 for the always low class was significantly lower than the always high class ($\chi^2(1) = 7.61$, $p < .050$; Figure 1).

SES Mobility Among Black Participants

Table 3 details information on model fit statistics and selection criteria for the black sample. The model with one to six classes was considered. The four-class model showed the lowest level of Akaike information criterion and a-BIC, but not the BIC. BLRT of the four-class model was marginally significant ($p < .1$), indicating that the three-class model was preferable. Entropy for the larger models ranged from 0.80 to 0.84. Based on the model selection criteria, the best-fitting model for black participants was between the three-class and four-class models. Closer inspection indicated that an additional class in the four-profile model shows a nonrepetitive, meaningful, and interpretable class. Thus, the four-class model was selected as the best-fit model for theoretical explanation and further analysis.

TABLE 3. Latent Class Membership Probabilities and Item-Response Probabilities

White (*n* = 592)

Indicator	Class 1: Always Low (1.95%)	Class 2: Upwardly Mobile (18.14%)	Class 3: Subjectively Downward (27.74%)	Class 4: Always High (52.17%)
Childhood SES				
Parent graduated from HS/GED or higher (O)	.18	.43	**.78**	**.91**
Family of origin never received welfare (O)	.52	**.79**	**.92**	**1.00**
High financial level growing up (S)	.13	.37	**.70**	**.82**
Adult SES				
Some college or higher (O)	.05	**.74**	**.85**	**.96**
High income-to-poverty ratio (O)	.00	**.97**	**.79**	**.96**
High current financial status (S)	.00	**.86**	.22	**.93**
Enough money to fulfill basic needs (S)	.00	**.99**	.32	**.96**
Not difficult paying bills (S)	.00	**.80**	.06	**.97**

Black (*n* = 158)

Indicator	Class 1: Always Low (32.97%)	Class 2: Downwardly Mobile (35.84%)	Class 3: Subjectively Always High (6.48%)	Class 4: Objectively Always High (24.71%)
Childhood SES				
Parent graduated from HS/GED or higher (O)	.49	**.60**	.50	**.74**
Family of origin never received welfare (O)	.22	**1.00**	.23	**.73**
High financial level growing up (S)	.44	**.93**	**.79**	.51
Adult SES				
Some college or higher (O)	.48	**.68**	.24	**1.00**
High income-to-poverty ratio (O)	.36	.52	.19	**1.00**
High current financial status (S)	.18	.19	**.61**	**.86**
Enough money to fulfill basic needs (S)	.08	.30	**1.00**	**.92**
Not difficult paying bills (S)	.08	.08	**.82**	**.88**

SES = socioeconomic status; HS = high school; GED = general educational development; O = objective indicator of SES; S = subjective indicator of SES.

Boldface type indicates high probability for the indicator.

