Journal of the International Neuropsychological Society (2024), **30**, 253–263
doi:10.1017/S1355617723000474

Research Article

Mechanisms underlying the association between adverse childhood experiences and racial disparities in later-life cognition

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Abstract

Objective: Adverse childhood experiences (ACEs) may be a risk factor for later-life cognitive disorders such as dementia; however, few studies have investigated underlying mechanisms, such as cardiovascular health and depressive symptoms, in a health disparities framework. **Method:** 418 community-dwelling adults (50% nonHispanic Black, 50% nonHispanic White) aged 55+ from the Michigan Cognitive Aging Project retrospectively reported on nine ACEs. Baseline global cognition was a z-score composite of five factor scores from a comprehensive neuropsychological battery. Depressive symptoms were assessed using the Center for Epidemiologic Studies Depression Scale. Cardiovascular health was operationalized through systolic blood pressure. A mediation model controlling for sociodemographics, childhood health, and childhood socioeconomic status estimated indirect effects of ACEs on global cognition via depressive symptoms and blood pressure. Racial differences were probed via t-tests and stratified models. **Results:** A negative indirect effect of ACEs on cognition was observed through depressive symptoms [$\beta = -.040$, 95% CI (−.067, −.017)], but not blood pressure, for the whole sample. Black participants reported more ACEs (Cohen's $d = .21$), reported more depressive symptoms (Cohen's $d = .35$), higher blood pressure (Cohen's $d = .41$), and lower cognitive scores (Cohen's $d = 1.35$) compared to White participants. In stratified models, there was a negative indirect effect through depressive symptoms for Black participants [$\beta = -.074$, 95% CI (−.128, −.029)] but not for White participants. **Conclusions:** These results highlight the need to consider racially patterned contextual factors across the life course. Such factors could exacerbate the negative impact of ACEs and related mental health consequences and contribute to racial disparities in cognitive aging.

Keywords: psychological trauma; cognitive aging; life-course perspective; minority health; depressive symptoms; blood pressure; mediation analysis; neuropsychological tests

(Received 27 September 2022; final revision 26 June 2023; accepted 5 July 2023; First Published online 25 August 2023)

Dementia is increasingly recognized as a multifactorial disease that partially arises from modifiable life-course risk exposures, such as inadequate levels of physical exercise and social engagement (Livingston et al., 2020). Previous literature suggests that adverse childhood experiences (ACEs) may be an additional modifiable factor for dementia prevention (Korten et al., 2014; Ritchie et al., 2011; Tani et al., 2020). Specifically, ACEs have been associated with lower cognitive functioning in later life (Ritchie et al., 2011), faster cognitive decline (Korten et al., 2014), and an increased risk for dementia (Tani et al., 2020). Additionally, racial disparities in Alzheimer's disease and related dementias (ADRD) are prominent, such that nonHispanic Black (hereafter "Black") adults are twice as likely to have ADRD than nonHispanic White (hereafter "White") adults (Alzheimer's Association, 2020; Power et al., 2021). Racial differences in the prevalence of ACEs have also been documented, such that Black individuals report more ACEs than White individuals, on average (Child Trends, 2019; Lee & Chen, 2017; Merrick et al., 2018). However, investigation of the potential mechanisms through which ACEs may contribute to cognitive functioning and racial disparities in later-life cognition is underdeveloped.

ACEs and cognition

ACEs include stressful, potentially traumatic events experienced in childhood (Felitti et al., 1998). Some commonly studied examples of ACEs are abuse, neglect, and household dysfunction (e.g., criminal behavior and domestic violence; Dong et al., 2004; Gilbert et al., 2015). Previous literature has suggested that ACEs may have a lasting impact on cognition through their deleterious effects on brain development, particularly in regions such as the neocortex and hippocampus (Bick & Nelson, 2016; Teicher et al., 2003) that are responsible for cognitive functions, including memory and attention (Eichenbaum, 2000; Petersen & Posner, 2012). Indeed, childhood is a critical period for brain development, and early life disadvantages may affect life-course patterns of health and disease (Cuevas et al., 2020).

