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ORIGINAL RESEARCH

Hypertension and Diabetes Status by Patterns of Stress in Older Adults From the US Health and Retirement Study: A Latent Class Analysis

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BACKGROUND: Hypertension and diabetes disproportionately affect older non-Hispanic Black and Hispanic adults in the United States. Chronic stress may partially explain these disparities. This study identified underlying stress profiles of older US adults, analyzed stress profiles in relation to hypertension and diabetes, examined the distribution of stress profiles by race and ethnicity, and assessed patterns of change in latent classes of stress over time.

METHODS AND RESULTS: Latent class analysis was conducted with a nationally representative sample of older US adults who completed 3 waves of the HRS (Health and Retirement Study) (ie, 2010 [n=6863], 2014 [n=4995], and 2018 [n=3089]). Latent classes of stress in 2010 (ie, stress profiles) were identified using 15 indicators of unmet needs within 5 categories (ie, physiological, safety/security, belonging, esteem, and self-fulfillment). Hypertension and diabetes status were examined as outcomes of latent class membership at 3 time points, and race and ethnicity were examined in association with class membership, adjusting for sociodemographic covariates. Finally, a latent transition analysis examined the stability of latent class membership and racial and ethnic differences in the patterns of stress profiles experienced from 2010 to 2018. Five classes were identified: Generally Unmet Needs (13% of sample), Generally Met Needs (42% of sample), Unmet Self-Efficacy/Goal Needs (12% of sample), Unmet Financial Needs (20% of sample), and Unmet Social Belonging Needs (13% of sample). Compared with the Generally Met Needs class, the Generally Unmet Needs class had higher odds of hypertension (odds ratio [OR], 1.80; [95% CI, 1.35–2.39]) and diabetes (OR, 1.94; [95% CI, 1.45–2.59]), and the Unmet Financial Needs class had higher odds of diabetes (OR, 1.50; [95% CI, 1.10–2.05]). Non-Hispanic Black participants compared with non-Hispanic White participants had higher odds of being members of the Generally Unmet Needs, Unmet Self-Efficacy/Goal Needs, and Unmet Financial Needs classes (OR, 2.70; [95% CI, 1.59–4.58]; OR, 1.99; [95% CI, 1.15–3.43]; and OR, 4.74; [95% CI, 3.32–6.76], respectively). Class membership remained relatively stable over time, with 93% of participants remaining in Generally Met Needs and 78% of participants remaining in Generally Unmet Needs across time points. Compared with non-Hispanic White participants, non-Hispanic Black participants had lower odds of Generally Met Needs class membership at any time point (OR, 0.60; [95% CI, 0.42–0.84]) and had lower odds of moving into the Generally Met Needs class and higher odds of moving into the Unmet Financial Needs class from 2010 to 2014 (OR, 0.33; [95% CI, 0.13–0.86]; and OR, 3.02; [95% CI, 1.16–7.87], respectively).

CONCLUSIONS: Underlying classes of stress based on unmet needs were associated with hypertension and diabetes status. Racial and ethnic differences were observed for both latent class membership and transitions between classes over time. Latent classes of stress associated with unmet needs, hypertension, and diabetes and the ability to transition between classes may explain the perpetuation of racial and ethnic disparities in cardiovascular health. Interventions targeting unmet needs may be used to confront these disparities.

Key Words: aging ■ diabetes, type 2 ■ epidemiology ■ hypertension ■ race and ethnicity ■ social determinants of health ■ stress

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CLINICAL PERSPECTIVE

What Is New?

- This is the first longitudinal latent transition analysis study to report an association between patterns of stress based on various unmet needs (ie, unmet physiological, safety and security, social belonging, esteem, and/or self-fulfillment needs) and hypertension and diabetes status among older US adults.
- Compared with non-Hispanic White older adults, non-Hispanic Black older adults were more likely to have *Generally Unmet Needs* and *Unmet Financial Needs* compared with *Generally Met Needs*, and these stress patterns were associated with higher probabilities of hypertension and/or diabetes status.

What Are the Clinical Implications?

- Clinical interventions should address potential stressors based on unmet needs across multiple life domains when seeking to reduce racial and ethnic disparities in hypertension and diabetes among older adults.

Nonstandard Abbreviations and Acronyms

HRS	Health and Retirement Study
LCA	latent class analysis
LTA	latent transition analysis
SA-BIC	sample-size adjusted Bayesian information criterion

Cardiovascular disease (CVD), the leading cause of death in the United States, contributed to >840 000 US deaths in 2016.[1] Hypertension and diabetes are 2 major CVD risk factors and frequent drivers of CVD-related mortality.[2,3] Hypertension has been linked to an increased risk of adverse cardiovascular events (ie, myocardial infarctions, ischemic strokes, and hemorrhagic strokes) and was considered a primary or contributing cause of nearly half a million US deaths in 2018.[4,5] Similarly, those with diabetes were twice as likely to have heart disease or stroke compared with those without diabetes, and 100 000 US deaths were attributed to diabetes in 2020.[6,7]

Despite the dangers of hypertension and diabetes, both conditions are highly prevalent in the United States, and in 2018, nearly half of US adults (ie, 115 million Americans) were diagnosed with hypertension and 34.2 million US adults were diagnosed with diabetes.[4,8] Prevalence of these conditions among older adults is even higher, with hypertension affecting >75% of adults aged ≥75 years and diabetes affecting 26.8% of adults aged ≥65 years.[8,9] Given this high prevalence and the serious consequences of hypertension and diabetes, there is a continued need to identify underlying contributors to CVD risk, such as chronic stress exposure, among older adults in the United States.[10]

More important, the prevalence of hypertension and diabetes vary by race and ethnicity. Recent studies suggest that non-Hispanic Black Americans have higher rates of hypertension (42%) compared with non-Hispanic White Americans (28%).[11] Rates of diabetes are also higher among non-Hispanic Black Americans (12%) and Hispanic Americans (13%) compared with non-Hispanic White Americans (7%).[12] Furthermore, although some Hispanic subpopulations report lower rates of hypertension compared with non-Hispanic White Americans, Hispanic Americans are more likely to have undiagnosed, untreated, or uncontrolled hypertension than any other racial and ethnic group.[13,14]

Moreover, these racial and ethnic disparities in hypertension and diabetes prevalence persist among older adult populations, who are already at greater risk of developing hypertension and diabetes because of their age.[15] Older non-Hispanic Black and Hispanic Americans compared with older non-Hispanic White Americans are more likely to experience serious complications associated with both hypertension (eg, greater cognitive decline[16,17]) and diabetes (eg, increased diabetes-related mortality at earlier ages[18]).

Given these highlighted disparities, along with recent projections that the national burden of chronic diseases will grow in the coming decades attributable to an aging US population,[19,20] uncovering contributors to racial and ethnic differences in hypertension and diabetes among older populations has received increased research attention.[21] One potential explanation for these differences is chronic stress exposure. Repeated or chronic exposure to stress can directly activate physiological responses that increase the risk of both hypertension and diabetes (eg, compromising the body's ability to return to resting blood pressure levels[22] and/or increasing cortisol, glucose, and insulin resistance[23]). Furthermore, evidence suggests that chronic stress exposure differs among racial and ethnic groups, which may partially explain disparities in hypertension and diabetes among Black and Hispanic populations in the United States.[24]

There is a growing body of literature on chronic stress as one potential contributor to the disproportionate burden of hypertension and diabetes among older Black and Hispanic populations.[12,22] Recent studies call for improved psychosocial stress measures that fully capture the complex nature of stress,[25] additional studies using comprehensive stress measures

as predictors of hypertension and diabetes,[25,26] and a particular focus on person-centered approaches that consider how patterns of stress among subgroups of older adults can contribute to chronic diseases (eg, latent class analyses [LCAs]).[27,28]

Much of the existing research examining chronic stress used single-item measures or single domains of chronic stress.[25,29] Recent studies, however, recommend using comprehensive measures to capture individual stressors (eg, financial strain), social stressors (eg, interpersonal discrimination), and self-concept stressors (eg, social status stressors that compromise self-esteem).[24] This multidimensional approach is particularly relevant to racial and ethnic health disparities as it can incorporate stressors more commonly encountered by members of Black and Hispanic populations (eg, socioeconomic stress, stress associated with racism and discrimination, and goal-striving stress), which have been recently linked to worse cardiovascular health.[24,30] In addition, research suggests that organizing stressors based on their underlying psychosocial features (eg, physiological stressors, such as hunger, and interpersonal stressors, such as relationship problems) can help identify mechanisms linking chronic stress to physical health outcomes.[26]

Motivational frameworks related to biological and psychosocial needs (ie, "need-based models") have been linked to chronic stress[31,32] and may be well suited for addressing these recent suggestions to improve chronic stress measures. However, many of the need-based models used in previous studies focused on physiological stress, with fewer studies examining whether unmet needs were associated with individual, social, and self-concept stressors.[33,34] Maslow's Hierarchy of Needs is a widely cited framework of human behavior that could be used to capture stressors, including *physiological* needs (eg, food, shelter, and rest), *safety needs* (eg, physical and psychological security), *social belonging* needs (eg, interpersonal relationships), *esteem needs* (eg, social status and respect), and *self-fulfillment* needs (eg, fulfilling one's purpose in life).

There is limited work connecting comprehensive measures of stress (ie, multilevel or multidomain measures) to hypertension and diabetes.[25] Previous studies that examined physical stress (eg, neighborhood violence and hunger early in life), social stress (eg, criticism from friends and everyday discrimination), and self-concept stress (ie, lack of control at work) found that higher stress exposure explained a substantial portion of disparities in self-rated health among Black and US-born Hispanic adults compared with White adults.[35] Similarly, additional studies using comprehensive measures of stress found that vulnerability across different life domains (ie, material, social, and health vulnerabilities) had a negative influence on older adults' well-being,[28] that unmet basic needs (ie, housing, food, safety, and financial needs) were associated with greater perceived stress and lower likelihood of scheduling follow-up health visits,[36] and that chronic stress measured across 5 domains (ie, health, financial, residential, relationship, and caregiving) revealed racial and ethnic differences in both chronic stress exposure and stress appraisal (ie, the extent to which stressors were considered upsetting).[37]

Although this initial set of studies contributed to an increased appreciation for assessing stress comprehensively, these studies did not focus on hypertension and diabetes outcomes. Moreover, few studies used LCA approaches to characterize chronic stress based on unmet needs among older adults.[28] LCA offers a strategy to identify subgroups of older adults who experience certain patterns of chronic stress. Given the increased vulnerability to the physical effects of chronic stress on the immune system and stressors associated with aging (eg, increased dependence on others, fewer job stressors if retired, and/or reduced ability to reach goals),[38] unique patterns in the associations between chronic stress and hypertension and diabetes outcomes could be observed in older populations. In addition, LCA is well suited to address calls for comprehensive psychosocial measures of stress given the ability of latent class modeling to explicitly model measurement error when estimating complex relationships.[39]

Furthermore, previous literature on chronic stress and cardiovascular health outcomes has been largely cross-sectional, with limited evidence examining composite measures of stress over time.[40] Latent transition analysis (LTA), a longitudinal form of LCA, has received growing attention in recent epidemiologic literature.[39,41] Building on the identification of latent classes at single points in time, LTA can be used to assess whether class membership remains stable over multiple time points, whether there are certain patterns of movement for those who do transition between classes, and whether certain factors (eg, sociodemographic characteristics) affect potential changes to class membership.

The present study sought to address these gaps identified in the literature by conducting an LCA with a nationally representative sample of older adults. Specifically, the study objectives (Figure 1) included the following: (1) identifying underlying classes of stress based on individuals' unmet needs, (2) examining the association between classes of stress and hypertension and diabetes status, (3) assessing whether race and ethnicity were associated with class membership, (4) examining stability of class membership across 3 time points, and (5) assessing whether race and ethnicity were associated with likelihood to transition between classes over time.

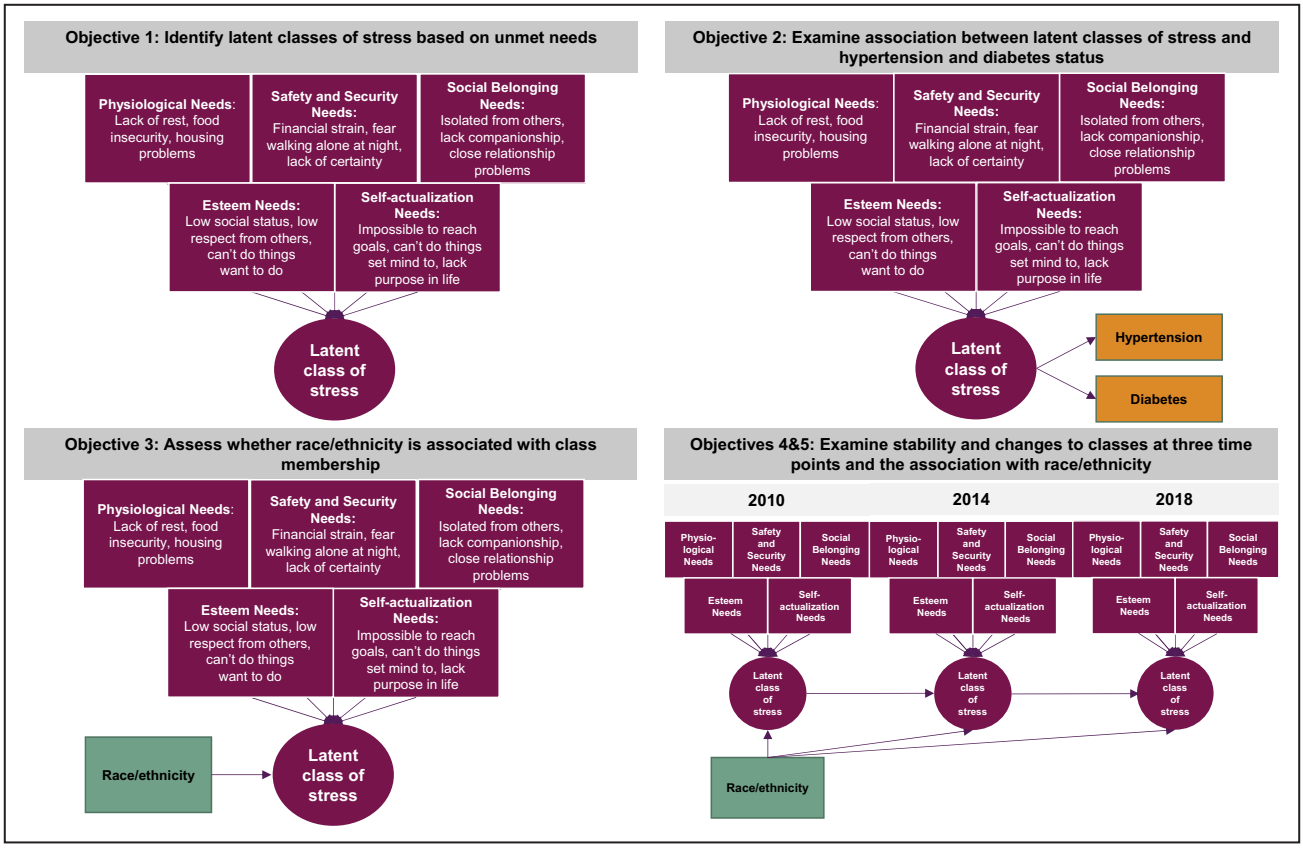

Figure 1. Overview of study objectives.
This figure represents the study objectives. Objectives 1 to 3 were conducted using a cross-sectional analysis using the 2010 unmet needs indicators. Objectives 4 and 5 were conducted using a longitudinal latent transition analysis of the 2010, 2014, and 2018 data sets. Objective 2 included the hypertension and diabetes outcomes measured in 2010, 2014, and 2018. Objectives 3, 4, and 5 examined whether self-identified race and ethnicity were associated with stress profiles experienced in 2010, 2014, and 2018.