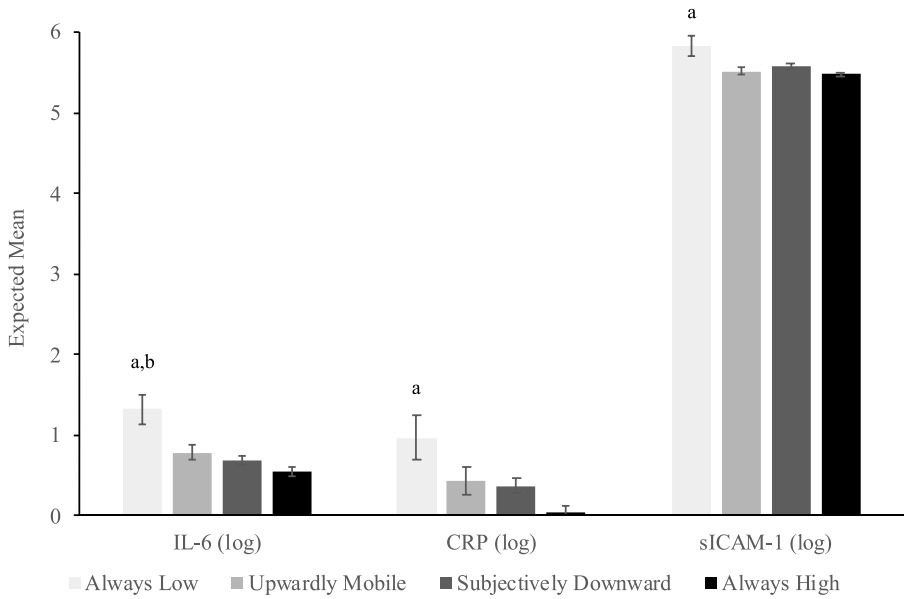

FIGURE 1. Class membership and inflammation markers among whites. [a] Significantly different from the always high ($p < .050$). [b]Significantly different from the subjectively downward ($p < .050$). [c]Significantly different from the upwardly mobile ($p < .050$). To compensate for multiple comparisons, Bonferroni correction was applied. IL-6 = interleukin-6; CRP = C-reactive protein; sICAM-1 = soluble intracellular adhesive molecule 1. Color image is available only in the online version (www.psychosomaticmedicine.org).

Latent class membership probabilities and item-response probabilities for the four-class model of life-course SES among black sample are shown in the bottom part of Table 4. Class 1 (32.97%) was labeled *always low*; it characterized by low levels of objective and subjective SES across the life course. Class 2 (35.84%) was characterized by high objective and subjective childhood SES, high education, but low objective and subjective adult SES. This class was named *downwardly mobile*. Class 3 (6.48%) was labeled *subjectively always high*, characterized by low objective childhood SES, low objective adult SES, high subjective childhood SES, and high subjective adult SES. Class 4 (24.71%) was characterized by high objective childhood SES, high objective adult SES, high subjective adult SES, but low subjective childhood SES. This class was labeled *objectively always high*.

SES Mobility and Inflammation Markers Among Black Participants

The expected mean of log IL-6 ($\chi^2(3) = 4.38$, $p = .22$) and log sICAM-1 ($\chi^2(3) = 2.79$, $p = .42$) did not significantly differ, whereas the expected mean of log CRP ($\chi^2(3) = 7.22$, $p = .065$) marginally differed by SES mobility. Pairwise comparisons indicated that there were no significantly different expected means of log IL-6, log CRP, and log sICAM-1 between classes (Figure 2).

DISCUSSION

This study is among the first that uses LCA to examine heterogeneity of SES mobility using both objective and subjective indicators of SES among white and black adults in the United States. Furthermore, this article was intended to investigate the association between SES mobility and inflammation markers, including IL-6, CRP, and sICAM-1. We found that the four-class solution was the best-fitting model for both white and black participants. However, the class structure of SES mobility was different between white and black participants. Among black participants, class membership was not a significant predictor of inflammation. On the other hand, class membership among white participants was significantly associated with all markers of inflammation.

Among white participants, we found two classes of stable life-course SES (always high and always low) and two classes that are characterized by mobility (upwardly mobile and subjectively downward). The overwhelming prevalence of stable high class among white participants represents the general characteristics of MIDUS study participants that include mostly individuals from middle to higher levels of SES. Except for the subjectively downward, the three other classes are similar to findings from previous studies on SES mobility using a traditional comparison of childhood SES and adult SES approach. The subjectively downward is a unique SES mobility class that comes up as we combined both subjective and objective indicators of SES. Given that MIDUS Refresher was conducted after the Great Recession, the low probabilities in all subjective adult SES despite high probability for income in this class may be the indication of how recession affects some white participants. Studies have shown that when using objective SES, minorities are disproportionately experienced losses compared with whites (36). The subjectively downward class may be an indication that among some white participants, the impact of the Great Recession on subjective SES is more salient.