While a growing body of literature provides evidence that the negative cognitive effects of ACEs may extend into later life

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Cite this article: Wilhoite S.R., Zaheed A.B., Palms J.D., Morris E.P., Sol K., Martino A., & Zahodne L.B. (2024) Mechanisms underlying the association between adverse childhood experiences and racial disparities in later-life cognition. *Journal of the International Neuropsychological Society*, **30**: 253–263, https://doi.org/10.1017/S1355617723000474

(Donley et al., 2018; Geoffroy et al., 2016; Korten et al., 2014; Radford et al., 2017; Ritchie et al., 2011; Tani et al., 2020), some findings have been mixed. For example, one study found that three individual ACEs (parent's remarriage, mother's death, and father's death) were associated with worse cognition in older adults, but composite ACE score was not associated with cognition (Gold et al., 2021). Another study found that some experiences (e.g., being sent to a foster home) were associated with worse late-life cognitive outcomes, but other experiences (i.e., physical and sexual abuse) were associated with a *lower* risk of cognitive dysfunction (Ritchie et al., 2011). However, the analyses in this study may have been over-adjusted, as they controlled for depressive symptoms, thus removing what may have accounted for a substantial portion of the variance between ACEs and cognition. Indeed, mental and physical health may represent mechanisms underlying associations between ACEs and later-life cognitive functioning.

Another potentially contributing factor to mixed findings is varying methods for measuring ACEs. Studies vary in which ACEs are measured, such as including war experiences (Korten et al., 2014) or abuse (Ritchie et al., 2011), and in how ACEs are measured, such as through scaled (Radford et al., 2017) or binary responses (Tani et al., 2020). Therefore, it is important to clarify associations between ACEs and later-life cognition using an existing ACEs measure to increase results' comparability. Furthermore, a broad ACEs measure incorporating multiple types of ACEs would be most helpful before investigating individual ACEs since prior research on mechanisms and racial disparities in this area are sparse.

The mediating roles of depressive symptoms and cardiovascular health

A review of previous literature points to depressive symptoms and cardiovascular health as life-course health factors that may mediate the relationship between ACEs and later-life cognition. Specifically, ACEs have been associated with depressive symptoms in adulthood (Danese et al., 2009; Ege et al., 2015; Felitti et al., 1998), and depressive symptoms in later life have been prospectively associated with an increased risk of cognitive impairment and dementia (Ownby et al., 2006; Richard et al., 2013; Sol et al., 2020; Zahodne et al., 2014). Similarly, ACEs have been associated with worse cardiovascular health, as indicated by heart disease, hypertension, and stroke (Felitti et al., 1998; Jakubowski et al., 2018; Stein et al., 2010), and worse cardiovascular health has been associated with cognitive impairment and dementia in later life (Baumgart et al., 2015; Samieri et al., 2018; Saxton et al., 2000). However, research directly quantifying the extent to which depression and/or cardiovascular health may mediate the association between ACEs and later-life cognition is sparse (see Tani et al., 2020). Identification of these mediating factors could help inform interventions aimed at interrupting risk pathways for cognitive impairment in later life among individuals who have experienced ACEs.

The role of ACEs in cognitive disparities

Racial disparities in ACEs, depressive symptoms, and cardiovascular health have been documented. Black individuals have been found to report a higher level of overall ACE exposure compared to White individuals, on average (Merrick et al., 2018). Black individuals have also been found to more frequently report specific ACEs compared to Whites, such as childhood maltreatment, household drug abuse, and domestic violence (Child Trends, 2019; Lee & Chen, 2017). Black adults have been shown to have higher rates of cardiovascular health conditions (e.g., hypertension, stroke) and risk factors (e.g., diabetes, obesity) than White adults (Carnethon et al., 2017). While diagnoses of major depression are often found to be lower among Black adults, studies have demonstrated that individual depressive symptoms are more prevalent and depressive disorders are more chronic among Blacks than Whites (Hooker et al., 2019; Vyas et al., 2020; Williams et al., 2007). Risk factors may also differentially impact cognitive function between Black and White adults. For example, depressive symptoms have been shown to be more strongly associated with episodic memory and executive functioning for Black older adults than for White older adults (Zahodne et al., 2014). One study found race to interact with ACEs, such that ACEs were more detrimental to mental health among Black adults than White adults (LaBrenz et al., 2020). Despite these disparities, racial differences in the associations between ACEs, depressive symptoms, cardiovascular health, and cognition in older adults are severely understudied.