METHODS

Data Source and Setting

The LCA was conducted using data from the HRS (Health and Retirement Study), which is sponsored by the National Institute on Aging and the Social Security Administration. The HRS is a nationally representative longitudinal household survey of US adults aged >50 years that captures a wide range of items, including participants' health, employment and/or retirement, income, and family structure.[42] Approximately 20 000 US adults complete the core survey every 2 years by telephone or in face-to-face interviews as well as select survey sections completed at home and returned by mail. Before each interview, participants provide verbal consent (except for survey sections completed by mail, in which consent is inferred by returning completed surveys), and all data collection for the HRS is approved by the University of Michigan Institutional Review Board. The data used in this study are deidentified and publicly available on the HRS website (https://hrsdata.isr.umich.edu/data-products/public-survey-data). The analytic methods of the present study (ie, statistical code and additional files used in the analysis) are available from the corresponding author on request.

In 2006, the HRS began administering a face-to-face physical health interview (eg, height, weight, waist circumference, and blood pressure measured by the interviewer) as well as a self-reported psychosocial survey (eg, items related to well-being, personality, and experiences of discrimination).[43] Participants were randomly assigned to complete both sets of measures every 4 years. The present study included the subpopulation of participants who completed the physical health and psychosocial surveys in 2010, 2014, and 2018. Given that the psychosocial survey was revised after 2008, the use of the 2010 subpopulation allowed for examining the same set of stress measures across 3 separate time points.

Variables

Unmet Needs (Indicators)

A total of 15 indicators of unmet needs (Table S1) were selected from existing data sets to capture the 5 levels of Maslow's Hierarchy of Needs (ie, physiological,

safety and security, social belonging, esteem, and self-fulfillment). Three different indicators were assigned to each of the 5 levels to capture the major needs within each level of Maslow's Hierarchy and provided balanced representation from each level. Each of the 15 indicators were dichotomized (0=met need, and 1=unmet need).

Hypertension and Diabetes (Distal Outcomes)

Blood pressure was measured using an Omron BP 760N Monitor at 3 time points during the in-person interview (ie, measured in a sitting position, with feet flat on the floor, and the cuff placed above the elbow). Systolic blood pressure and diastolic blood pressure were calculated using an average of the 3 measurements obtained from the blood pressure monitor. Participants were considered hypertensive if they had one of the following indicators: systolic blood pressure ≥140 mm Hg, diastolic blood pressure ≥90 mm Hg, or a history of high blood pressure (ie, if a health care provider had ever told participants they had high blood pressure or hypertension).[44] Diabetes was assessed using a single item of whether a health care provider had ever told participants they had diabetes or high blood sugar. Hypertension and diabetes were each dichotomized (0=no hypertension, and 1=hypertension; 0=no diabetes, and 1=diabetes).

Sociodemographic Characteristics (Covariates)

Participants self-identified their race as "White/Caucasian" [*ie, term originally used by the HRS, but henceforth referred to as "White"*], "Black/African American," or "other". "Other" race included responses of American Indian, Alaska Native, Asian, Native Hawaiian, and Pacific Islander. This code was collapsed in the public HRS data set to protect participant confidentiality due to smaller sample sizes within these categories. Participants self-identified their ethnicity as "Yes," "No," or "Don't Know" in response to the question "Do you consider yourself Hispanic or Latino?". Participants' responses to the race and ethnicity items were combined into 4 categories for the analysis: non-Hispanic Black, non-Hispanic White, non-Hispanic other race, and Hispanic or Latino. Participants' age (<60, 60–75, and >75 years), sex (male or female), education (high school diploma or less or college degree and above), and annual household income (<$25 000, $25 000–$75 000, and >$75 000 per year) were also used as sociodemographic covariates.

Statistical Analysis

The statistical analysis first assessed sociodemographic characteristics of the study population at the 3 time points included in the study (ie, 2010, 2014, and 2018). Next, the cross-sectional LCAs included participants' stress and sociodemographic characteristics reported in 2010, as well as their hypertension and diabetes status reported at 3 separate time points in 2010, 2014, and 2018. Finally, the LTA examined changes to initial class membership from 2010 to 2018.

Sociodemographic Characteristics of the Study Population

Descriptive statistics were calculated using R version 4.1.0 to describe the sociodemographic characteristics of the study population. Specifically, for each sociodemographic category, the number of participants and the percentage of the total study population were tabulated and χ^2 tests were used to examine group differences among the study population when stratified by the combined race and ethnicity categories of non-Hispanic Black, non-Hispanic White, Hispanic or Latino, and non-Hispanic other race.

Cross-Sectional LCAs

The LCA was conducted using the 2010 subpopulation of participants who completed the physical health interview and the psychosocial survey (N=6863). To account for the complex survey design of the HRS (ie, multistage national probability sampling and oversampling of Black and Hispanic adults, as well as Florida residents), sample weights, clustering, and stratification variables provided by HRS were used in the analysis.[43] All analyses were conducted in M*plus* Version 8.6.[45] Given that subpopulation analysis in M*plus* does not handle missing values in the sample weighting, a small positive number (ie, 0.0000001) was assigned to participants who had missing values on the sample weight, clustering, and/or strata variables, which allowed variance estimates to be computed for all participants.[46]

The cross-sectional LCA included 3 stages of analysis associated with participants' class membership in 2010: (1) identifying the latent classes based on the 15 indicators of unmet needs in 2010, (2) analyzing the association between the 2010 latent classes and the distal outcomes (ie, hypertension and diabetes status in 2010, 2014, and 2018), and (3) examining whether class membership in 2010 varied by race and ethnicity.

Identification of latent classes

A multistep approach was used to identify the latent classes. Latent classes were generated using the 15 indicators of unmet needs. Classes were first examined using a stepwise model comparison approach (eg, 1, 2, and 3 classes) based on the unconditional model without covariates and/or distal outcomes

included in the model.[47] Maximum likelihood estimation with robust SEs allowed for the use of the full study population in the identification of the classes (N=6863) by accounting for any missing data on the indicators.

In this first step, model fit indexes included the sample-size adjusted Bayesian information criterion (SA-BIC) and entropy values. The SA-BIC was selected on the basis of guidance from prior LCA literature that the SA-BIC performs well with complex data and unequal sample sizes relative to the traditional Bayesian information criterion and/or the Akaike information criterion.[48,49] The Lo-Mendell-Rubin and bootstrapped likelihood ratio tests were not examined because they would not account for the complex data.[50] Lower SA-BIC and higher entropy values represent better model fit (with entropy >0.70 indicating acceptable classification accuracy[51]). These fit statistics, along with consideration of adequate class sizes over 5%, as recommended in prior literature,[52] were used to identify the optimal number of classes.

Next, measurement invariance was assessed to test for any systematic group differences in the interpretation of the indicators. Consistent with recent guidance, each of the items were separately regressed on the sociodemographic covariate predictors and model comparisons were used to test for noninvariance (ie, nonequivalency[53]). The direct effects of the covariates on the noninvariant indicators were added to the model and the solution was reestimated using a 1-step approach (ie, the recommended model to reduce bias in parameter estimates in the presence of noninvariant indicators and multiple covariates). The estimated solution using the 1-step approach was compared with the unconditional model to confirm that the classes remained consistent across the 2 models.

Hypertension and diabetes status (distal outcomes)

Next, the distal outcomes analysis was used to assess the association between participants' underlying stress profiles reported in 2010 and their hypertension and diabetes status in 2010, 2014, and 2018. Hypertension and diabetes status at each time point were regressed on participants' 2010 latent class membership, adjusting for the direct effects of the sociodemographic covariates on hypertension, diabetes, and any noninvariant indicators. Odds ratios (ORs) with 95% CIs were used to compare probabilities of having hypertension and diabetes between the latent classes. Pairwise comparisons were used to examine differences in the odds of hypertension and diabetes between latent classes. In the distal outcome and the covariate analysis (below), the Mplus standard method of listwise deletion was used (ie, 23 participants were dropped from the analysis because of missing data on the distal outcomes and/or covariates).

Sociodemographic characteristics (covariates)

Finally, multinomial regression was used to examine the association between latent class membership and self-identified race and ethnicity (ie, non-Hispanic Black, Hispanic or Latino, non-Hispanic other race, and non-Hispanic White), controlling for the remaining sociodemographic covariates. All covariates were established a priori given their well-documented role in stress and health and frequent use in epidemiologic literature. Univariate models were also conducted for each of the sociodemographic variables to check for consistent patterns with the multivariate model. ORs with 95% CIs were used to assess the conditional probabilities of each covariate being present within the latent class for both the multivariate and univariate models.

Latent Transition Analyses

Following the cross-sectional LCAs, the LTA was used to examine changes in class membership across the 3 time points (ie, 2010, 2014, and 2018). Participants were included in the LTA if they completed the psychosocial and physical health interviews in 2010, 2014, and 2018 (N=3075), and participants' sample weights from 2010 were used in the subpopulation analysis. A series of stepwise model comparisons were used to examine the best fitting solutions in 2014 and 2018. Models were estimated separately using the 15 unmet needs indicators from each time point and were assessed using SA-BIC, entropy, and class size, as noted above. Measurement invariance of the indicators across time was then assessed by comparing a fully constrained model (ie, the prevalence of each indicator in each latent class held constant at all time points) with a less restrictive free model (ie, the prevalence of all indicators allowed to vary freely across classes at all time points).[54] The direct effects and 1-step approach applied in the cross-sectional analysis were used to estimate the LTA.

The stability of latent class membership was then assessed using transition probabilities (ie, the likelihood that individuals would remain in the same class between time points) and descriptive counts of the most frequent patterns of stability/movement across time. Next, racial and ethnic differences in class membership patterns were examined by creating binary variables (eg, being a member versus never being a member of certain classes across the 3 time points) and regressing these variables on race and ethnicity, adjusting for sex, age, education, and income. Finally, covariate effects on the transition probabilities were assessed across the 3 time points.

Table 1. Study Population Characteristics in 2010, 2014, and 2018

Time point 1: 2010					
	Total study population (N=6863)*	Non-Hispanic Black (n=1084)	Non-Hispanic White (n=4950)	Hispanic or Latino (n=643)	Non-Hispanic other race (n=180)
Sex	*P*<0.01				
Women	4009 (58.4)	719 (66.3)	2810 (56.8)	381 (59.3)	97 (53.9)
Men	2854 (41.6)	365 (33.7)	2140 (43.2)	262 (40.7)	83 (46.1)
Age, y	*P*<0.01				
<60	2104 (30.7)	463 (42.7)	1238 (25.0)	311 (48.4)	86 (47.8)
60–75	3153 (45.9)	476 (43.9)	2352 (47.5)	257 (40.0)	68 (37.8)
>75	1606 (23.4)	145 (13.4)	1360 (27.5)	75 (11.6)	26 (14.4)
Income, $	*P*<0.01				
<25 000	2073 (30.2)	556 (51.3)	1110 (22.4)	349 (54.3)	56 (31.1)
25 000–75 000	2966 (43.2)	364 (33.6)	2319 (46.9)	213 (33.1)	69 (38.3)
>75 000	1824 (26.6)	164 (15.1)	1521 (30.7)	81 (12.6)	55 (30.6)
Education	*P*<0.01				
High school diploma or lower	4814 (70.1)	870 (80.3)	3273 (66.1)	557 (86.6)	109 (60.6)
College degree or higher	2032 (29.6)	212 (19.5)	1662 (33.6)	86 (13.4)	71 (39.4)
Missing data	17 (0.3)	2 (0.2)	15 (0.3)	0 (0.0)	0 (0.0)
Time point 2: 2014					
	Total study population (n=4995)	Non-Hispanic Black (n=746)	Non-Hispanic White (n=3661)	Hispanic or Latino (n=454)	Non-Hispanic other race (n=129)
Sex	*P*<0.01				
Women	3005 (60.2)	509 (68.2)	2148 (58.7)	274 (60.4)	72 (55.8)
Men	1990 (39.8)	237 (31.8)	1513 (41.3)	180 (39.6)	57 (44.2)
Age, y	*P*<0.01				
<60	968 (19.4)	203 (27.2)	580 (15.8)	138 (30.4)	43 (33.3)
60–75	2521 (50.5)	410 (55.0)	1811 (49.5)	234 (51.5)	65 (50.4)
>75	1506 (30.1)	133 (17.8)	1270 (34.7)	82 (18.1)	21 (16.3)
Income, $	*P*<0.01				
<25 000	1403 (28.1)	387 (51.9)	743 (20.3)	226 (49.8)	45 (34.9)
25 000–75 000	2128 (42.6)	264 (35.4)	1658 (45.3)	161 (35.5)	45 (34.9)
>75 000	1464 (29.3)	95 (12.7)	1260 (34.4)	67 (14.7)	39 (30.2)
Education	*P*<0.01				
High school diploma or lower	3425 (68.6)	599 (80.3)	2352 (64.3)	398 (87.7)	72 (55.8)
College degree or higher	1556 (31.1)	145 (19.4)	1297 (35.4)	56 (12.3)	57 (44.2)
Missing data	14 (0.3)	2 (0.3)	12 (0.3)	0 (0.0)	0 (0.0)
Time point 3: 2018					
	Total study population (N=3089)	Non-Hispanic Black (n=423)	Non-Hispanic White (n=2332)	Hispanic or Latino (n=245)	Non-Hispanic other race (n=86)
Sex	*P*<0.01				
Women	1869 (60.5)	298 (70.4)	1378 (59.1)	146 (59.6)	46 (53.5)
Men	1220 (39.5)	125 (29.6)	954 (40.9)	99 (40.4)	40 (46.5)
Age, y	*P*<0.01				
<60	191 (6.2)	36 (8.5)	123 (5.3)	25 (10.2)	7 (8.1)
60–75	1764 (57.1)	285 (67.4)	1249 (53.5)	170 (69.4)	57 (66.3)
>75	1134 (36.7)	102 (24.1)	960 (41.2)	50 (20.4)	22 (25.6)

