

Latent Class Analysis of Depressive Symptom Phenotypes Among Black/African American Mothers

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All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Yale University Institutional Review Board (approval #1311012986) approved procedures for this study. Informed consent was obtained from all individual participants included in the study.

The authors have no conflicts of interest to report.

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Abstract

Background: Depression is a growing global problem with significant individual and societal costs. Despite their consequences, depressive symptoms are poorly recognized and undertreated because wide variation in symptom presentation limits clinical identification—particularly among African American (AA) women—an understudied population at increased risk of health inequity.

Objective: To explore depressive symptom phenotypes among AA women and examine associations with epigenetic, cardiometabolic, and psychosocial factors.

Methods: This cross-sectional, retrospective analysis included self-reported Black/AA mothers from the Intergenerational Impact on Blood Pressure (InterGEN) study (data collected 2015–2020). Clinical phenotypes were identified using latent class analysis. Bivariate logistic regression examined epigenetic age, cardiometabolic traits (i.e., BMI $\geq$ 30, hypertension, or diabetes), and psychosocial variables as predictors of class membership.

Results: All participants were Black/AA and predominantly non-Hispanic. Over half of the sample had one or more cardiometabolic traits. Two latent classes were identified (low vs. moderate depressive symptoms). Somatic and self-critical symptoms characterized the moderate symptom class. Higher stress overload scores significantly predicted moderate symptom class membership.

Discussion: In this sample of AA women with increased cardiometabolic burden, increased stress was associated with depressive symptoms that standard screening tools may not capture. Research examining the effect of specific stressors and the efficacy of tools to identify at-risk AA women are urgently needed to address disparities and mental health burdens.

Keywords: African Americans, chronic medical conditions, depressive symptoms, stress, women

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Depression is a growing global problem affecting over 322 million people worldwide, with adverse effects on functioning, quality of life, and lifespan (Kessler & Bromet, 2013; Penninx, 2017; World Health Organization [WHO], 2017). An estimated 1 in 5 people experience significant depressive symptoms during their life, and populations with comorbid medical conditions are at a two- to three-fold increased risk (Kessler & Bromet, 2013; WHO, 2017). Those who experience depressive symptoms in combination with other medical conditions—particularly cardiometabolic (CM) conditions (i.e., hypertension, diabetes, obesity)—have an increased risk of complications, disability, and premature mortality (Brailean et al., 2020; Greenberg et al., 2015; Penninx, 2017). Care for persons with depressive symptoms in the United States costs over \$210 billion annually, primarily due to chronic conditions that are highly comorbid with depressive symptoms (Greenberg et al., 2015). Despite their significant effects, depressive symptoms are poorly recognized and undertreated as wide variation in presentation and the lack of diagnostic biomarkers remain barriers to clinical identification.

Depression is not characterized as a single symptom but rather as a syndrome requiring several symptoms to be present over a period of time, a conceptualization consistent with the Diagnostic Statistical Manual (DSM). According to the DSM criteria, several hundred possible combinations of symptoms meet criteria for a depressive disorder, and it is possible for patients to share no common symptoms yet the same diagnostic label (Pilgrim & Bentall, 1999). For a diagnosis of major depressive disorder (MDD), criteria include experiencing at least one cardinal symptom (i.e., depressed mood or anhedonia) and four or more additional symptoms (e.g., sleep

disturbance, feelings of guilt, hopelessness, or worthlessness, reduced energy, appetite change) more days than not for at least 2 weeks (American Psychiatric Association [APA], 2013), criteria which have evolved over the past several decades. The lack of consistent transcultural and transhistorical agreement concerning the minimum necessary and sufficient criteria for depression further signifies depression as conceptually disjunctive and raises doubt regarding the appropriateness of binary categorization (i.e., depressed vs. not depressed) in research and clinical practice (Pilgrim & Bentall, 1999). In actuality, depressive symptoms occur across a continuum of severity, a spectrum of overlapping diagnoses not limited to depressive disorders, and demonstrate negative effects on health—particularly CM indices—even at levels below clinical cut-offs for MDD (APA, 2013; Gonzalez et al., 2007).

Depressive symptoms go beyond classic mood and affect symptoms, including cognitive and somatic domains. Cognitive symptoms include impaired attention, concentration, and memory. Somatic domain symptoms include decreased energy, hypersomnia or insomnia, change in appetite, psychomotor retardation or agitation, increased pain, and decreased libido (APA, 2013). Emerging research suggests that differences in symptom presentation may be related to factors such as the age of onset, exposure to early life stress, comorbidities, and inflammation (Brailean et al., 2020; Penninx, 2017), findings in line with the notion that several subphenotypes of depression exist. For example, when compared to melancholic presentations characterized by depressed mood, anhedonia, excess guilt, and lack of reactivity to pleasurable stimuli, women with atypical depressive symptoms (e.g., hypersomnia, fatigue, leaden paralysis, hyperphagia, weight gain, hypersensitivity to interpersonal rejection, mood reactivity) were more likely to exhibit specific metabolic features (higher BMIs, waist/hip ratios, and abdominal fat;

Cizza et al., 2012). Here, we focus on symptoms to overcome limitations of diagnostic categories and aim to characterize phenotypes following the National Institute of Mental Health Research Domain Criteria (RDoC) that emphasizes exploring relationships between symptoms and behavioral, biological, and social factors (Katahira & Yamashita, 2017).