These disparities likely reflect effects of structural racism, such as racial residential segregation, discriminatory incarceration, and/or inequalities in health care quality and access, which may disproportionately affect Black families across generations in the United States (Bailey et al., 2017; Gee & Ford, 2011). For example, residential segregation restricts economic opportunity, leads to increased exposure to crime, and limits access to quality health care resources (Bailey et al., 2017). These racially patterned contextual factors increase adversities for Black children, such as parental incarceration, family illness, and parental death. Black individuals who are exposed to these disadvantages early in life may be at greater risk for additional adversity, accumulating over time (i.e., cumulative disadvantage), which may compound risk for cognitive impairment later in life (Ferraro & Kelley-Moore, 2003). One limitation of extant literature on ACEs and later-life cognition is that prior studies include mostly White samples. This may contribute to biased estimates of the prevalence of ACEs, and accurate estimation of ACE exposure is necessary to optimize intervention efforts. While racial disparities in exposure to ACEs have been documented, it is less clear whether the impact of ACEs on cognitive aging differs across racial groups. Indeed, differences in both the exposure to and impact of ACEs on health may contribute to racial disparities in later-life cognition (Ward et al., 2019). Examining the differential impacts of ACEs across Black and White adults could improve our understanding of cognitive inequalities and inform the development of targeted, culturally relevant interventions.

The current study

The overall goal of the current cross-sectional study was to extend the literature on the associations between ACEs and later-life cognition by identifying potential mediators and characterizing racial differences. We investigated mediation through depressive symptoms and cardiovascular health, operationalized via systolic blood pressure (sBP), which is a key metric of overall cardiovascular health (Lloyd-Jones et al., 2010). The first aim (1) was to determine whether depressive symptoms and/or sBP mediate associations between ACEs and later-life global cognition. We hypothesized (1) that experiencing more ACEs would be associated with greater depressive symptoms and higher sBP and that greater depressive symptoms and higher sBP would each be

https://doi.org/10.1017/S1355617723000474 Published online by Cambridge University Press

Table 1. Participant characteristics for variables of interest

	Full Sample ($N = 418$)		White Participants ($n = 210$)		Black Participants ($n = 208$)		
Variable (sample range)	M	SD	M	SD	M	SD	Effect Size[a]
Age (55–82 years)	63.62	3.16	63.75	3.22	63.49	3.10	0.08
% Female	59.3%	–	56.2%	–	62.5%	–	0.06
Childhood Health (1[excellent]–5[poor])	1.85	1.00	1.80	0.95	1.89	1.05	0.09
Parental Education (1.5–19 years)	11.41	2.98	12.15	2.74	10.65	3.03	0.52*
Depressive Symptoms (0–27)	7.98	6.16	6.92	5.87	9.04	6.28	0.35*
Systolic Blood Pressure (87–207 mmHg)	137.43	19.76	133.48	18.69	141.42	20.04	0.41*
ACEs (0–8)	2.30	1.88	2.10	1.93	2.50	1.81	0.21*
Global Cognition (z-score composite)	0.06	0.93	0.57	0.74	−0.47	0.81	1.35*

ACEs = adverse childhood experiences.
[a]Cohen's *d* was computed for continuous variables, and Cramér's V was computed for categorical variables.
*$p < .05$.

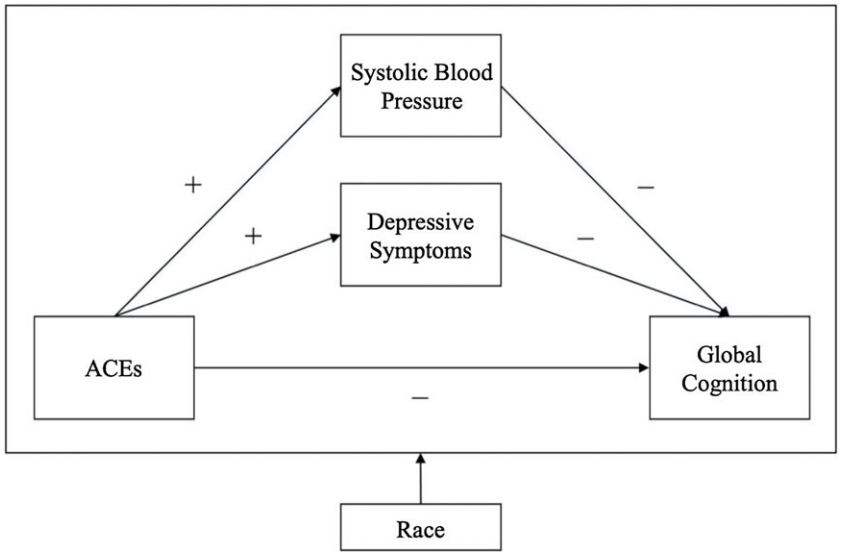

Figure 1. Conceptual diagram of simultaneous mediation model utilized for study aims. ACEs = adverse childhood experiences.