(*Continued*)

Table 1. Continued

Time point 3: 2018					
	Total study population (N=3089)	Non-Hispanic Black (n=423)	Non-Hispanic White (n=2332)	Hispanic or Latino (n=245)	Non-Hispanic other race (n=86)
Income, $	*P*<0.01				
<25 000	757 (24.5)	199 (47.1)	423 (18.1)	110 (44.9)	24 (27.9)
25 000–75 000	1393 (45.1)	155 (36.6)	1099 (47.1)	103 (42.0)	35 (40.7)
>75 000	939 (30.4)	69 (16.3)	810 (34.8)	32 (13.1)	27 (31.4)
Education	*P*<0.01				
High school diploma or lower	1990 (64.4)	335 (79.2)	1392 (59.7)	214 (87.3)	47 (54.7)
College degree or higher	1088 (35.2)	86 (20.3)	931 (39.9)	31 (12.7)	39 (45.3)
Missing data	11 (0.4)	2 (0.5)	9 (0.4)	0 (0.0)	0 (0.0)

Data are presented as number (percentage).

*The total study population listed for each time point includes participants who had missing data for race and ethnicity items (n=6 [2010], n=5 [2014], and n=3 [2018]). These participants were included in the identification of the latent classes, but were not included in the distal outcomes and sociodemographic covariate analyses (n=23 total). *P* values are based on χ^2 tests of group differences when stratified by race and ethnicity.

RESULTS

Sociodemographic Characteristics of the Study Population

Most participants self-identified as non-Hispanic White (72%) and women (58%) at the first time point (ie, 2010; Table 1). Participants were most likely to be aged 60 to 75 years (46%), reported an annual household income of $25 000 to $75 000 (43%), and had a high school diploma or less (70%). These percentages remained relatively consistent in both 2014 and 2018, with the exception of the age category given that some participants moved into older categories across the 3 time points.

When stratified by race and ethnicity, participants who self-identified as non-Hispanic Black or Hispanic or Latino had greater proportions of participants who reported less income (across the 3 time points) and had a high school diploma or less compared with those who identified as non-Hispanic White and non-Hispanic other race. Those who identified as non-Hispanic White were older than all other racial and ethnic groups.

Cross-Sectional LCAs

Identification of Latent Classes

The 5-class solution was selected as the best fitting model based on model fit indexes (ie, the SA-BIC and entropy) and adequate class sizes (ie, classes ≥5%) (Figure S1). The probabilities of being members of each class, contributing to entropy, are represented in Figure S2. Measurement invariance was established for all indicators, except for the one item measuring close relationships. This model revealed slightly better fit when direct effects between the sociodemographic covariates and the close relationships item were included. After adding these direct effects to the 5-class solution, the classes remained consistent with the unconditional model, and all subsequent analyses included these direct paths. The 5 classes were then labeled on the basis of the relative differences in the probabilities of unmet needs across classes (Table 2).

Class 1, labeled *Generally Unmet Needs* (12.6% of the study population), was characterized by medium to high probability of unmet needs for most unmet needs indicators. Class 2, labeled *Unmet Self-Efficacy/Goal Needs* (12.1% of the study population), was characterized by medium and higher probabilities of unmet esteem and self-fulfillment needs. Class 3, labeled *Unmet Social Belonging Needs* (13.4% of the study population), was characterized by high probability of unmet social belonging needs. Class 4, labeled *Unmet Financial Needs* (20.3% of the study population), was characterized by high probability of financial strain. Finally, Class 5, labeled *Generally Met Needs* (41.6% of the study population), was characterized by low probability of unmet need for all 15 unmet needs indicators (Figure 2).

Hypertension and Diabetes Status (Distal Outcomes)

Consistent patterns emerged in the prevalence of hypertension and diabetes associated with the latent classes at each time point. Participants in the *Generally Unmet Needs* class in 2010 had higher odds of having hypertension compared with all other classes at all 3 time points and the ORs were highest compared with the *Generally Met Needs* class (OR, 1.80 [95% CI, 1.35–2.40] [2010]; OR, 1.97 [95% CI, 1.33–2.93] [2014]; and OR, 2.14 [95% CI, 1.38–3.33] [2018]) (Tables 3 and 4).

Participants in the *Generally Unmet Needs* and the *Unmet Financial Needs* classes in 2010 had higher odds of having diabetes compared with the *Generally Met Needs* class at all 3 time points (OR, 1.94 [95% CI, 1.45–2.59] [2010]; OR, 1.99 [95% CI, 1.49–2.68] [2014]; and

Table 2. Estimated Probabilities of Unmet Needs for Each Class in 2010 Cross-Sectional Analysis

Needs	Class 1: Generally Unmet Needs (n=860; 12.6%)	Class 2: Unmet Self-Efficacy/Goal Needs (n=826; 12.1%)	Class 3: Unmet Social Belonging Needs (n=918; 13.4%)	Class 4: Unmet Financial Needs (n=1392; 20.3%)	Class 5: Generally Met Needs (n=2844; 41.6%)
Lack of rest	0.35	0.17	0.11	0.16	0.08
Food insecurity	0.31	0.01	0.02	0.22	0.01
Housing problems	0.54	0.08	0.06	0.38	0.01
Financial strain	0.93	0.30	0.40	0.91	0.24
Lack of physical safety	0.33	0.21	0.14	0.24	0.06
Lack of certainty	0.53	0.36	0.22	0.16	0.04
Isolated from others	0.89	0.26	0.85	0.27	0.09
Lack of companionship	0.87	0.41	1.00	0.44	0.16
Close relationship problems	0.58	0.11	0.35	0.38	0.09
Low social status	0.58	0.11	0.10	0.27	0.02
Low respect from others	0.66	0.23	0.40	0.35	0.17
Inability to do desired things	0.55	0.58	0.10	0.08	0.00
Inability to reach goals	0.68	0.45	0.31	0.31	0.09
Inability to do anything mind is set to do	0.40	0.53	0.09	0.03	0.03
Lack of direction and purpose in life	0.40	0.22	0.18	0.09	0.06

Shaded cells indicate highest estimated probabilities of unmet needs across latent classes.

OR, 1.89 [95% CI, 1.33–2.68] [2018] [Generally Unmet Needs]; OR, 1.47 [95% CI, 1.14–1.91] [2010]; OR, 1.37 [95% CI, 1.01–1.87] [2014]; and OR, 1.58 [95% CI, 1.14–2.17] [2018] [Unmet Financial Needs]) (Tables 3 and 4).

Sociodemographic Characteristics (Covariates)

On the basis of the distal outcome analysis, the covariate analysis focused on the association between race and ethnicity and the classes associated with higher odds of hypertension and diabetes (ie, Class 1, *Generally Unmet Needs*, and Class 4, *Unmet Financial Needs*, compared with Class 5, *Generally Met Needs*). On the basis of latent class membership in 2010, non-Hispanic Black participants had higher odds of being members of the *Generally Unmet Needs* and *Unmet Financial Needs* classes versus the *Generally Met Needs* class (OR, 2.70 [95% CI, 1.59–4.58]; OR, 4.74 [95% CI, 3.32–6.76], respectively). Hispanic or Latino participants versus non-Hispanic White participants did not have higher odds of belonging to the *Generally Unmet Needs* or *Unmet Financial Needs* classes compared with the *Generally Met Needs* class (Table 5).

Latent Transition Analysis

The 5-class solution was selected as the best fitting model in 2010, 2014, and 2018 based on model fit indexes and adequate class sizes over 5% (Figures S3 and S4). The tests for measurement invariance revealed invariance of indicators across time as the fully constrained model had stronger fit based on SA-BIC compared with the less restrictive free model. The classes were highly consistent across the 3 time points (Figure 3). The analysis revealed relatively stable latent class membership across time (Figure 4). The probability that participants would remain in their original classes (ie, their class membership in 2010 and 2014, respectively) ranged from 69% to 93% between 2010 and 2014 (average probability, 78%) and from 63% to 93% between 2014 and 2018 (average probability, 76%) (Figure 4). Participants in Class 5, *Generally Met Needs*, had the highest probability of remaining in the same class across both sets of time points (93% for both transition points), followed by Class 1, *Generally Unmet Needs* (80%; 2010–2014), and Class 3, *Unmet Social Belonging Needs* (78%; 2014–2018). Furthermore, remaining in the *Generally Met Needs* class at all 3 time points was the most frequent pattern across time (31.6% of the total population), yet 49.4% of participants were never members of the *Generally Met Needs* class. The odds of being in the *Generally Met Needs* class at any time point were lower for non-Hispanic Black participants compared with non-Hispanic White participants (OR, 0.60 [95% CI, 0.42–0.84]) (Table 6).

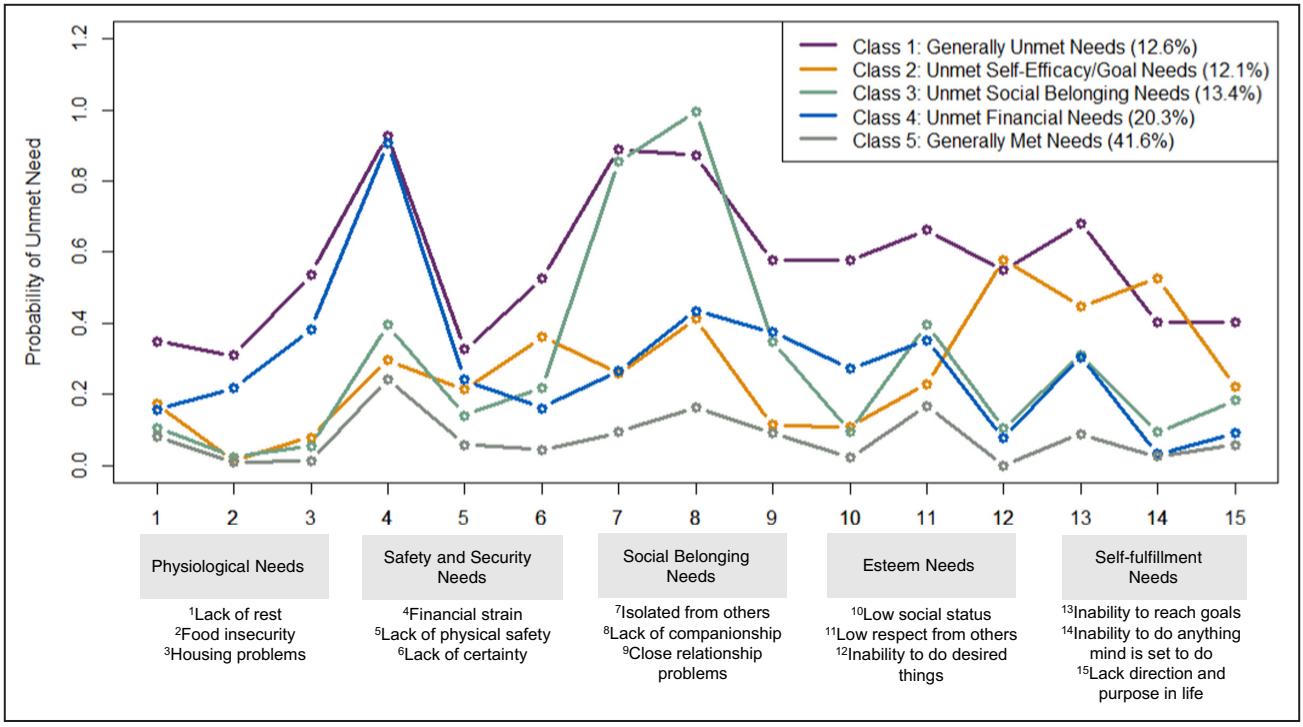

Figure 2. Five-class solution of estimated probabilities of unmet needs for the 2010 cross-sectional analysis.
The figure represents the estimated probabilities of unmet needs across the 15 needs indicators (with 1 representing unmet needs) for each of the latent classes in the 2010 5-class solution. The 15 needs indicators are listed on the *x* axis. The percentage of participants from the overall sample included in each latent class is listed in the figure legend.

In examining the transition probabilities with respect to race and ethnicity, the odds of transitioning from the *Generally Met Needs* class into *Unmet Financial Needs* class relative to staying in the *Generally Met Needs* class was higher for non-Hispanic Black participants compared with non-Hispanic White participants from 2010 to 2014 (OR, 3.02 [95% CI, 1.16–7.87]). In addition, the odds of transitioning out of the *Unmet Financial Needs* class into the *Generally Met Needs* class relative to staying in the *Unmet Financial Needs* class were lower for non-Hispanic Black participants compared with non-Hispanic White participants from 2010 to 2014 (OR, 0.33, [95% CI, 0.13–0.86). There were no differences in transition probabilities between Hispanic or Latino participants and non-Hispanic White participants (Table 7). All covariate effects on transition probabilities are presented in Table S2.