African American Women Are at Risk for Depression and Health Disparities

The heterogeneity of depression, combined with the lack of symptomatology studies in at-risk populations, leads to misdiagnosis and missed care—deepening disparities in mental health. Although depression affects persons of all ages, identities, and socioeconomic backgrounds, it is twice as common in women than in men (Kessler & Bromet, 2013; WHO, 2017). African American (AA) women experience several notable disparities in health: They are at particularly elevated risk for depressive symptoms due to the higher presence of several biopsychosocial factors, including disproportionate CM burden, overrepresentation in low-income groups, complex life demands (e.g., stress from multigenerational caregiving responsibilities, financial stress), and ongoing exposure to racism, violence, and other forms of trauma (Walton & Boone, 2019). Rates of depressive symptoms among AA women are unclear due to the lack of empirical data that accounts for both race and gender. It is well documented, however, that when compared to other demographic groups, AA women have higher rates of depression characterized by chronicity, severity, and undertreatment (Sohail et al., 2014).

Poor identification and undertreatment of depressive symptoms in AA women are arguably linked to the paucity of research—both epidemiological and symptomatology studies—in this population (Walton & Boone, 2019). Just as expressions and experiences of pain are

affected by culture and ethnicity (Kwok & Bhuvanakrishna, 2014), depressive symptomatology may also be influenced by sociodemographic factors. Nurses and other health care providers may miss symptoms in AA women who often emphasize somatic symptoms, report irritability more often than depressed mood and present with comorbidities that complicate the clinical picture (Lincoln et al., 2007; Sohail et al., 2014). More research is needed to better understand depressive phenotypes in AA women to improve precision in early detection and reduce disparities (Walton & Boone, 2019).

Biological Weathering and Social Determinants of Health

The same social stressors that place AA women at increased risk of depressive symptoms (i.e., multiple interlocking forms of oppression and membership in multiple disadvantaged groups) may also contribute to biological weathering in this population (Geronimus, 1992). Biological weathering is the early deterioration of health resulting from socioeconomic disadvantage and has been quantified with measures of allostatic load and accelerated aging indices including epigenetic clocks (McCrory et al., 2019). In AA women, socioeconomic stress and discrimination are associated with accelerated aging and DNA methylation (DNAm; de Mendoza et al., 2018; McCrory et al., 2019). Depressive phenotypes demonstrate links with several aging indicators (e.g., telomeres, inflammatory pathways), but use of age acceleration as defined by DNAm is nascent (Wolkowitz et al., 2010). It is not known how age acceleration may be related to depressive phenotypes in AA women, a population at risk for developing CM conditions—which are often considered associated with aging—at significantly younger ages (Brailean et al., 2020; D'Eramo Melkus et al., 2010).

It is well established that socioeconomic disadvantage, early life stress, and trauma are associated with depressive symptoms and the development of chronic conditions (Felitti et al., 1998). Considering a combination of epigenetic, CM, and psychosocial factors may clarify how social determinants of health (SDoH) are biologically embedded and provide opportunities for intervention and prevention. This retrospective analysis aimed to explore clinical phenotypes of depressive symptoms in AA women using a diagnosis-agnostic, latent class analysis (LCA) approach and to examine variables associated with latent class membership.

Methods

Study Design and Participants

The Intergenerational Impact of Genetic and Psychological Factors on Blood Pressure (InterGEN) study is a multidisciplinary, longitudinal investigation of genomic, environmental, and psychosocial factors influencing blood pressure in a cohort of 250 mother–child dyads (Crusto et al., 2016; Taylor et al., 2016). Participants were recruited from southwest and central Connecticut early care and education (ECE) centers. Data were collected between 2015–2020. Women included met the following criteria: (a) English speaking, (b) ≥ 21 years old, (c) self-identified AA or Black, (d) had a biological child between 3–5 years of age, and (e) no evidence of psychiatric or cognitive impairment that could interfere with reliable reporting of information—assessed by Mini-Mental Status Examination (MMSE; Crusto et al., 2016). Yale University Institutional Review Board (approval #1311012986) approved procedures for this study. Informed consent was obtained from all individual participants included in the study.