Among black participants, we found two similar characteristics of SES mobility as in previous studies (always low and downwardly mobile) and two novel characteristics of mobility (subjectively always high and objectively always high). Only one class among four classes in black (objectively always high) has high item-response probability for income-to-poverty line ratio, whereas there were three classes among white participants (upwardly mobile, subjectively downward, and always high). This

TABLE 4. Expected Mean of Inflammation Markers Based on SES Mobility Among Whites and Blacks

White (*n* = 592)

Outcome	Omnibus Test (Wald χ^2, *df* = 3)	Class 1: Always Low (1.95%)	Class 2: Upwardly Mobile (18.14%)	Class 3: Subjectively Downward (27.74%)	Class 4: Always High (52.17%)
		M (SE)			
IL-6 (log)	17.44***	1.32 (0.19)[a]	0.79 (0.11)	0.69 (0.06)	0.55 (0.05)[b]
CRP (log)	15.08**	0.97 (0.28)[a]	0.43 (0.17)	0.37 (0.09)	0.05 (0.08)[b]
sICAM-1 (log)	12.89**	5.83 (0.12)[a]	5.52 (0.04)	5.58 (0.03)[a]	5.48 (0.02)[b]

Black (*n* = 158)

Outcome	Omnibus Test (Wald χ^2, *df* = 3)	Class 1: Always Low (32.97%)	Class 2: Downwardly Mobile (35.84%)	Class 3: Subjectively Always High (6.48%)	Class 4: Objectively Always High (24.71%)
		M (SE)			
IL-6 (log)	4.38	1.16 (0.10)	0.94 (0.11)	0.86 (0.27)	0.82 (0.14)
CRP (log)	7.22†	1.15 (0.20)[a]	0.65 (0.18)	1.13 (0.51)	0.42 (0.20)
sICAM-1 (log)	2.79	5.47 (0.08)	5.36 (0.09)	5.51 (0.35)	5.20 (0.14)

SES = socioeconomic status; *df* = degrees of freedom; M = mean; IL-6 = interleukin-6; CRP = C-reactive protein; sICAM-1 = soluble intracellular adhesive molecule 1.

* $p < .050$.

** $p < .010$.

*** $p < .001$.

† $p < .1$.

[a] Significantly higher than the overall group mean ($p < .05$).

[b] Significantly lower than the overall group mean ($p < .05$).

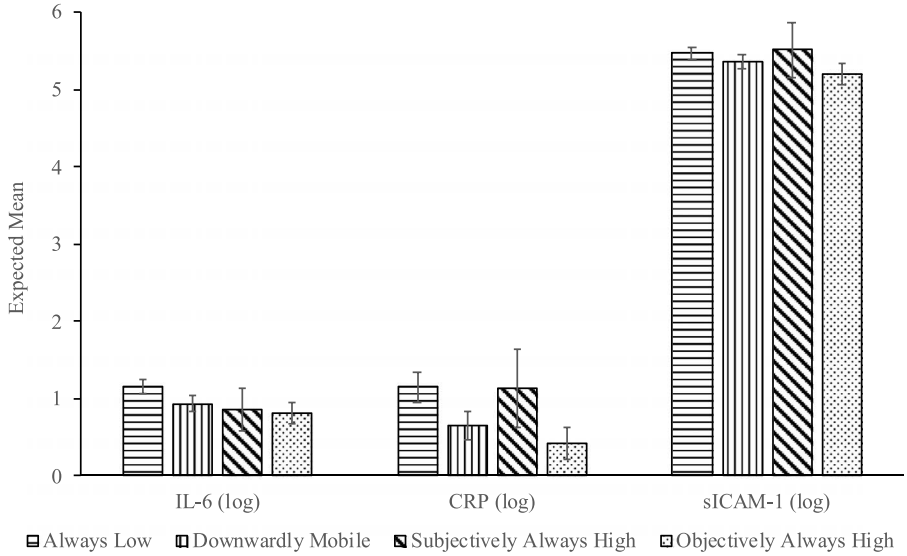

FIGURE 2. Class membership and inflammation markers among blacks. No significant pairwise comparison found across all inflammation markers. IL-6 = interleukin-6; CRP = C-reactive protein; sICAM-1 = soluble intracellular adhesive molecule 1.

result corroborates previous findings that blacks have lower levels of material resources compared with white across all levels of SES (19). The lower levels of material resources among blacks may also be a reason for the lack of an upwardly mobile class among black participants. Given that most black participants in this study were drawn from Milwaukee County, the lack of pattern of upward mobility may be unique to this sample.