DISCUSSION

The present study examined the extent to which underlying stress profiles were associated with hypertension and diabetes status using a large population-based sample that included substantial representation of older Black and Hispanic or Latino adults. This research addressed gaps in the chronic stress and health disparities literature by measuring stress based on a broad range of unmet needs, including social stressors that are often missing from stress research and disproportionately affect the health of non-Hispanic Black and Hispanic or Latino populations (eg, lack of social status and respect from others).[24,30] In addition, this study examined whether non-Hispanic Black and Hispanic or Latino participants were more likely to experience latent class stress profiles associated with hypertension and diabetes and whether race and ethnicity were associated with transitioning between latent classes of stress from 2010 to 2018.

Key Results

Identification of Latent Classes of Stress and Associations With Hypertension and Diabetes

Findings from the LCA revealed 5 distinct patterns, including *Generally Unmet Needs*, *Unmet Self-Efficacy/Goal Needs*, *Unmet Financial Needs*, *Unmet Social Belonging Needs*, and *Generally Met Needs*. Consistent with previous LCAs[28,36] and research on the accumulation of stressors across life domains,[24,25,35,55] the present study identified a class in which individuals reported a high number of stressors in all domains (ie, *Generally Unmet Needs*). Prior evidence suggests that individuals can experience high clusters of overlapping stressors, given that multiple stressors in various life domains are often correlated.[56] Furthermore, stressful experiences can diminish resources (eg, material,

Table 3. ORs Comparing Associations Between 2010 Classes and Hypertension and Diabetes Status in 2010, 2014, and 2018

	Class 1: Generally Unmet Needs			Class 2: Unmet Self-Efficacy/Goal Needs			Class 3: Unmet Social Belonging Needs			Class 4: Unmet Financial Needs		
Reference class	2010	2014	2018	2010	2014	2018	2010	2014	2018	2010	2014	2018
Hypertension												
Class 2: Unmet Self-Efficacy/Goal Needs	1.87 (1.28–2.73)	1.41 (1.00–1.99)	1.77 (1.10–2.84)	…	…	…	…	…	…	…	…	…
Class 3: Unmet Social Belonging Needs	1.56 (1.10–2.21)	1.94 (1.18–3.20)	2.35 (1.41–3.92)	0.84 (0.59–1.18)	1.38 (0.91–2.09)	1.33 (0.87–2.02)	…	…	…	…	…	…
Class 4: Unmet Financial Needs	1.49 (1.05–2.12)	1.75 (1.12–2.74)	2.15 (1.28–3.61)	0.80 (0.56–1.13)	1.24 (0.86–1.79)	1.21 (0.77–1.92)	0.96 (0.71–1.30)	0.90 (0.64–1.26)	0.91 (0.61–1.36)	…	…	…
Class 5: Generally Met Needs	1.80 (1.35–2.39)	1.97 (1.33–2.93)	2.14 (1.38–3.33)	0.96 (0.73–1.27)	1.40 (1.02–1.92)	1.21 (0.86–1.70)	1.15 (0.92–1.45)	1.02 (0.79–1.31)	0.91 (0.66–1.26)	1.21 (0.91–1.60)	1.13 (0.83–1.53)	1.00 (0.69–1.44)
Diabetes												
Class 2: Unmet Self-Efficacy/Goal Needs	1.45 (0.97–2.19)	1.44 (0.93–2.22)	1.66 (1.11–2.50)	…	…	…	…	…	…	…	…	…
Class 3: Unmet Social Belonging Needs	1.45 (0.98–2.13)	1.64 (1.09–2.47)	1.71 (1.11–2.62)	0.99 (0.68–1.46)	1.14 (0.71–1.82)	1.03 (0.65–1.63)	…	…	…	…	…	…
Class 4: Unmet Financial Needs	1.29 (0.93–1.80)	1.36 (0.99–1.86)	1.20 (0.80–1.80)	0.89 (0.58–1.37)	0.94 (0.62–1.42)	0.72 (0.47–1.10)	0.89 (0.57–1.40)	0.83 (0.54–1.26)	0.70 (0.45–1.10)	…	…	…
Class 5: Generally Met Needs	1.94 (1.45–2.59)	1.99 (1.49–2.68)	1.89 (1.33–2.68)	1.33 (0.98–1.82)	1.39 (0.95–2.02)	1.13 (0.81–1.59)	1.34 (0.96–1.87)	1.22 (0.84–1.76)	1.10 (0.75–1.62)	1.50 (1.10–2.05)	1.47 (1.14–1.91)	1.58 (1.14–2.17)

Models adjusted for direct effects of sociodemographic characteristics on hypertension and diabetes (ie, race and ethnicity, sex, age, income, and education). The 95% CIs are in parentheses. OR indicates odds ratio.

Table 4. Estimated Probabilities of Hypertension and Diabetes for Each Class in 2010 Cross-Sectional Analysis

Variable	Class 1: Generally Unmet Needs	Class 2: Unmet Self-Efficacy/ Goal Needs	Class 3: Unmet Social Belonging Needs	Class 4: Unmet Financial Needs	Class 5: Generally Met Needs
2010					
Hypertension	0.75	0.69	0.65	0.66	0.61
Diabetes	0.28	0.24	0.21	0.24	0.16
2014					
Hypertension	0.78	0.76	0.62	0.66	0.61
Diabetes	0.32	0.26	0.21	0.26	0.18
2018					
Hypertension	0.81	0.75	0.63	0.66	0.64
Diabetes	0.34	0.26	0.23	0.32	0.22

Models adjusted for direct effects of sociodemographic characteristics on hypertension and diabetes (ie, race and ethnicity, sex, age, income, and education).

Table 5. Multinomial Logistic Regression of Sociodemographic Covariates for the 2010 5-Class Solution Model

Variable	OR [95% CI]			
	Class 1 Generally Unmet Needs	Class 2 Unmet Self-Efficacy/Goal Needs	Class 3 Unmet Social Belonging Needs	Class 4 Unmet Financial Needs
Race/Ethnicity				
*Non-Hispanic Black/African American (vs non-Hispanic White)	2.70 (1.59–4.58)	1.99 (1.15–3.43)	0.93 (0.53–1.64)	4.74 (3.32–6.76)
*Hispanic or Latino (vs non-Hispanic White)	0.79 (0.44–1.40)	1.25 (0.47–3.31)	1.05 (0.63–1.76)	1.71 (0.99–2.96)
*Non-Hispanic Other Race (vs non-Hispanic White)	2.39 (1.11–5.16)	1.30 (0.49–3.41)	1.50 (0.63–3.56)	3.53 (1.81–6.88)
Univariate estimates				
Non-Hispanic Black/African American (vs non-Hispanic White)	5.14 (3.06–8.62)	2.74 (1.61–4.67)	1.19 (0.75–1.90)	7.77 (5.62–10.73)
Hispanic or Latino (vs non-Hispanic White)	2.35 (1.38–3.99)	0.92 (0.44– 1.92)	1.55 (0.95– 2.53)	4.17 (2.59–6.74)
Non-Hispanic Other Race (vs non-Hispanic White)	3.21 (1.64–6.27)	0.96 (0.35– 2.65)	1.50 (0.66–3.42)	3.72 (2.03–6.82)
Sex				
*Men (vs women)	1.08 (0.84–1.40)	0.71 (0.55–0.90)	0.84 (0.67–1.05)	0.99 (0.76–1.29)
Univariate estimates				
Men (vs women)	0.86 (0.69–1.06)	0.63 (0.48–0.82)	0.73 (0.59–0.91)	0.89 (0.70–1.13)
Age, y				
*<60 (vs 60–75)	3.80 (2.66–5.43)	0.62 (0.40–0.95)	1.47 (1.03–2.11)	3.64 (2.74–4.83)
*>75 (vs 60–75)	0.36 (0.22–0.60)	2.08 (1.44–3.00)	1.12 (0.80–1.56)	0.32 (0.21–0.50)
Univariate estimates				
<60 (vs 60–75)	2.17 (1.64–2.88)	0.58 (0.38–0.88)	1.20 (0.83–1.74)	2.55 (2.01–3.22)
>75 (vs 60–75)	0.67 (0.47–0.95)	2.33 (1.73–3.15)	1.48 (1.12–1.96)	0.43 (0.27–0.68)
Income				
*<25 000 (vs 25 000–75 000)	6.22 (4.57–8.49)	1.59 (1.07–2.38)	1.98 (1.41–2.78)	2.74 (1.89–3.99)
*>75 000 (vs 25 000–75 000)	0.20 (0.11–0.36)	0.69 (0.50–0.95)	0.75 (0.56–1.02)	0.29 (0.19–0.42)
Univariate estimates				
<25 000 (vs 25 000–75 000)	4.99 (3.67–6.80)	2.16 (1.44–3.24)	2.01 (1.47–2.75)	2.70 (1.92–3.79)
>75 000 (vs 25 000–75 000)	0.22 (0.13–0.38)	0.46 (0.33–0.64)	0.72 (0.55–0.94)	0.32 (0.22–0.47)
Education				
*College degree or higher (vs high school diploma or lower)	0.39 (0.29–0.53)	0.56 (0.39–0.82)	0.85 (0.67–1.09)	0.42 (0.30–0.59)
Univariate estimates				
College degree or higher (vs high school diploma or lower)	0.27 (0.20–0.37)	0.44 (0.33– 0.60)	0.70 (0.55– 0.90)	0.31 (0.22–0.43)

Odds ratios of being members of given class compared with Class 5, Generally Met Needs, profile as reference. OR indicates odds ratio. The 95% CIs are presented in parentheses.

*Represents estimates from model including all covariates. Univariate estimates presented below.

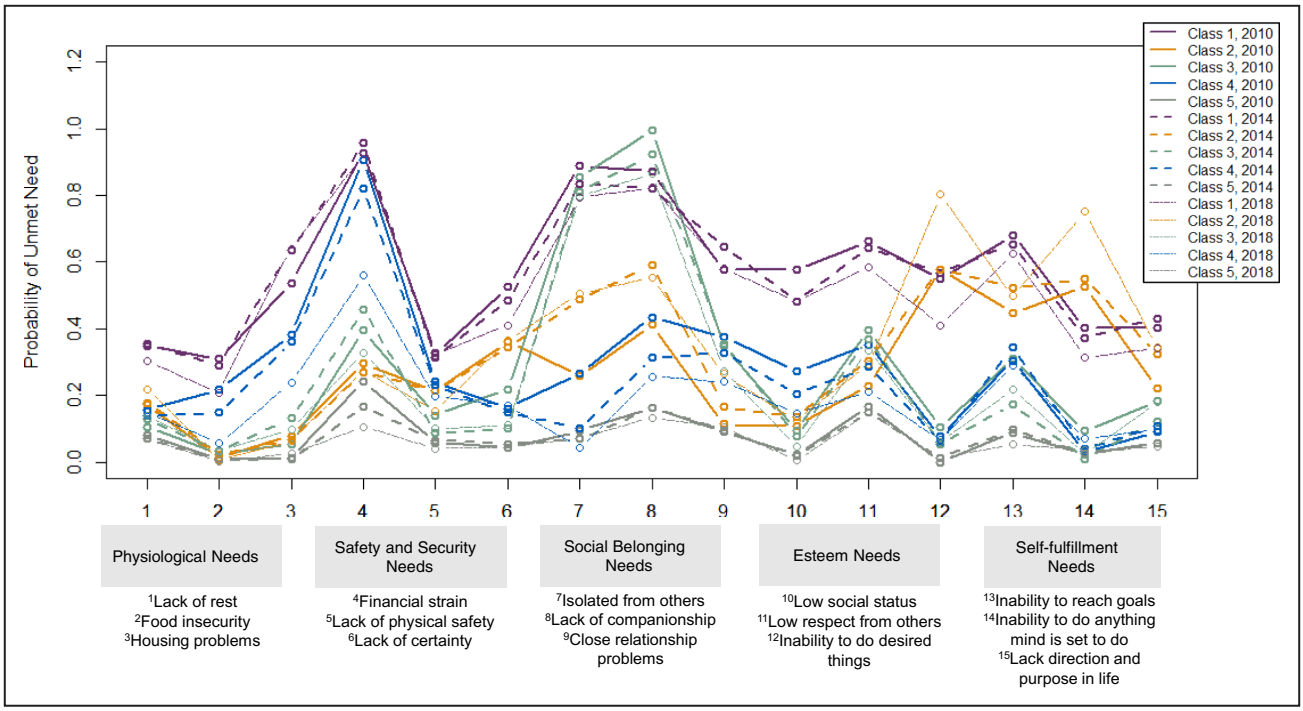

Figure 3. Cross-sectional 5-class solutions of unmet needs (2010, 2014, and 2018).
The figure represents the estimated probabilities of unmet needs across the 15 needs indicators (with 1 representing unmet needs) for each of the latent classes in the 2010, 2014, and 2018 5-class solutions. The 15 needs indicators are listed on the *x* axis.

social, and/or cognitive), which increases the risk of experiencing additional stressors.[57,58] Socioeconomic and residential disadvantage, for example, can increase exposure to other associated stressors (eg, poverty-related stress, unemployment, and unsafe living), while limiting socioeconomic resources to use as buffers of stress.[35,37] In the present study, those in the *Generally Unmet Needs* class were more likely to report lower income and education level, aligning with prior literature. Moreover, previous evidence suggests an association between psychological stressors and a greater risk of chronic disease and mortality.[59] Consistent with these findings, those in the *Generally Unmet Needs* class had significantly higher odds of hypertension and diabetes compared with those in the *Generally Met Needs* class.

In addition, the present study identified classes characterized as *Unmet Financial Needs* and *Unmet Social Belonging Needs*. These classes are also consistent with the results of other LCAs among older adults.[28] In the present study, however, compared with the *Generally Met Needs* class, those in the *Unmet Financial Needs* class had higher odds of diabetes, whereas those in the *Unmet Social Belonging Needs* class did not have higher odds of hypertension or diabetes. These findings may be partially explained by previous literature connecting social status and financial resources to well-being.[60,61] The *Unmet Social Belonging Needs* class had lower probabilities of unmet social status needs and financial strain, which may suggest that their perceptions of high status and low financial strain may protect against the physical effects of social belonging stress.