Study procedures have been comprehensively described (Crusto et al., 2016; Taylor et al., 2016). Briefly, trained research staff collected clinical (blood pressure, height, and weight) and questionnaire data (using audio self-assisted software) every 6 months over 2 years. DNA samples (saliva) using Oragene Format tubes were collected at the first visit (Taylor et al., 2016). The present cross-sectional analysis includes data from women with depressive symptom measures and DNA samples collected at the first visit. Study methods and results are reported using the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement for cross-sectional studies (von Elm et al., 2007).

Instruments and Measures

Sociodemographic variables were self-reported and included age, race, ethnicity, income range, education, and employment within the last 12 months. All participants in this study identified as Black or AA and data on additional race and ethnicity identities were collected. Race was categorized as American Indian, Asian, Black or African American, Pacific Islander, White, or Other, and ethnicity was classified as Hispanic (yes/no; Crusto et al., 2016).

Depressive symptoms were assessed with the Beck Depression Inventory (BDI-I), which includes 21 items individually scored from 0–3. Participants rate the degree that they experienced each item (e.g., sadness, guilt, low libido, insomnia) over the past 2 weeks. Total scores range from normal ups and downs (0–10), mild and moderate symptoms (11–30), to severe and extreme depression (over 30). The BDI-I is considered reliable and valid in populations with and without diagnosed MDD and those with chronic medical conditions; it demonstrates high internal consistency (Cronbach's $\alpha = 0.9$) in low-income AA outpatient groups (Grothe et al., 2005).

The Stress Overload Scale (SOS) is a 24-item 5-point Likert scale, self-report measure of feelings of vulnerability and recent stressful events (Amirkhan, 2012). The SOS is psychometrically strong with high validity and reliability (Cronbach's $\alpha = 0.95$) and has been tested in various multiethnic community samples (Amirkhan, 2012). Exposure to potentially traumatic events (e.g., natural disasters, assault, rape, and war) was assessed with the Life Events Checklist (LEC-5; Gray et al., 2004). LEC-5 demonstrates strong convergence with other trauma-related measures in nontreatment-seeking adults (Gray et al., 2004).

Physiologic measures and health history questionnaires gauged the presence of CM traits. Diagnosis of hypertension and diabetes mellitus (DM) were determined through health history questionnaires (Crusto et al., 2016). The research staff obtained height, weight, and blood pressure. BMI (weight in kg/ height in m^2) was examined according to WHO guidelines.

DNA methylation analysis and calculation of DNAm age acceleration in this sample have previously been described (Li et al., 2019). In brief, DNAm was examined with the Illumina Infinium Methylation EPIC (850K) BeadChip, and confirmation was achieved with methylation-specific polymerase chain reaction (PCR) and bisulfite sequencing (Taylor et al., 2016). A detection p -value threshold (> 0.001) for each CpG site was used to exclude sites with missing rates over 10% (Li et al., 2019; Taylor et al., 2016). The Horvath multi-tissue epigenetic clock was used to define biological age (DNAm age) in contrast to chronological age. This method calculates DNAm age from the β values from 353 CpG sites; it regresses these values along chronological age to define DNAm age acceleration (DNAm aa) as the residual term (C. Li et al., 2019).

Statistical Analysis

For continuous variables, histograms, scatterplots, and Shapiro-Wilks testing were used to assess normality, and measures of central tendency (e.g., distributions, medians, interquartile ranges [IQRs]) were calculated. Categorical variables were summarized with frequencies and percentages. Patterns of missingness were assessed (completely missing at random, missing at random, and not missing at random) to address the possibility of social desirability bias inherent in questionnaires.

We used LCA to identify phenotype subgroups within the sample based on depressive symptoms. LCA groups cases based upon a presumed latent variable estimated by relationships among several polytomous manifest variables (Magidson & Vermunt, 2002). LCA offers probability-based classification estimated by maximum likelihood methods (in contrast to ad hoc approaches for classification)—which means that the cluster/class criterion is less arbitrary (Magidson & Vermunt, 2002). LCA also does not assume equal variances or zero correlations (Magidson & Vermunt, 2002)—an advantage in light of the high degree of correlation between depressive symptoms. The 21 items from the BDI-I were used as the indicator variables for the LCA. Multiple iterations with varied numbers of classes were run to identify the model with the optimal number of latent classes based on the Bayesian information criterion (BIC), Akaike information criterion (AIC), G^2 , and X^2 . Following the identification of best-fitting latent classes indicated by BIC, G^2 , and X^2 , bivariate logistic regression examined variables potentially associated with latent class membership, such as DNAm aa, CM traits, stress, and income—all known depressive symptom correlates (Felitti et al., 1998; Penninx, 2017). All analyses were performed using R Statistical Software (RStudio, version 4.0.0; <https://www.r-project.org/>).