The downwardly mobile class among black participants was characterized by low objective and subjective adult SES despite high levels of objective and subjective childhood SES and education. In other studies, downward mobility is usually attributed to low levels of education despite the high level of childhood SES (9,37). For some black participants, the experience of college education may not guarantee higher levels of adult SES, both objectively and subjectively. Middle class blacks are especially vulnerable to downward mobility because despite achieving higher levels of education, they lag behind whites on accumulating wealth such as owning home (38), and they are more vulnerable to the impact of the economic downturn (36,38,39).

Despite low in prevalence, the subjectively always high is an interesting class among black participants, given that it was characterized by high subjective SES across the life course despite material deprivation in childhood and adulthood. One possible explanation regarding the subjectively always high class is the optimism and religiosity among black participants. As shown in a study (40), optimism among blacks is not differentiated by SES. Furthermore, optimism, but not pessimism, among blacks is rooted in their tendency to be spiritual, especially among the older cohort (41). Thus, the subjectively always high class may represent black participants who use spirituality and optimism to deal with material deprivation. On the other hand, the objectively always high class gives an indication that among black participants, even the most affluent group experiences a certain type of hardship across their life course. The perceived low childhood SES despite high objective childhood SES in this class may be associated with the perception of socioeconomic hardship that is experienced by black participants in general because of racism and discrimination, regardless of the level of SES.

Class membership among white participants was consistently associated with inflammation makers. As expected, constant objective and subjective socioeconomic adversity across the life course is associated with higher levels of inflammatory burden. On the other hand, constant high objective and subjective SES across the life course was associated with lower levels of inflammation. We found that levels of CRP, IL-6, and sICAM-1 of the most disadvantaged class were significantly higher than the most privileged class. These results corroborate findings from previous studies on the influence of SES mobility on the same inflammatory markers (9,26).

One interesting finding from the analysis among white participants was the lack of differences in terms of inflammatory burden between the upwardly mobile and subjectively downward classes. The expected means of inflammation markers for the upwardly mobile were not significantly different from the subjectively downward. Although low childhood SES may leave a *scar* in the physiological functioning for the upwardly mobile class, the better psychosocial mediators may play as protective factors. Future studies should prioritize directly testing whether there is a chain of risks from life-course SES adversity, psychosocial factors, and inflammatory burden. In addition, the expected means of inflammation markers for both the upwardly mobile and subjectively downward were not significantly different from the group means among white participants, except for the sICAM-1. The subjectively downward class showed an elevated level of sICAM-1 compared with the overall mean among white participants. The similar finding regarding downward mobility and elevated sICAM-1 was also found by Loucks et al. (9). sICAM-1 may be sensitive to current levels of SES, including both objective and subjective SES. A better understanding of the association between SES, psychosocial mediators, and sICAM-1 would have important public health implication. A previous study has shown that elevated sICAM-1 is associated with the development of cardiovascular disease (42).

That the biological indicators were not differentiated based on SES mobility among black participants may provide an indication of support for the diminishing return hypothesis. It is possible that the socioeconomic benefit among the most affluent blacks diminished

because of a constant experience of daily discrimination. Racial discrimination is rampant among blacks, regardless of SES, and associated with worse health outcome (43). The lack of health benefits among the most affluent black participants may be due to a better understanding of social injustice and racial discrimination among them associated with better education and SES in general (21). This realization of social injustice among the more affluent group in black may be associated with higher levels of stress that undermine the health benefit of being in higher levels of SES. A laboratory study found that higher perceived discrimination among blacks was associated with higher inflammatory response, especially among those with stronger racial identity (44). Future studies should consider testing the interaction between SES mobility, discrimination, and inflammation among white and black adults, especially in a natural setting.