Stress Profiles Experienced by Non-Hispanic Black Participants

Non-Hispanic Black participants were more likely to be members of the *Generally Unmet Needs* class, which had a higher probability of hypertension and diabetes (compared with the *Generally Met Needs* class) and had the highest probabilities of unmet needs for social status and respect from others. In addition, non-Hispanic Black participants were more likely to be members of the *Unmet Financial Needs* class, which had a higher probability of diabetes (compared with the *Generally Met Needs* class). These findings reflect previous literature reporting that the co-occurrence of multiple stressors was higher among Black participants compared with White participants and that lower social status, interpersonal discrimination, and financial hardship are disproportionately experienced by Black adults compared with their White counterparts.[24,25,35,62,63] Furthermore, these findings are also consistent with previous studies linking these stressors to CVD and diabetes among Black adults.[61,64–66] Together, the present study suggests that non-Hispanic Black adults are at an increased risk of hypertension

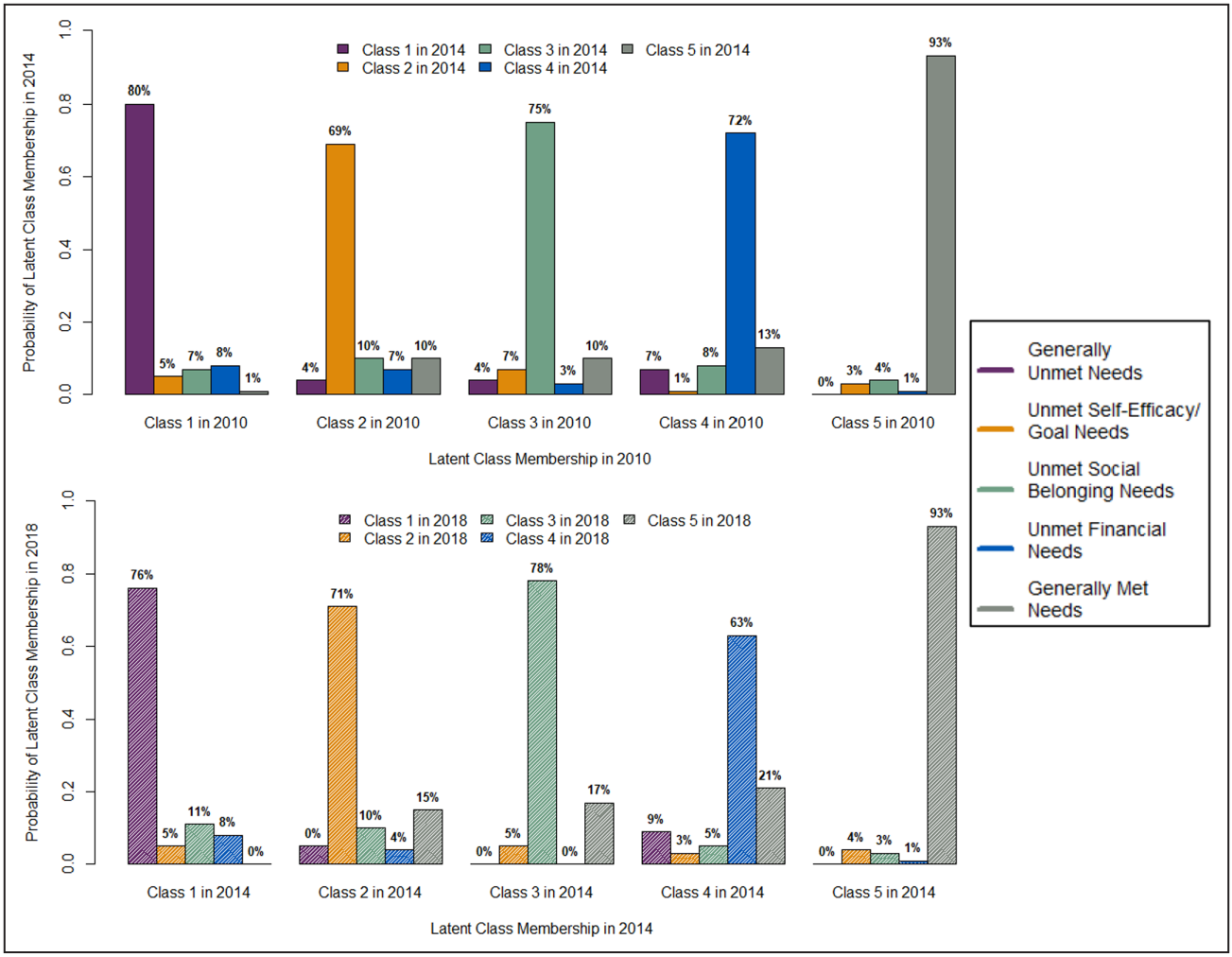

Figure 4. Latent class transition probabilities.
This figure represents the estimated probabilities of transitioning between classes from 2010 to 2014 and from 2014 to 2018. The *x* axis lists class membership in 2010 (top) and 2014 (bottom). The bars represent the probabilities of transitioning from the classes in 2010 to each class in 2014 (top), and from the classes in 2014 to each class in 2018 (bottom). For example, in the top graph, the first purple bar listed in "Class 1 in 2010" (80%) suggests that 80% of individuals in Class 1 in 2010 were also in Class 1 in 2014. The next highest frequency in the "Class 1 in 2010" category, the blue bar (8%), suggests that 8% of individuals who were in Class 1 in 2010 transitioned to Class 4 in 2014.

and diabetes through their higher likelihood of experiencing an overall pattern of unmet needs as well as unmet financial needs. These findings also extend the literature on social status and discrimination by including these indicators in a comprehensive measure of stress related to hypertension and diabetes.

Stress Profiles Experienced by Hispanic or Latino Participants

The present study did not find evidence that Hispanic or Latino participants were more or less likely to be members of the latent classes that were associated with hypertension and diabetes, which may reflect the mixed evidence in the literature linking chronic stress to chronic disease among Hispanic and Latino populations.[67] Previous studies suggest that variations in both stress exposure and health among Hispanic and Latino populations may differ by nativity status (foreign-born versus US-born Hispanic adults),[35] differences in Hispanic or Latino subgroups,[68] and/or sociocultural factors, such as acculturation and return migration later in life, which can differentially impact health.[69–71] Given that the present study examined Hispanic and Latino ethnicity as Hispanic or Latino versus not Hispanic or Latino because of small sample sizes within Hispanic or Latino ethnicity, there may be important subgroup differences based on country of origin or acculturation that could be further explored. In addition, the HRS participants' older age may be another important consideration for interpreting this pattern of results, and the study of stress and chronic

Table 6. ORs of Being a Member of Class 5, Generally Met Needs, at ≥1 Time Point(s)

Variable	OR (95% CI)
Race and ethnicity (vs non-Hispanic White)	
Non-Hispanic Black	0.60 (0.42–0.84)
Hispanic or Latino	1.27 (0.88–1.83)
Non-Hispanic other race	0.48 (0.23–0.99)
Sex (vs women)	
Men	1.04 (0.87–1.24)
Age, y (vs 60–75)	
<60	0.55 (0.46–0.66)
>75	1.27 (0.95–1.70)
Income, $ (vs 25 000–75 000)	
<25 000 reported in 2010	0.83 (0.59–1.15)
>75 000 reported in 2010	1.31 (1.03–1.66)
<25 000 reported in 2014	0.48 (0.31–0.73)
>75 000 reported in 2014	1.21 (0.89–1.65)
<25 000 reported in 2018	0.72 (0.52–0.98)
>75 000 reported in 2018	1.60 (1.14–2.23)
Education (vs high school diploma or lower)	
College degree or higher	1.20 (0.95–1.51)

OR indicates odds ratio.

health conditions in older Hispanic and Latino populations requires further attention.[72]

Stability of Latent Classes Over Time and Transition Probabilities Associated With Race and Ethnicity

The emergence of the same 5-class solution identified across 3 separate time points as well as the high probabilities of remaining in the same class in 2010, 2014, and 2018 suggest that latent class membership based on unmet needs is relatively stable over time.[73,74] More important, participants with the lowest unmet needs (ie, *Generally Met Needs*) and the highest unmet needs (ie, *Generally Unmet Needs*) had the highest average probabilities of remaining in the same class across the 3 time points (93% and 78%, respectively). These findings reiterate the importance of privilege and vulnerability as most of those with met needs continued to have their needs met and most of those with unmet needs continued with the same unmet needs between time points. Given that participants in the *Generally Unmet Needs* class had a higher likelihood of hypertension and diabetes compared with those in the *Generally Met Needs* class, were more likely to identify as non-Hispanic Black, and were more likely to report lower income and lower education attainment, these findings are particularly relevant to understanding the perpetuation of health disparities among racial and ethnic minority populations and those with lower socioeconomic status.

Overall, there were few covariate effects on the transition probabilities, which likely reflects the relatively low proportion of participants transitioning between classes between time points. For those who did transition between classes, there were notable patterns that varied by race and ethnicity. Specifically, the odds of transitioning into the *Unmet Financial Needs* class from the *Generally Met Needs* class were lower and the odds of transitioning from the *Generally Met Needs* class into the *Unmet Financial Needs* class were higher for non-Hispanic Black participants compared with non-Hispanic White participants. These findings suggest that transitioning to improved life circumstances over time may be more difficult and the transition from met needs to unmet financial needs may be more likely for non-Hispanic Black older adults compared with non-Hispanic White older adults. These findings highlight the importance of studying racial and ethnic differences in transitioning between classes of unmet needs as they relate to disparities in hypertension and diabetes outcomes.

Limitations

There are important limitations to consider when interpreting the findings from this study. Although the data include measures of hypertension and diabetes at multiple time points, the ability to make causal claims about the impact of chronic stress on hypertension and diabetes is limited. In addition, the HRS item on self-identified race is limited to White, Black, or "other" race. This reduces the ability to understand the racial groups represented by the "other" race category and limits the ability to interpret findings for additional racial groups. With respect to the stress measures, the measures based on Maslow's Hierarchy of Needs assume that these needs are universal, yet these items may not adequately capture stress among all individuals and may have underestimated the full impact of chronic stress on hypertension and diabetes.

Furthermore, the presence of direct effects of the covariates on the close relationship indicator suggests these findings should be interpreted carefully. To examine these concerns related to measurement noninvariance with respect to race and ethnicity, the 5-class solutions were estimated using multiple group analysis. The patterns of latent classes were consistent across racial and ethnic groups (Figure S5), thereby suggesting configural invariance of the underlying latent classes. Moreover, in the models stratified by race and ethnicity, the proportions of participants within each class varied according to the findings from the latent class covariate analysis. Together, these findings provide confidence in the general results of this study, despite the direct effects of covariates on the indicators. Finally, small cell sizes within certain categories

Table 7. Covariate Effects Associated With Latent Class Transition Probability ORs

	Latent class membership in 2010 and 2014 (starting classes)									
	Class 1: Generally Unmet Needs		Class 2: Unmet Self-Efficacy/ Goal Needs		Class 3: Unmet Social Belonging Needs		Class 4: Unmet Financial Needs		Class 5: Generally Met Needs	
Race and ethnicity (non-Hispanic Black vs non-Hispanic White)										
Latent class membership in 2014 and 2018 (ending classes)										
	2010–2014	2014–2018	2010–2014	2014–2018	2010–2014	2014–2018	2010–2014	2014–2018	2010–2014	2014–2018
Class 1: Generally Unmet Needs	…	…	1.22 (0.08–19.06)	0.85 (0.01– 73.58)	1.95 (0.84–4.50)	1.05 (0.13–8.64)	0.84 (0.32–2.22)	0.32 (0.09–1.17)	2.53 (0.79–8.08)	0.80 (0.19–3.44)
Class 2: Unmet Self-Efficacy/Goal Needs	0.82 (0.05–12.79)	1.18 (0.01–101.77)	…	…	1.60 (0.11–23.84)	1.24 (0.02– 94.44)	0.69 (0.06–8.02)	0.38 (0.00–34.24)	2.07 (0.26–16.63)	0.94 (0.01–78.85)
Class 3: Unmet Social Belonging Needs	0.51 (0.22–1.19)	0.95 (0.12–7.81)	0.63 (0.04–9.37)	0.81 (0.01–61.76)	…	…	0.43 (0.14–1.30)	0.31 (0.03–2.71)	1.30 (0.37–4.56)	0.76 (0.15–3.77)
Class 4: Unmet Financial Needs	1.19 (0.45–3.16)	3.11 (0.85–11.38)	1.46 (0.13–17.06)	2.65 (0.03–239.80)	2.33 (0.77–7.03)	3.27 (0.37–29.06)	…	…	3.02 (1.16–7.87)	2.49 (0.77–8.06)
Class 5: Generally Met Needs	0.40 (0.13–1.26)	1.25 (0.29–5.35)	0.48 (0.06–3.78)	1.08 (0.01–90.03)	0.77 (0.22–2.69)	1.31 (0.26–6.53)	0.33 (0.13–0.86)	0.40 (0.12–1.30)	…	…
Race and ethnicity (Hispanic or Latino vs non-Hispanic White)										
Latent class membership in 2014 and 2018 (ending classes)										
	2010–2014	2014–2018	2010–2014	2014–2018	2010–2014	2014–2018	2010–2014	2014–2018	2010–2014	2014–2018
Class 1: Generally Unmet Needs	…	…	0.47 (0.06–3.99)	0.77 (0.03–24.18)	2.24 (0.24–21.26)	3.32 (0.26–41.93)	0.64 (0.06–6.99)	0.29 (0.03–3.10)	0.53 (0.06–4.54)	1.09 (0.09–13.12)
Class 2: Unmet Self-Efficacy/Goal Needs	2.11 (0.25–17.74)	1.30 (0.04–40.74)	…	…	4.71 (0.40–54.99)	4.31 (0.25–75.39)	1.35 (0.08–24.56)	0.38 (0.01–16.87)	1.11 (0.07–17.80)	1.41 (0.19–10.45)
Class 3: Unmet Social Belonging Needs	0.45 (0.05–4.25)	0.30 (0.02–3.80)	0.21 (0.02–2.48)	0.23 (0.01–4.05)	…	…	0.29 (0.02–5.59)	0.09 (0.00–2.90)	0.24 (0.02–3.44)	0.33 (0.04–2.79)
Class 4: Unmet Financial Needs	1.56 (0.14–16.95)	3.43 (0.32–36.48)	0.74 (0.04–13.40)	2.64 (0.06–117.79)	3.48 (0.18–67.68)	11.40 (0.35–376.70)	…	…	0.82 (0.18–3.84)	3.72 (0.27–52.03)
Class 5: Generally Met Needs	1.91 (0.22–16.51)	0.91 (0.07–11.39)	0.90 (0.06–14.45)	0.72 (0.10–5.32)	4.23 (0.29–61.03)	3.06 (0.37–25.61)	1.22 (0.26–5.74)	0.27 (0.02–3.91)	…	…

Estimates presented are odds ratios. The 95% CIs are presented in parentheses. All covariate effects on transition probabilities are presented in Table S2.

of the transition analysis resulted in relatively wide CIs for these cells. These point estimates should be interpreted with caution.