Results

A total of 227 AA mothers met criteria for inclusion in this analysis. Table 1 presents sample characteristics, including sociodemographic metrics, depressive symptoms, CM and age acceleration indices, and psychological variables. Participants were predominantly non-Hispanic (91.63%) with a median (IQR) age of 31.23 years (27.32, 35.62). The age range was 21–46 years. Overall, depressive symptom scores were heavily skewed toward a range indicating typical ups and downs (4, [IQR: 1,11]). Somatic symptom domain subscores were the highest of the depressive symptom domains (2.5, [IQR 0,5]). Over half of the participants (54.19%) had at least one CM trait, with BMI ≥ 30 (44.93%) being the most prevalent. High-stress scores were present for 38.22% of participants, and overall, this sample experienced approximately five [IQR: 1,16.7] potentially traumatic experiences (e.g., natural disasters, serious injury, and assault). This sample demonstrated younger DNAm age (28.13 [IQR: 24.36, 32.47] years) than chronological age and overall negative DNAm aa.

The R package poLCA was used to perform the LCA. Several models were run with two, three, and four classes, at which point models indicated negative degrees of freedom, signifying futility with further iterations. Several fit criteria (Table 2) were used to determine the optimal number of latent classes, including BIC, AIC, G^2 , and X^2 . For all of these statistics, lower values are considered more desirable and indicate better class separation and interpretability. The two-class model demonstrated the highest performance, evidenced by its lower BIC and AIC and higher within-class homogeneity and between-class separation.

In this two-class model, the first (moderate symptom) class—showing minimal/moderate depressive symptoms—included an estimated 27.1% of the sample. The second (low symptom) class—showing no/negligible depressive symptoms—comprised an estimated 72.9% of the sample. These proportions echo the percentages of women who fell above and below the BDI-I clinical cut-off indicative of possible MDD displayed in Table 1. Supplementary Table 1 (see Supplemental Digital Content [SDC], <http://links.lww.com/NRES/A454>) displays the predicted probability of each item's response value according to latent class. Within the moderate symptom class, several symptoms were predicted as having a higher probability of endorsement including, feeling like a failure, anhedonia, self-hate or self-disgust, self-blame, irritability, disinterest with others, feeling unattractive, insomnia, fatigue, and decreased libido.

Results from the bivariate logistic regression analysis assessing associations between sample characteristics and latent class membership (low symptoms class compared to moderate symptoms class) are displayed in Table 3. The slopes or β presented indicate the degree and direction of the relationship between the predictors and the likelihood of class membership. The R output for the regression analysis provides the β values, which are the log odds of membership in the low symptom class compared to the moderate symptom class. For greater interpretability, odds ratios were calculated by exponentiating these β values. The intercept is the estimated ratio of women in each class (i.e., low symptom class to moderate symptom class).

The majority of characteristics did not significantly associate with latent class membership, except for stress score ($p < .001$) and DM status ($p < .0001$). Specifically, higher stress scores robustly predicted membership in the moderate symptom class, with 0.9 times the

odds of membership in the low symptom group. In other words, women with higher stress scores demonstrated 1.11 times the odds of moderate symptom group membership. Conversely, the presence of DM predicted low-symptom class membership, demonstrating immeasurable odds of membership in the low-symptom class in participants with DM. Despite *p*-values slightly exceeding the traditional .05 threshold, it is worth noting that participants who reported identification with more than one racial group had 2.08 times the odds of moderate symptom class membership ($p = .054$). Additionally, unmarried participants demonstrated 2.70 times the odds of moderate symptom class membership ($p = .076$). The other factors examined (i.e., income, education, employment, BMI, blood pressure, DNAm aa, trauma exposure, smoking) were not predictive of latent class membership.

Discussion

In this analysis, we explored depressive phenotypes in a sample of AA mothers and identified two latent classes. Higher stress and DM status significantly predicted membership in moderate and low symptom classes, respectively. The moderate symptom class was characterized by increased scores of several somatic (e.g., insomnia, decreased libido, fatigue) and self-critical (e.g., self-hate, self-blame, feeling unattractive) symptoms, in addition to less typically considered symptoms such as anhedonia and irritability.

Consistent with previous literature examining depressive symptoms in Black adults (Lincoln et al., 2007), the current study identified two latent classes differentiated primarily by symptom severity. The finding that increased stress increased the likelihood of moderate symptom class membership is in line with the well-known high degree of correlation between

stress and depressive symptoms (Penninx, 2017)—particularly in AA women. Social stress, specifically, was identified as a predictor of high symptom membership in a nationally representative sample of over 4,915 AAs and Caribbean Blacks (Lincoln et al., 2007); however, respondents with higher incomes and levels of education were more likely to be in a low symptom group—a distinction from the current study in which socioeconomic status was not predictive of class membership.