Strength and Limitations

The present study applied a novel statistical analysis to examine SES mobility using both objective and subjective indicators of SES across the life course. The LCA provides an intuitive and parsimonious description of the heterogeneity of SES mobility across the life course. This study provides a novel knowledge regarding the different structure of SES mobility between white and black adults and racial differences related to how SES mobility associated with inflammation markers. The results from this study added to the lack of knowledge regarding the association between SES mobility and biological mediator of health.

In light of these strengths, there are several limitations of the current study. First, life-course SES data were collected using a self-report retrospective method that may lead to measurement imprecision. Future replication is needed using prospective data to test the reliability of the SES mobility classes among white and black participants. Second, these data were collected right after the Great Recession at the end of the 2000s. The classes of SES mobility that we found in this study may be unique because of the impact of the economic downturn. Replication using data from a different wave of the MIDUS study will be an interesting way to test the reliability of the classes. Furthermore, most of black participants in this study were drawn from Milwaukee County in contrast to white participants who were drawn from a national sample. Milwaukee is known for its high levels of racial segregation (45). The lack of SES mobility differentiation on inflammatory burden among black participants may be due to a unique experience of the Milwaukee participants in this study. Future research should further examine the diminished return hypothesis using a more representative of the national black population.

In addition to that, the low number of black participants in this study may have resulted in insufficient power to detect the significant association between class membership and the outcomes. We conducted power analysis to further examine that possibility. Although there is no clear information on the effect size of the association between SES mobility and inflammation among black, we found that in general the effect size between SES and inflammation is ranging from small to medium (0.150–0.300) (6,46,47). We found that the required sample size to detect the effect ($\alpha = .050$, $1 - \beta = 0.800$) is ranging from 143 to 571. Although the black sample size is in the lower end of the required sample size, our results align with those previous studies with larger sample sizes, which all demonstrated consistent results of a lack of significant association between SES and inflammation markers, especially IL-6 and CRP (6–8).

The distal outcome analyses were not adjusted for age, sex, and body mass index. It is possible to analyze the interaction between latent classes of SES mobility and age or sex and their associations with markers of inflammation by conducting multiple-group distal outcome analysis. However, given that some classes have a rather small prevalence and given that this study included rather a smaller sample size, a multiple-group distal outcome analysis would be underpowered. Future studies should prioritize analyzing the modifying role of age and sex on the association between SES mobility and inflammation markers among white and black participants. Our additional analysis indicated that measurement invariance assumption based on sex among black participants was violated ($\chi^2(32) = 53.98$, $p < .010$), but not among white participants. This may indicate differences in the heterogeneity of SES mobility between male and female black participants that may lead to a different association between SES mobility and inflammation based on sex among black participants. As previously shown in another study (6), there are sex differences in the association between SES and CRP and IL-6 between black male and female participants, but not among white participants. Although this may a raise question regarding the validity of SES mobility classes among black participants, our findings reflect the general pattern of SES mobility among overall black participants. The consistency with previous findings (6–8) strongly suggests that there is no differentiation of CRP and IL-6 based on SES among blacks. Nonetheless, the intersectionality between sex and SES among blacks should be a priority for future studies in understanding disparities in inflammation. Finally, there are several limitations regarding the life-course SES measures used in this analysis. Although we divided SES into objective and subjective measures, the objective indicators of SES were still based on self-report, which may decrease the objectivity of the measures. Furthermore, respondents may vary in the referent they use in making subjective ratings.

In summary, the current study adds to the knowledge of how SES mobility, using both objective and subjective indicators, is associated with inflammation markers. Using LCA, we showed that white and black participants have different class structure of SES mobility. In addition, we found that class membership of SES mobility is associated with inflammatory burden among white participants, but not among black participants. The lack of SES mobility differentiation on inflammation may be an indication of diminished return for the most affluent group among black participants.

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