Strengths

Despite these limitations, the present study included several strengths. Specifically, this study addressed calls to measure stress across multiple domains and examined the association between a multidimensional measure of stress and hypertension and diabetes status. This study also focused on older adults who may experience unique patterns of stress and are at increased risk of hypertension and diabetes. Moreover, this study examined whether the associations between stress, hypertension, and diabetes status varied by race and ethnicity, with a specific focus on non-Hispanic Black and Hispanic or Latino older adults. Finally, this study extended previous cross-sectional studies on chronic stress by examining patterns of change over time.

Implications for Future Research

Future studies could consider using latent class mediation analysis to examine whether certain latent classes of stress influence specific health characteristics (eg, body mass index and self-rated health status), in turn, increasing the risk of developing hypertension and diabetes. In addition, future research could examine whether latent classes of stress are associated with incident hypertension and diabetes status in study populations who have low prevalence of hypertension and diabetes at baseline.

Implications of the present work may also be considered in the context of other pressing lines of research in the aging population. Frailty syndrome, for example, has gained increased attention in the role of CVD, as a state of increased physiological vulnerability in older adults.[75,76] In addition to declines in multiple organs in the system, frailty reduces the ability to cope with stress, thereby increasing the likelihood of additional declines in physical and mental health.[77,78] Given the strong connections between frailty and stress (eg, lack of social support, environmental stressors, and financial strain), the present research might suggest an association between latent classes of stress based on unmet needs, frailty syndrome, and hypertension and diabetes. Future studies may consider examining these relationships and are especially needed to inform strategies to address expected increases in chronic diseases among the aging population in the coming decades.

Finally, this study provides a contextual approach to understand the dynamic complexities of unmet needs that affect hypertension and diabetes status. The groupings observed in the present study (eg, the grouping of unmet needs, classes with high prevalence of both hypertension and diabetes, and the grouping of racial and ethnic minority status, lower income, and/or education) may be considered using a syndemic framework (ie, examining the ways in which biological, social, behavioral, and environmental factors dynamically interact with co-occurring diseases[79]). These findings can also be applied to research on syndemic vulnerabilities and the right to health (ie, addressing social, political, and structural determinants to confront health inequities holistically[80]). The person-centered approach in the present study aligns well with the holistic approach of syndemic vulnerabilities and has significant implications. Specifically, intervention approaches may investigate the determinants of health that may be the most changeable among those disproportionately burdened with unmet needs, hypertension, and diabetes.

CONCLUSIONS

Consistent with prior literature, the present study reinforces the negative impact of co-occurring stress and financial hardship on the health of non-Hispanic Black older adults and further highlights the importance of examining psychosocial stressors as predictors of hypertension and diabetes. The present study also reiterates the need for the continued study of stress and chronic disease among Hispanic or Latino older adults to help resolve mixed evidence in the literature. Such findings could be used in support of policies and programs directed at improving health equity through addressing the roots of chronic stress across multiple levels (eg, improving access to physiological needs via antipoverty and food security programs, antiracism strategies to reduce interpersonal and institutional discrimination that affects safety/security, social belonging, and esteem needs). These efforts, along with the continued study of the ways in which chronic stress impacts hypertension and diabetes, may help reduce disparities in CVD.

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Disclosures

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Supplemental Material

Tables S1–S2
Figures S1–S5

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SUPPLEMENTAL MATERIAL

Table S1. Unmet Needs at 2010, 2014, and 2018 Timepoints

Needs	Item Description	Coding	Frequency 2010	Frequency 2014	Frequency 2018
Physiological					
Lack of rest	How often do you feel really rested when you wake up in the morning?	1: Not rested (rarely or never) 0: Feel rested (most of the time, sometimes)	1: n= 942 0: n=5916	1: n=833 0: n=5227	1: n=662 0: n=3966
Food insecurity	In the last two years, have you always had enough money to buy the food you need?	1: Has not always had enough money for food 0: Has always had enough money for food	1: n=623 0: n=6197	1: n=507 0: n=5510	1: n=294 0: n=4275
Housing problems	Mark whether or not any of these are current and ongoing problems that have lasted twelve months or longer: Ongoing housing problems	1: Yes, happened 0: No, did not happen	1: n=1135 0: n=5516	1: n=972 0: n=4332	1: n=648 0: n=2935
Safety and security					
Financial strain	Mark whether or not any of these are current and ongoing problems that have lasted twelve months or longer: Ongoing financial strain	1: Yes, happened 0: No, did not happen	1: n=3142 0: n=3522	1: n=2251 0: n=3069	1: n=1321 0: n=2270
Lack of physical safety	People would be afraid to walk alone in this area after dark	1: Yes (includes items 5 and above on 7pt scale) 0: No	1: n=1199 0: n=5461	1: n=931 0: n=4431	1: n=555 0: n=3062
Lack of certainty	I have little control over the things that happen to me	1: Agree 0: Disagree	1: n=1340 0: n=5418	1: n=1032 0: n=4398	1: n=628 0: n=3012
Social belonging					
Isolated from others	How much of the time do you feel isolated from others?	1: Yes (Some of the time, Often) 0: No (Hardly ever or never)	1: n=2233 0: n=4478	1: n=1723 0: n=3668	1: n=1143 0: n=2501
Lack of companionship	How much of the time do you feel you lack companionship?	1: Yes (Some of the time, Often) 0: No (Hardly ever or never)	1: n=3026 0: n=3727	1: n=2409 0: n=3013	1: n=1545 0: n=2124
Close relationship problems	Mark whether or not any of these are current and ongoing problems that have lasted twelve months or longer: Ongoing problems in a close relationship	1: Yes, happened 0: No, did not happen	1: n=1554 0: n=5095	1: n=1320 0: n=3998	1: n=830 0: n=2755
Esteem					

Needs	Item Description	Coding	Frequency 2010	Frequency 2014	Frequency 2018
Low social status	Think of this ladder as representing where people stand in our society. At the top of the ladder are the people who are the best off - those who have the most money, most education, and best jobs. At the bottom are the people who are the worst off - who have the least money, least education, and the worst jobs or no jobs. The higher up you are on this ladder, the closer you are to the people at the very top and the lower you are, the closer you are to the people at the very bottom	1: Perceived Low Status (indicated 4 or below on ladder) 0: Perceived High Status	1: n=931 0: n=5199	1: n=708 0: n=4292	1: n=386 0: n=3050
Low respect from others	You are treated with less courtesy or respect than other people	1: Yes (Few times a year, few times a month, at least once a week, almost everyday) 0: No (Never, Less than once a year)	1: n=1984 0: n=4770	1: n=1512 0: n=3898	1: n=951 0: n=2693
Inability to do desired things	I can do the things I want to do	1: Disagree 0: Agree	1: n=1152 0: n=5622	1: n=983 0: n=4467	1: n=575 0: n=3080
Self-fulfillment					
Inability to reach goals	I feel it is impossible for me to reach the goals that I would like to strive for	1: Agree 0: Disagree	1: n=1931 0: n=4791	1: n=1556 0: n=3810	1: n=943 0: n=2700
Inability to do anything mind is set to do	I can do just about anything I really set my mind to	1: Disagree 0: Agree	1: n=996 0: n=5789	1: n=830 0: n=4616	1: n=525 0: n=3134
Lack of direction and purpose in life	I have a sense of direction and purpose in my life	1: Disagree 0: Agree	1: n=916 0: n=577	1: n=833 0: n=4549	1: n=520 0: n=3087

Table S2. All Covariate Effects Associated with Latent Class Transition Probability Odds Ratios

	Odds Ratios [95% CI]									
	Latent Class Membership in 2010 and 2014 (Starting Classes)									
	Class 1 Generally Unmet Needs		**Class 2** Unmet Self-Efficacy/ Goal Needs		**Class 3** Unmet Social Belonging Needs		**Class 4** Unmet Financial Needs		**Class 5** Generally Met Needs	
Race/ethnicity (Non-Hispanic Black/African American versus Non-Hispanic White)										
Latent Class Membership in 2014 and 2018 (Ending Classes)										
	2010-14	**2014-18**	**2010-14**	**2014-18**	**2010-14**	**2014-18**	**2010-14**	**2014-18**	**2010-14**	**2014-18**
Class 1 Generally Unmet Needs	—	—	1.22 [0.08, 19.06]	0.85 [0.01, 73.58]	1.95 [0.84, 4.50]	1.05 [0.13, 8.64]	0.84 [0.32, 2.22]	0.32 [0.09, 1.17]	2.53 [0.79, 8.08]	0.80 [0.19, 3.44]
Class 2 Unmet Self-Efficacy/ Goal Needs	0.82 [0.05, 12.79]	1.18 [0.01, 101.77]	—	—	1.60 [0.11, 23.84]	1.24 [0.02, 94.44]	0.69 [0.06, 8.02]	0.38 [0.00, 34.24]	2.07 [0.26, 16.63]	0.94 [0.01, 78.85]
Class 3 Unmet Social Belonging Needs	0.51 [0.22, 1.19]	0.95 [0.12, 7.81]	0.63 [0.04, 9.37]	0.81 [0.01, 61.76]	—	—	0.43 [0.14, 1.30]	0.31 [0.03, 2.71]	1.30 [0.37, 4.56]	0.76 [0.15, 3.77]
Class 4 Unmet Financial Needs	1.19 [0.45, 3.16]	3.11 [0.85, 11.38]	1.46 [0.13, 17.06]	2.65 [0.03, 239.80]	2.33 [0.77, 7.03]	3.27 [0.37, 29.06]	—	—	3.02 [1.16, 7.87]	2.49 [0.77, 8.06]
Class 5 Generally Met Needs	0.40 [0.13, 1.26]	1.25 [0.29, 5.35]	0.48 [0.06, 3.78]	1.08 [0.01, 90.03]	0.77 [0.22, 2.69]	1.31 [0.26, 6.53]	0.33 [0.13, 0.86]	0.40 [0.12, 1.30]	—	—
Race/ethnicity (Hispanic or Latino versus Non-Hispanic White)										
Latent Class Membership in 2014 and 2018 (Ending Classes)										
	2010-14	**2014-18**	**2010-14**	**2014-18**	**2010-14**	**2014-18**	**2010-14**	**2014-18**	**2010-14**	**2014-18**
Class 1 Generally Unmet Needs	—	—	0.47 [0.06, 3.99]	0.77 [0.03, 24.18]	2.24 [0.24, 21.26]	3.32 [0.26, 41.93]	0.64 [0.06, 6.99]	0.29 [0.03, 3.10]	0.53 [0.06, 4.54]	1.09 [0.09, 13.12]
Class 2 Unmet Self-Efficacy/ Goal Needs	2.11 [0.25, 17.74]	1.30 [0.04, 40.74]	—	—	4.71 [0.40, 54.99]	4.31 [0.25, 75.39]	1.35 [0.08, 24.56]	0.38 [0.01, 16.87]	1.11 [0.07, 17.80]	1.41 [0.19, 10.45]
Class 3 Unmet Social Belonging Needs	0.45 [0.05, 4.25]	0.30 [0.02, 3.80]	0.21 [0.02, 2.48]	0.23 [0.01, 4.05]	—	—	0.29 [0.02, 5.59]	0.09 [0.00, 2.90]	0.24 [0.02, 3.44]	0.33 [0.04, 2.79]
Class 4 Unmet Financial Needs	1.56 [0.14, 16.95]	3.43 [0.32, 36.48]	0.74 [0.04, 13.40]	2.64 [0.06, 117.79]	3.48 [0.18, 67.68]	11.40 [0.35, 376.70]	—	—	0.82 [0.18, 3.84]	3.72 [0.27, 52.03]
Class 5 Generally Met Needs	1.91 [0.22, 16.51]	0.91 [0.07, 11.39]	0.90 [0.06, 14.45]	0.72 [0.10, 5.32]	4.23 [0.29, 61.03]	3.06 [0.37, 25.61]	1.22 [0.26, 5.74]	0.27 [0.02, 3.91]	—	—

95% confidence intervals are presented in brackets.