We also found that multiracial participants had twice the odds of moderate symptom class membership, and although this finding just exceeded a *p*-value of 0.05, this trend is consistent with epidemiological data—which demonstrates that compared to other racial and ethnic identity groups, depression is highest among those who report two or more races (National Institute of Mental Health, 2022). Rather than an effect of race *per se*, this pattern may be an effect of discrimination and othering from multiple groups at once, warranting further study. Indeed, associations between race and psychological symptoms are nuanced, and heterogeneity within the U.S. Black population should be considered. Lincoln et al. (2007) reported that among Caribbean Blacks, those who had lived in the U.S. for less than 10 years were less likely to be in high depressive symptom groups than U.S.-born or Caribbean Blacks who had resided in the U.S. for more than 10 years. Their findings support that the differentiating feature is exposure to racism (rather than nativity status), as immigrants from minority-White areas have better mental health than U.S.-born Blacks; this advantage erodes with longer residency in the U.S. majority-White racial context (Lincoln et al., 2007).

Our finding that participants with DM all fell within the low symptom class was unexpected but further underscores the need to consider cultural and racial contexts in assessing mental health. The direction of this association from a very small subsample ($n = 14$) conflicts with the longstanding association between depressive symptoms and DM in research (Khaledi et al., 2019). Nevertheless, aggregating racially and ethnically diverse groups of women with DM to assess depressive symptom prevalence may inevitably neglect cultural specificity; it may suggest an illusory contrast between the current study and prior investigations. Further, when race is considered in the psychological experience of women with DM, White women frequently report depressed moods, while Black women report high levels of emotional distress but not depression (D'Eramo Melkus et al., 2009).

LCA has previously been used as a data-driven approach to identify subtypes in various populations with depressive disorders (Lamers et al., 2010; Li et al., 2014; Lincoln et al., 2007; Sullivan et al., 1998; Wahid et al., 2021), but focused studies on symptoms in AA women are rare. Similar to the current study, others have employed using depressive symptoms as the observed indicators of latent class and considered psychosocial and demographic variables as potential predictors of class membership—but only a few assess relationships to CM conditions or indices (Lamers et al., 2010; Sullivan et al., 1998). Specifically, among individuals with depression, participants who are women, have higher BMIs, or have metabolic syndrome, have increased odds of membership in classes characterized by atypical (rather than melancholic) symptoms (Lamers et al., 2010; Li et al., 2014). Although these findings seemingly contrast our results, it is possible that the low level of depression symptoms in the InterGEN sample may obscure direct comparison to samples with higher symptom severity or diagnosed MDD. Our

study adds to the limited literature examining latent classes of depressive symptom phenotypes with CM traits. To our knowledge, this is the only LCA to include accelerated aging as a potential predictor of class membership. We found no association between depressive class membership and DNAm aa in this sample, adding to the mixed findings in this area of inquiry—which may be partly due to a pattern of threshold-dependent associations between depression severity and DNAm aa.

Depressive symptoms with the highest probability of endorsement by the moderate symptom class from this analysis comprised negative feelings toward the self and somatic symptoms but did not include depressed mood, hopelessness, or increased crying. Low endorsement of depressed mood and emphasis on somatic symptoms has been reported in other studies examining depressive symptoms in AA women (Lincoln et al., 2007). That somatic depressive symptom subscores were the highest domain in this sample is noteworthy, especially because the BDI-I underestimates it.

Although we explored depressive symptom phenotypes and their potential relationship to various biological and psychosocial factors, additional factors including, discrimination, racism, and assessment bias, should be noted. Cumulative evidence implicates discrimination and other aspects of racism as detrimental to health (Williams & Mohammed, 2009), particularly CM and mental health in AA women (Ibrahim et al., 2021; Millender et al., 2021). Future studies should include this and other significant stressors as potential mediators in examining depressive symptoms in AA women.

This study utilized the BDI-I to assess depressive symptoms. Although this measure has established reliability and validity, it may not capture this sample's complete range of relevant depressive symptoms. Questions regarding its efficacy, as well as linguistic and cultural relevance in populations of AA women, have previously been raised (Gary et al., 2018). In preliminary psychometric studies, AAs have comprised 1%–10% of included samples (Gary et al., 2018). In line with our findings, Gary et al. (2018) also noted an unexpectedly minimal level of depressive symptoms across their sample of midlife AA women, as well as an emphasis on somatic and self-critical symptoms (Gary et al., 2018). The notion that the BDI-I may lack the necessary specificity and sensitivity to detect at-risk AA women is concerning for both research and practice—and could further exacerbate existing disparities experienced by AA women in mental health care delivery (Gary et al., 2018; Perez et al., 2021).

Strengths and Limitations

This study is cross-sectional and, therefore, unable to substantiate causal inference related to associations between latent class membership and included variables. Increased sample size, as well as the share of women with DM, would have also enhanced the strength of this study. Further, this sample demonstrated a minimal variability of depressive symptom severity limited to the normal range. Although this may simply be a consequence of sampling healthy volunteers, the strengths and limitations of the BDI-I should be considered. The BDI-I does not include the questions about hypersomnia, weight gain, and increased appetite—all considered atypical symptoms—that were added to the BDI-II to reflect the updated criteria in the DSM-IV. Such symptoms may have particular relevance for individuals with CM traits (over 50% of this sample); therefore, somatic domain symptoms were likely underestimated. Despite these

shortcomings, the use of the BDI-I is a strength, not only because of its psychometric qualities but also the precedent for use in research and clinical settings—enhancing study comparability and clinical applicability of our findings. A related strength of this study was the focus on depressive symptoms and domains rather than solely on total scores or diagnostic labels, which give rise to highly heterogeneous cases (Katahira & Yamashita, 2017). Our findings should not be generalized to severely depressed older adults, or nulliparous populations of AA women, as all participants in this sample were mothers with a median age of 31. A final strength of this study stems from the richness and rigor of the parent study, which enabled the exploration of depressive symptom phenotypes among AA women, an insufficiently investigated topic in a population at increased risk for depression characterized by high chronicity, severity, and undertreatment (Perez et al., 2021; Sohail et al., 2014).

Implications for Clinical Practice and Future Research

Although the limitations of this study may reduce the overall potential influence on clinical practice and research, the findings highlight the need for precision approaches to mental health care. Basic 2-item depression screening tools may not be sufficient to identify significant psychological symptoms that should be addressed, not only to improve functioning and quality of life but also to prevent the worsening of chronic medical conditions. This is particularly salient in populations with chronic conditions who may present predominately with symptoms considered atypical (Cizza et al., 2012). Nurses and other clinicians need also be aware of the self and public stigma surrounding acknowledging mental health issues that have been documented in AA communities, as well as the potential for normalization of depression (Gary et al., 2018; Sohail et al., 2014). The cultural context in which depressive symptoms are

conceptualized further underscores the need for holistic assessments of psychological concerns—which include depressive symptoms, anxiety, and emotional distress—and for providers to seek to understand patients’ perceptions and beliefs about these symptoms. Requisite to these essential tasks is the need for providers and institutions—which remain predominantly White and male—to address biased perceptions and policies that result in expressed racism and microaggressions toward AA clients (Gary et al., 2018) and the perpetuation of long-standing inequities with mental health care access (Perez et al., 2021). Nurses and other primary care providers—often the point of entry for referral to mental health services—must be supported on a system and policy level to have the time required to provide holistic patient care. Current reimbursement models and financial constraints promote short, assembly-line style visits incompatible with quality person-centered care, maintaining the status quo of health inequities.

Future studies examining depressive symptomology in AA women should consider prioritizing larger samples with a full array of depressive symptoms and symptom severity, which may result in subgroups with more nuanced distinctions. Inclusion of women across the adult lifespan and higher proportions of women with DM would enhance generalizability and internal validity, respectively. Including additional CM clinical indices (e.g., HA1C, fasting glucose, lipids) would further bolster this objective, as many with metabolic syndrome or DM are unaware of their condition. Longitudinal designs could offer an opportunity to assess temporal relationships and variability within and between groups. In light of both the limitations in symptom measurement and the depressive symptomology studies including AA women, qualitative or mixed approaches may offer a path for a complete understanding of depressive symptoms and their significance to AA women within a cultural context.

Conclusion

This study demonstrates associations between increased stress and depressive symptoms among AA women and highlights salient somatic and self-critical symptoms that standard screening tools may not capture. Future studies should explore potential differences across types of stressors relevant to this population (e.g., discrimination, caregiver burden) as such gains in knowledge could guide actionable interventions in clinical practice and public health policy aimed to improve mental health and reduce health disparities.

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Table 1

Sociodemographic and Clinical Characteristics of the Sample

Characteristic	Median or <i>n</i>	IQR or (%)
Chronological age, years	31.23	(27.32, 35.62)
DNAm age, years	28.81	(24.36, 32.47)
Δ Age, years	-3.19	(-5.93, -0.43)
DNAm aa, years	-0.12	(-2.98, 2.58)
DNAm aa > 0 (binary)	52	(22.91%)
Hispanic/ Latina ^a	19	(8.37%)
Multiracial ^b	16	(7.05%)
Marital Status		
Married	54	(23.79%)
Single	149	(65.64%)
Other	24	(10.57%)
Highest Level of Education		
Less than high school	13	(5.73%)
High school / GED	78	(34.36%)
Some college	76	(33.48%)
Associate degree	26	(11.45%)
Bachelor's degree	25	(11.01%)
Master's degree	7	(3.08%)
Doctorate	2	(0.88%)
Annual Income		
> \$5,000	51	(22.47%)
\$5,000 to \$9,999	30	(13.22%)
\$10,000 to \$14,999	26	(11.45%)
\$15,000 to \$19,999	18	(7.93%)
\$20,000 to \$24,999	22	(9.69%)
\$25,000 to \$34,999	30	(13.22%)
\$35,000 to \$49,999	27	(11.89%)
\$50,000 to \$74,999	12	(5.29%)
\$75,000 to \$99,999	7	(3.08%)
\$100,000 or higher	4	(1.76%)
Employed ^a	155	(68.28%)