	Odds Ratios [95% CI]									
	Latent Class Membership in 2010 and 2014 (Starting Classes)									
	Class 1 Generally Unmet Needs		**Class 2** Unmet Self-Efficacy/ Goal Needs		**Class 3** Unmet Social Belonging Needs		**Class 4** Unmet Financial Needs		**Class 5** Generally Met Needs	
Race/ethnicity (Non-Hispanic Other Race versus Non-Hispanic White)										
Latent Class Membership in 2014 and 2018 (Ending Classes)										
	2010-14	**2014-18**	**2010-14**	**2014-18**	**2010-14**	**2014-18**	**2010-14**	**2014-18**	**2010-14**	**2014-18**
Class 1 Generally Unmet Needs	—	—	0.32 [0.04, 2.31]	2.29 [0.23, 23.20]	1.70 [0.50, 5.77]	0.74 [0.13, 4.08]	1.44 [0.28, 7.38]	0.39 [0.09, 1.82]	4.27 [0.68, 26.67]	0.78 [0.11, 5.80]
Class 2 Unmet Self-Efficacy/ Goal Needs	3.16 [0.43, 22.94]	0.44 [0.04, 4.42]	—	—	5.36 [0.86, 33.27]	0.32 [0.05, 2.06]	4.55 [0.22, 94.63]	0.17 [0.02, 1.80]	13.46 [2.97, 60.98]	0.34 [0.04, 2.69]
Class 3 Unmet Social Belonging Needs	0.59 [0.17, 2.00]	1.36 [0.25, 7.54]	0.19 [0.03, 1.16]	3.12 [0.49, 20.06]	—	—	0.85 [0.15, 4.72]	0.53 [0.07, 4.03]	2.51 [0.55, 11.50]	1.06 [0.30, 3.71]
Class 4 Unmet Financial Needs	0.69 [0.14, 3.55]	2.55 [0.55, 11.83]	0.22 [0.01, 4.57]	5.85 [0.55, 61.78]	1.18 [0.21, 6.54]	1.88 [0.25, 14.17]	—	—	2.96 [0.22, 39.67]	1.99 [0.20, 20.07]
Class 5 Generally Met Needs	0.23 [0.04, 1.48]	1.28 [0.17, 9.58]	0.08 [0.02, 0.34]	2.94 [0.37, 23.44]	0.40 [0.09, 1.83]	0.94 [0.27, 3.29]	0.34 [0.03, 4.60]	0.50 [0.05, 5.13]	—	—
Sex (Male versus Female)										
Latent Class Membership in 2014 and 2018 (Ending Classes)										
	2010-14	**2014-18**	**2010-14**	**2014-18**	**2010-14**	**2014-18**	**2010-14**	**2014-18**	**2010-14**	**2014-18**
Class 1 Generally Unmet Needs	—	—	1.31 [0.30, 5.77]	1.75 [0.34, 9.13]	1.15 [0.46, 2.87]	0.66 [0.18, 2.44]	0.72 [0.30, 1.73]	0.99 [0.33, 2.92]	0.94 [0.28, 3.15]	1.06 [0.32, 3.55]
Class 2 Unmet Self-Efficacy/ Goal Needs	0.76 [0.17, 3.37]	0.57 [0.11, 2.97]	—	—	0.88 [0.29, 2.67]	0.38 [0.12, 1.16]	0.55 [0.14, 2.20]	0.56 [0.10, 3.18]	0.71 [0.31, 1.67]	0.61 [0.21, 1.75]
Class 3 Unmet Social Belonging Needs	0.87 [0.35, 2.16]	1.52 [0.41, 5.64]	1.14 [0.37, 3.45]	2.67 [0.86, 8.24]	—	—	0.62 [0.24, 1.60]	1.50 [0.35, 6.47]	0.81 [0.31, 2.15]	1.62 [0.65, 4.06]
Class 4 Unmet Financial Needs	1.39 [0.58, 3.36]	1.01 [0.34, 3.00]	1.82 [0.46, 7.31]	1.78 [0.31, 10.06]	1.61 [0.63, 4.11]	0.67 [0.16, 2.87]	—	—	1.30 [0.51, 3.32]	1.08 [0.33, 3.51]
Class 5 Generally Met Needs	1.07 [0.32, 3.60]	0.94 [0.28, 3.14]	1.40 [0.60, 3.27]	1.65 [0.57, 4.71]	1.23 [0.47, 3.27]	0.62 [0.25, 1.54]	0.77 [0.30, 1.96]	0.93 [0.28, 3.03]	—	—

95% confidence intervals are presented in brackets.

	Odds Ratios [95% CI]									
	Latent Class Membership in 2010 and 2014 (Starting Classes)									
	Class 1 Generally Unmet Needs		**Class 2** Unmet Self-Efficacy/ Goal Needs		**Class 3** Unmet Social Belonging Needs		**Class 4** Unmet Financial Needs		**Class 5** Generally Met Needs	
Age (<60 years versus 60-75 years)										
Latent Class Membership in 2014 and 2018 (Ending Classes)										
	2010-14	**2014-18**	**2010-14**	**2014-18**	**2010-14**	**2014-18**	**2010-14**	**2014-18**	**2010-14**	**2014-18**
Class 1 Generally Unmet Needs	—	—	1.19 [0.29, 4.86]	1.54 [0.30, 7.95]	0.81 [0.31, 2.09]	0.84 [0.24, 2.91]	0.84 [0.28, 2.54]	1.62 [0.65, 4.08]	0.44 [0.14, 1.40]	0.79 [0.25, 2.55]
Class 2 Unmet Self-Efficacy/ Goal Needs	0.84 [0.21, 3.42]	0.65 [0.13, 3.33]	—	—	0.68 [0.19, 2.44]	0.55 [0.16, 1.91]	0.71 [0.16, 3.23]	1.05 [0.21, 5.35]	0.37 [0.12, 1.18]	0.51 [0.18, 1.44]
Class 3 Unmet Social Belonging Needs	1.23 [0.48, 3.18]	1.19 [0.34, 4.10]	1.47 [0.41, 5.29]	1.83 [0.52, 6.41]	—	—	1.04 [0.33, 3.25]	1.93 [0.46, 8.12]	0.54 [0.23, 1.27]	0.94 [0.43, 2.06]
Class 4 Unmet Financial Needs	1.19 [0.39, 3.59]	0.62 [0.25, 1.55]	1.42 [0.31, 6.47]	0.95 [0.19, 4.85]	0.96 [0.31, 3.01]	0.52 [0.12, 2.19]	—	—	0.52 [0.18, 1.50]	0.49 [0.15, 1.56]
Class 5 Generally Met Needs	2.27 [0.72, 7.21]	1.27 [0.39, 4.08]	2.71 [0.85, 8.65]	1.95 [0.70, 5.49]	1.84 [0.79, 4.31]	1.07 [0.49, 2.34]	1.91 [0.67, 5.48]	2.05 [0.64, 6.57]	—	—
Age (>75 years versus 60-75 years)										
Latent Class Membership in 2014 and 2018 (Ending Classes)										
	2010-14	**2014-18**	**2010-14**	**2014-18**	**2010-14**	**2014-18**	**2010-14**	**2014-18**	**2010-14**	**2014-18**
Class 1 Generally Unmet Needs	—	—	1.09 [0.27, 4.39]	0.17 [0.03, 1.08]	2.15 [0.60, 7.73]	1.23 [0.14, 10.58]	1.24 [0.36, 4.25]	0.66 [0.16, 2.63]	3.45 [0.61, 19.49]	0.97 [0.19, 5.00]
Class 2 Unmet Self-Efficacy/ Goal Needs	0.92 [0.23, 3.69]	5.78 [0.93, 35.89]	—	—	1.97 [0.84, 4.58]	7.09 [1.09, 46.36]	1.13 [0.31, 4.17]	3.80 [0.90,16.03]	3.16 [1.01, 9.96]	5.57 [2.03, 15.34]
Class 3 Unmet Social Belonging Needs	0.47 [0.13, 1.68]	0.82 [0.10, 7.02]	0.51 [0.22, 1.19]	0.14 [0.02, 0.92]	—	—	0.58 [0.16, 2.03]	0.54 [0.08, 3.79]	1.61 [0.45, 5.78]	0.79 [0.17, 3.60]
Class 4 Unmet Financial Needs	0.81 [0.24, 2.77]	1.52 [0.38, 6.09]	0.88 [0.24, 3.24]	0.26 [0.06, 1.11]	1.73 [0.49, 6.11]	1.87 [0.26, 13.24]	—	—	2.79 [0.48, 16.15]	1.47 [0.40, 5.37]
Class 5 Generally Met Needs	0.29 [0.05, 1.64]	1.04 [0.20, 5.37]	0.32 [0.10, 1.00]	0.18 [0.07, 0.49]	0.62 [0.17, 2.24]	1.26 [0.28, 5.74]	0.36 [0.06, 2.07]	0.68 [0.19, 2.50]	—	—

95% confidence intervals are presented in brackets.

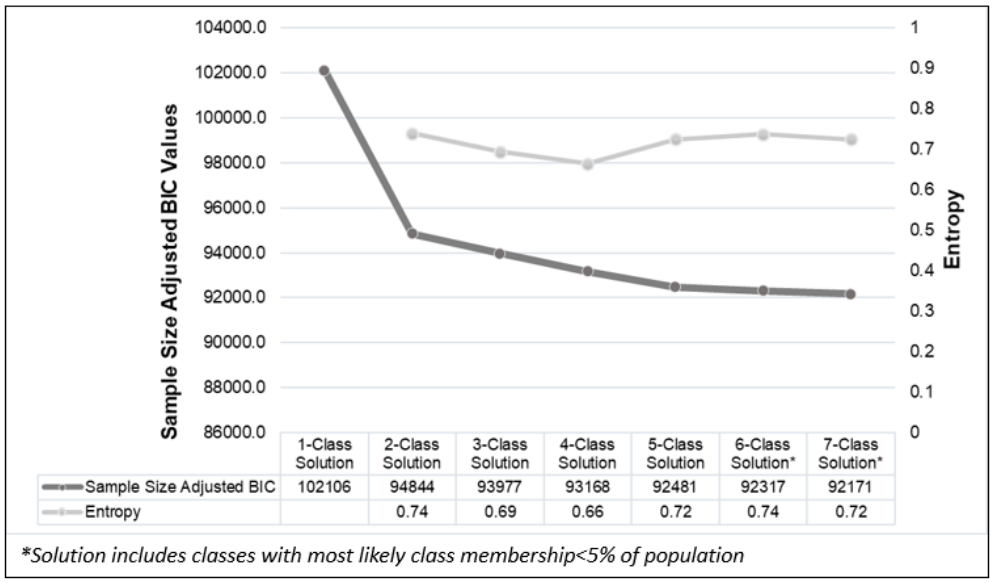
	Odds Ratios [95% CI]									
	Latent Class Membership in 2010 and 2014 (Starting Classes)									
	Class 1 Generally Unmet Needs		**Class 2** Unmet Self-Efficacy/ Goal Needs		**Class 3** Unmet Social Belonging Needs		**Class 4** Unmet Financial Needs		**Class 5** Generally Met Needs	
Income (<25K versus 25-75K)										
Latent Class Membership in 2014 and 2018 (Ending Classes)										
	2010-14	**2014-18**	**2010-14**	**2014-18**	**2010-14**	**2014-18**	**2010-14**	**2014-18**	**2010-14**	**2014-18**
Class 1 Generally Unmet Needs	—	—	1.77 [0.29, 10.77]	1.33 [0.21, 8.60]	1.19 [0.48, 2.91]	1.88 [0.42, 8.46]	1.32 [0.49, 3.58]	0.56 [0.19, 1.67]	0.80 [0.21, 3.14]	1.67 [0.46, 6.03]
Class 2 Unmet Self-Efficacy/ Goal Needs	0.56 [0.09, 3.42]	0.75 [0.12, 4.83]	—	—	0.67 [0.14, 3.27]	1.41 [0.40, 4.92]	0.74 [0.13, 4.24]	0.42 [0.06, 2.89]	0.45 [0.09, 2.31]	1.25 [0.40, 3.90]
Class 3 Unmet Social Belonging Needs	0.84 [0.34, 2.07]	0.53 [0.12, 2.41]	1.50 [0.31, 7.33]	0.71 [0.20, 2.49]	—	—	1.11 [0.40, 3.06]	0.30 [0.06, 1.61]	0.68 [0.19, 2.42]	0.89 [0.35, 2.29]
Class 4 Unmet Financial Needs	0.76 [0.28, 2.06]	1.78 [0.60, 5.25]	1.35 [0.24, 7.69]	2.37 [0.35, 16.21]	0.90 [0.33, 2.48]	3.33 [0.62, 17.80]	—	—	0.61 [0.15, 2.39]	2.97 [0.76, 11.61]
Class 5 Generally Met Needs	1.25 [0.32, 4.90]	0.60 [0.17, 2.15]	2.21 [0.44, 11.18]	0.80 [0.26, 2.48]	1.48 [0.41, 5.29]	1.12 [0.44, 2.87]	1.65 [0.42, 6.49]	0.33 [0.08, 1.33]	—	—
Income (>75K versus 25-75K)										
Latent Class Membership in 2014 and 2018 (Ending Classes)										
	2010-14	**2014-18**	**2010-14**	**2014-18**	**2010-14**	**2014-18**	**2010-14**	**2014-18**	**2010-14**	**2014-18**
Class 1 Generally Unmet Needs	—	—	1.21 [0.31, 4.73]	0.97 [0.15, 6.28]	2.07 [0.59, 7.21]	0.76 [0.18, 3.22]	1.39 [0.40, 4.83]	0.43 [0.10, 1.77]	1.70 [0.48, 6.12]	0.65 [0.14, 2.95]
Class 2 Unmet Self-Efficacy/ Goal Needs	0.83 [0.21, 3.22]	1.04 [0.16, 6.75]	—	—	1.70 [0.51, 5.73]	0.79 [0.23, 2.72]	1.15 [0.23, 5.68]	0.44 [0.11, 1.82]	1.41 [0.44, 4.52]	0.67 [0.25, 1.76]
Class 3 Unmet Social Belonging Needs	0.48 [0.14, 1.69]	1.31 [0.31, 5.53]	0.59 [0.18, 1.97]	1.27 [0.37, 4.36]	—	—	0.67 [0.14, 3.27]	0.56 [0.15, 2.14]	0.82 [0.32, 2.11]	0.85 [0.38, 1.88]
Class 4 Unmet Financial Needs	0.72 [0.21, 2.50]	2.35 [0.56, 9.78]	0.87 [0.18, 4.32]	2.27 [0.55, 9.33]	1.49 [0.31, 7.23]	1.79 [0.47, 6.87]	—	—	1.23 [0.31, 4.90]	1.52 [0.53, 4.30]
Class 5 Generally Met Needs	0.59 [0.16, 2.11]	1.55 [0.34, 7.09]	0.71 [0.22, 2.29]	1.50 [0.57, 3.95]	1.21 [0.47, 3.10]	1.18 [0.53, 2.64]	0.82 [0.20, 3.26]	0.66 [0.23, 1.88]	—	—

95% confidence intervals are presented in brackets.