Depression score (total)	4	(1, 11)
Affective subscore	0	(0, 2.25)
Cognitive subscore	1	(0, 3)
Somatic subscore	2.5	(0, 5)
Possible MDD ^c	63	(27.75%)
Stress Overload score	63	(42, 78.5)
Potentially traumatic events	5	(1, 10)
Hypertension diagnosed ^a	46	(20.26%)
Systolic BP	113.33	(105.67, 120.00)
Diastolic BP	72	(64.67, 79.33)
Diabetes diagnosed ^a	14	(6.17%)
BMI, kg/m ²	28.67	(23.53, 34.21)
BMI category		
underweight (< 18.5)	13	(5.73%)
normal weight (18.5–24.9)	56	(24.67%)
overweight (25–29.9)	56	(24.67%)
obese (> = 30)	102	(44.93%)
Any CM trait ^d	123	(54.19%)
Smoke cigarettes (current) ^a	52	(22.91%)

Note: DNA methylation age refers to the biological age calculated by the Horvath epigenetic clock; Δ Age is the difference between DNA methylation age and chronological age; DNAm aa is (DNA methylation age acceleration) is the value of the residual of DNA methylation age regressed on chronological age in a linear model; MDD (major depressive disorder); BP (blood pressure); CM (cardiometabolic); BMI (body mass index); CM trait refers to hypertension, DM, or obesity

^a Reflects the numbers and percentage of participants answering yes to this question

^b Reflects the numbers and percentage of participants who selected more than one race

^c Reflects number and percentage of participants with Beck Depression Inventory Scores ≥ 11

^d Reflects the number and percentage of participants with one or more cardiometabolic traits

Table 2

Fit statistics and predicted probability class membership for latent class models

Measure	Number of Classes			
	2	3	4	5
Fit statistics				
LL	-2433.39	-2324.25	-2300.19	-2206.95
Npar	121	182	243	304
df	92	31	-30	-91
AIC	5108.78	5012.43	5086.38	5021.90
BIC	5515.49	5624.19	5903.17	6043.73
G ²	3078.44	2860.09	2812.04	2625.56
χ^2	3.933264e+19	5.24693e+16	9.733429e+22	3.233384e+12
Class membership				
Class 1	0.27	0.24	0.23	0.17
Class 2	0.73	0.18	0.16	0.22
Class 3		0.58	0.03	0.17
Class 4			0.58	0.03
Class 5				0.41

Note: LL is the log likelihood (log of the likelihood ratio which compares the fit of two models); AIC is the Akaike information criterion; BIC is the Bayesian information criterion; df indicates degrees of freedom, Npar is the number of parameters in the model.

Table 3

Results from bivariate logistic regression analysis examining potential predictors of latent class membership

Characteristic	β	SE	<i>p</i> -value	Intercept	OR	95% CI
Chronological age	0.01	0.05	0.80	0.55	1.01	[0.91, 1.13]
DNAm age	0.02	0.05	0.69	0.45	1.02	[0.93, 1.12]
Δ Age	0.03	0.08	0.75	1.17	1.03	[0.87, 1.21]
DNAm aa	0.02	0.08	0.76	1.02	1.02	[0.87, 1.20]
Age acceleration (binary)	0.53	0.99	0.59	0.89	1.71	[0.25, 11.84]
Marital	-0.99	0.55	0.08	2.94	0.37	[0.13, 1.10]
Hispanic/ Latina	0.72	1.50	0.63	0.95	2.05	[0.11, 38.99]
Multiracial	-0.73	0.37	0.05	1.88	0.48	[0.23, 1.00]
Education	0.19	0.26	0.46	0.44	1.21	[0.73, 2.00]
Income	0.06	0.13	0.63	0.74	1.07	[0.82, 1.39]
Employed	0.36	0.60	0.55	0.73	1.44	[0.44, 4.73]
Systolic BP	0.01	0.02	0.70	-0.05	1.01	[0.96, 1.06]
Diastolic BP	0.01	0.03	0.83	0.59	1.01	[0.95, 1.06]
BMI	-0.02	0.03	0.52	1.49	0.98	[0.92, 1.04]
BMI, category	-0.32	0.37	0.39	1.67	0.73	[0.36, 1.50]
Hypertension	0.79	0.88	0.37	0.86	2.21	[0.39, 12.39]
Diabetes	16.70	0.00	0***	0.92	1.79e+07	[1.786e+7, 1.80e+7]
Any CM trait	-0.03	0.65	0.97	1.00	0.97	[0.27, 3.46]
Stress score	-0.07	0.02	0.001**	5.71	0.93	[0.90, 0.97]
Potential traumatic events	-0.00	0.00	0.19	1.07	0.99	[0.99, 1.00]
Substances	-0.38	0.30	0.21	1.55	0.69	[0.38, 1.23]
Smoke cigarettes	-0.09	0.68	0.89	-1.01	0.91	[0.24, 3.43]