	Odds Ratios [95% CI]									
	Latent Class Membership in 2010 and 2014 (Starting Classes)									
	Class 1 Generally Unmet Needs		**Class 2** Unmet Self-Efficacy/ Goal Needs		**Class 3** Unmet Social Belonging Needs		**Class 4** Unmet Financial Needs		**Class 5** Generally Met Needs	
Education (College Degree and Above versus High School Diploma and Less)										
Latent Class Membership in 2014 and 2018 (Ending Classes)										
	2010-14	**2014-18**	**2010-14**	**2014-18**	**2010-14**	**2014-18**	**2010-14**	**2014-18**	**2010-14**	**2014-18**
Class 1 Generally Unmet Needs	—	—	1.28 [0.38, 4.33]	0.65 [0.18, 2.40]	0.77 [0.30, 1.97]	0.76 [0.19, 3.08]	1.12 [0.49, 2.56]	0.58 [0.15, 2.22]	1.46 [0.46, 4.68]	0.61 [0.18, 2.00]
Class 2 Unmet Self-Efficacy/ Goal Needs	0.78 [0.23, 2.66]	1.53 [0.42, 5.61]	—	—	0.60 [0.23, 1.58]	1.16 [0.41, 3.33]	0.88 [0.26, 3.02]	0.89 [0.26, 3.09]	1.14 [0.45, 2.89]	0.93 [0.41, 2.09]
Class 3 Unmet Social Belonging Needs	1.31 [0.51, 3.36]	1.31 [0.33, 5.31]	1.67 [0.64, 4.37]	0.86 [0.30, 2.46]	—	—	1.46 [0.56, 3.85]	0.76 [0.19, 3.11]	1.91 [0.76, 4.80]	0.80 [0.37, 1.70]
Class 4 Unmet Financial Needs	0.89 [0.39, 2.04]	1.72 [0.45, 6.54]	1.14 [0.33, 3.93]	1.12 [0.32, 3.91]	0.68 [0.26, 1.80]	1.31 [0.32, 5.33]	—	—	1.30 [0.48, 3.56]	1.04 [0.39, 2.79]
Class 5 Generally Met Needs	0.69 [0.21, 2.19]	1.65 [0.50, 5.46]	0.87 [0.35, 2.20]	1.08 [0.48, 2.44]	0.53 [0.21, 1.32]	1.26 [0.59, 2.69]	0.77 [0.28, 2.09]	0.96 [0.36, 2.57]	—	—

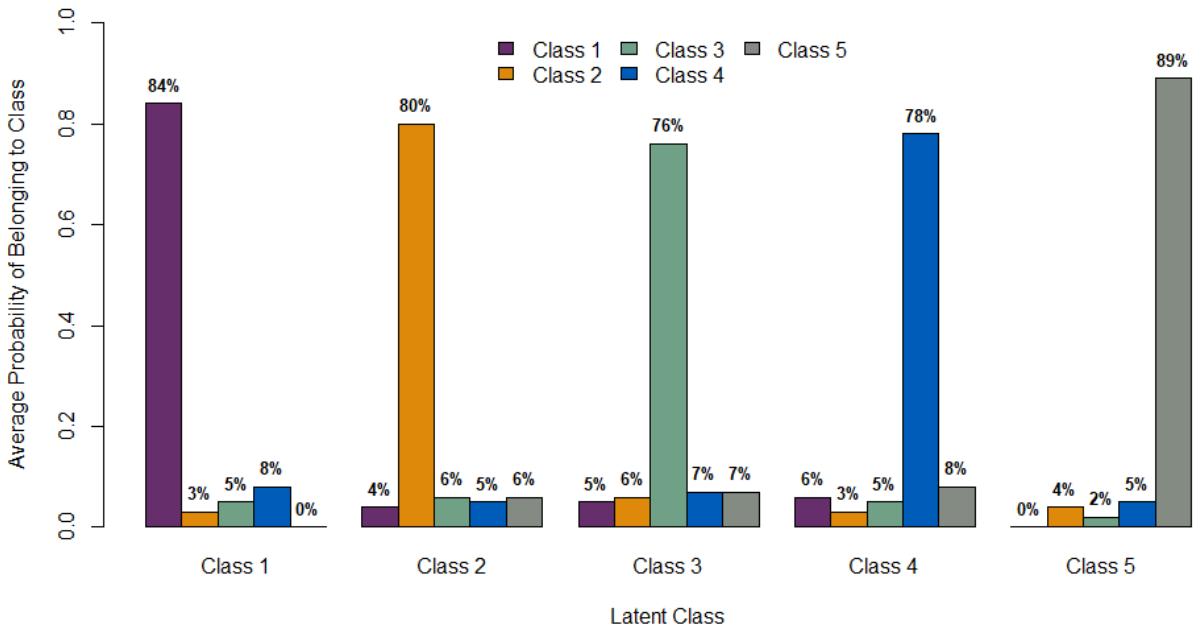
95% confidence intervals are presented in brackets.

Figure S1. Latent class model fit indices for 2010 model comparisons



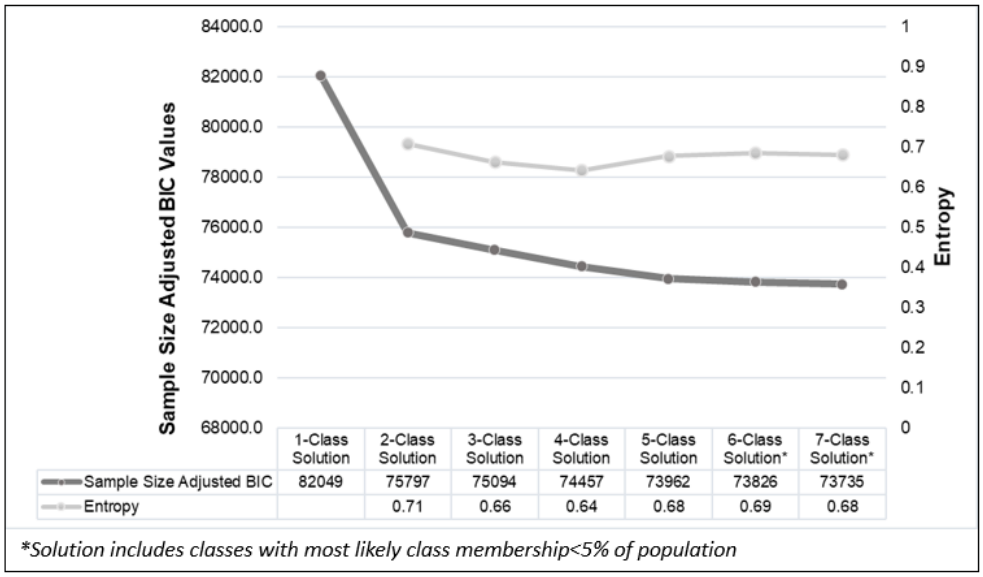
This figure includes the sample-size adjusted Bayesian information criterion (SA-BIC) and entropy values for each of the latent class model solutions (1-class to 7-class) at the 2010 timepoint. Lower SA-BIC and higher entropy values represent better model fit (with entropy above 0.70 indicating acceptable classification accuracy).

Figure S2. Average Latent Class Probabilities for Most Likely Latent Class Membership by Latent Class for 2010 Five-Class Solution



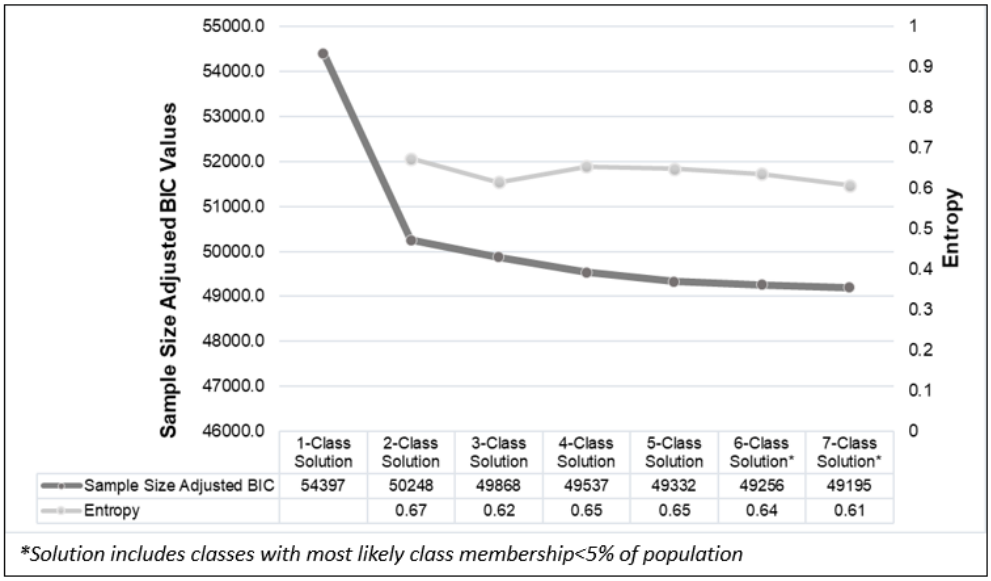
This figure represents the average probabilities of belonging to a given latent class based on responses to the set of indicators. The latent class analysis models accounted for fractional probabilities of belonging to multiple classes in their estimation.

Figure S3. Latent class model fit indices for 2014 model comparisons



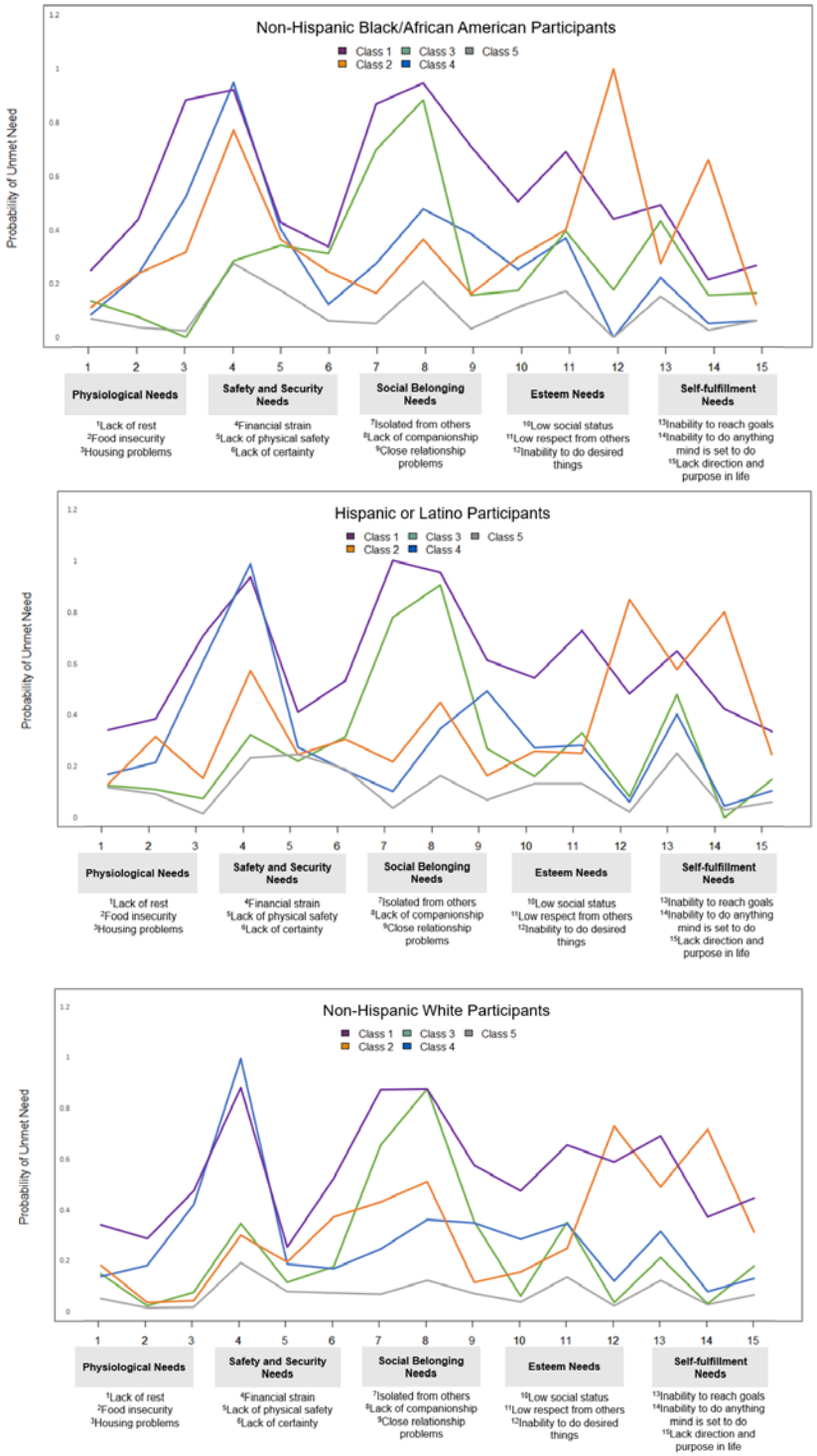
This figure includes the sample-size adjusted Bayesian information criterion (SA-BIC) and entropy values for each of the latent class model solutions (1-class to 7-class) at the 2014 timepoint. Lower SA-BIC and higher entropy values represent better model fit (with entropy above 0.70 indicating acceptable classification accuracy).

Figure S4. Latent class model fit indices for 2018 model comparisons



This figure includes the sample-size adjusted Bayesian information criterion (SA-BIC) and entropy values for each of the latent class model solutions (1-class to 7-class) at the 2018 timepoint. Lower SA-BIC and higher entropy values represent better model fit (with entropy above 0.70 indicating acceptable classification accuracy).

Figure S5. Multigroup comparisons of estimated probabilities of unmet needs for the 2010 cross-sectional analysis



This figure represents the multigroup comparisons of the estimated probabilities of unmet needs across the 15 needs indicators (with 1 representing unmet needs) in the 2010 five-class solution (i.e., among Non-Hispanic Black/African American, Hispanic or Latino, and Non-Hispanic White participants). The 15 needs indicators are listed on the x-axis.