Note: β indicates slopes generated from the bivariate logistic regression utilized to test the prediction of class membership based upon sample characteristics. β coefficients are the log-odds of membership in class 2 (low depressive symptoms) as compared to class 1 (moderate depressive symptoms) as the value of the predictor (i.e., characteristic) increases. Odds ratios (OR) have been calculated by exponentiating the β coefficients; DNA methylation age refers to the biological age calculated by the Horvath epigenetic clock; Δ Age is the difference between DNA methylation age and chronological age; DNAm aa is (DNA methylation age acceleration) is the value of the residual of DNA methylation age regressed on chronological age in a linear model; BP (blood pressure); CM (cardiometabolic); BMI (body mass index); CM trait refers to hypertension, DM, or obesity.

* *p*-value < 0.05

** *p*-value < 0.01

Supplemental Table 1*Predicted probabilities of class membership and item response for the selected latent class model*

Measures	Predicted latent class	
	Moderate depressive symptoms (Class 1)	Low depressive symptoms (Class 2)
Estimated class population share	0.271	0.729
Class membership predicted probability	0.267	0.732
Item response predicted probability		
BDI: Sadness		
1	0.450	0.966
2	0.428	0.034
3	0.086	0.000
4	0.035	0.000
BDI 2: Hopelessness		
1	0.5501	0.961
2	0.380	0.032
3	0.052	0.000
4	0.017	0.006
BDI 3: Feel like a failure		
1	0.387	0.951
2	0.475	0.029
3	0.121	0.006
4	0.017	0.013
BDI 4: Anhedonia		
1	0.186	0.891
2	0.693	0.109
3	0.121	0.000
4	0.000	0.000
BDI 5: Guilt		
1	0.452	0.966
2	0.357	0.034
3	0.173	0.000
4	0.017	0.000
BDI 6: Being Punished		
1	0.607	0.972
2	0.272	0.027
3	0.017	0.000
4	0.104	0.000
BDI 7: Self-hate/ self-disgust		
1	0.210	0.972
2	0.704	0.028
3	0.052	0.000
4	0.035	0.000
BDI 8: Self-blame		
1	0.299	0.906
2	0.428	0.085
3	0.238	0.000
4	0.034	0.000

BDI 9: Suicidal thoughts		
1	0.855	0.990
2	0.128	0.010
3	0.017	0.000
4	0.000	0.000
BDI 10: Crying		
1	0.535	0.935
2	0.292	0.046
3	0.104	0.000
4	0.069	0.019
BDI 11: Irritation		
1	0.269	0.899
2	0.541	0.101
3	0.173	0.000
4	0.017	0.000
BDI 12: Disinterest in others		
1	0.343	0.877
2	0.415	0.110
3	0.225	0.006
4	0.017	0.006
BDI 13: Decisions difficult		
1	0.498	0.961
2	0.398	0.032
3	0.104	0.006
4	0.000	0.000
BDI 14: Feel unattractive		
1	0.407	0.892
2	0.446	0.078
3	0.129	0.029
4	0.017	0.000
BDI 15: Work motivation		
1	0.417	0.927
2	0.357	0.047
3	0.209	0.025
4	0.017	0.000
BDI 16: Insomnia		
1	0.315	0.707
2	0.460	0.266
3	0.156	0.019
4	0.069	0.006
BDI 17: Fatigue		
1	0.210	0.972
2	0.704	0.028
3	0.059	0.000
4	0.035	0.000
BDI 18: Loss of appetite		
1	0.439	0.797
2	0.371	0.177
3	0.173	0.026
4	0.017	0.000

BDI 19: Weight loss		
1	0.689	0.794
2	0.190	0.122
3	0.070	0.032
4	0.050	0.052
BDI 20: Worried about health		
1	0.416	0.811
2	0.410	0.150
3	0.105	0.038
4	0.069	0.000
BDI 21: Decreased libido		
1	0.306	0.775
2	0.486	0.180
3	0.156	0.026
4	0.053	0.019

Note: Item response numbers correspond to the BDI responses with 1 point subtracted for each response as a value of 0 could not be incorporated into the LCA (e.g. Item responses of 1 on this table correspond to values of 0 on the BDI). Abbreviations: BDI#=Beck Depression Inventory question /item numbers