associated with worse cognition. The second aim of the study was (2a) to quantify racial disparities in ACEs, depressive symptoms, sBP, and global cognition and (2b) to examine whether associations among them differ between Black and White older adults. We hypothesized that (2a) Black older adults would report more ACEs and demonstrate worse mental, physical, and cognitive health than White older adults and that (2b) associations between these would be stronger among Black older adults than White older adults. Figure 1 depicts our conceptual model.

Method

Participants

Participants for the current cross-sectional study were drawn from the Michigan Cognitive Aging Project (MCAP), an ongoing, longitudinal cohort study of racially and socioeconomically diverse older adults in Southeast Michigan. Participants were recruited beginning in 2017 from Wayne and Washtenaw counties through direct mailings using the 2016 voter registration list, supplemented by word of mouth. Inclusion criteria required participants to be age 55 or older and have no previous diagnosis of dementia at study baseline. There were 499 participants in the sample as of June 2021, when the present analyses were conducted. Because the current study focused on identifying Black–White racial differences, participants who self-reported any other race or reported Hispanic ethnicity were excluded from the analyses ($n = 34$). Additional exclusion criteria were missing data for any measures of interest, including covariates ($n = 47$). Participants that were excluded from the analyses ($N = 81$) were younger (62.93, Cohen's $d = .22$), had worse childhood health (2.13, Cohen's $d = .28$), and had lower global cognition (−.32, Cohen's $d = .40$) than the final analytic sample ($N = 418$). Characteristics of the final sample are detailed in Table 1.

Procedure

Participants completed a psychosocial interview and cognitive assessment in person either at their homes or at office spaces in Ann Arbor or Detroit, Michigan. Participants were prescreened for study eligibility prior to study enrollment via phone or email. Trained research staff collected data, scored neuropsychological tests, and entered study data. All participants provided written informed consent. This study was approved by the University of Michigan Institutional Review Board and complied with the ethical rules for human experimentation stated in the Helsinki Declaration.

Measures

Global cognition. MCAP participants completed a comprehensive neuropsychological battery consisting of 12 neuropsychological tests assessing five domains of cognition: episodic memory,

https://doi.org/10.1017/S1355617723000474 Published online by Cambridge University Press

executive function, processing speed, language, and visuospatial functioning. Factor scores were derived for each cognitive domain using confirmatory factor analysis (Zahodne, 2021). Supplementary Table 1 outlines indicators from the neuropsychological assessment that were used to derive each domain score. Factors scores were then standardized, and global cognition was computed as the average of the standardized factor scores. Higher scores corresponded to better global cognitive functioning.

Adverse childhood experiences (ACEs). A modified ACEs questionnaire adapted from the Reasons for Geographic and Racial Disparities in Stroke study (Howard et al., 2005) was used to assess nine ACEs: (1) *Parents were separated or divorced*; (2) *Parent remarried*; (3) *Serious illness of a family member*; (4) *Death of a parent*; (5) *Witnessed domestic violence*; (6) *Substance abuse by a family member*; (7) *Loss of job by a parent*; (8) *Parent had to go to jail*; (9) *Abuse (physical or sexual)*. A similar version of this questionnaire was also used by Gold and colleagues (2021). Participants responded "yes" (1) or "no" (0) to each item to indicate whether or not they experienced the event prior to age 18. A sum score was computed with higher scores indicating the participant experienced more ACEs.

Cardiovascular health. Cardiovascular health was assessed through sBP, as blood pressure is a key metric of overall cardiovascular health (Lloyd-Jones et al., 2010). sBP, as compared to diastolic blood pressure, is a strong predictor of cardiovascular disease risk (He & Whelton, 1999; Strandberg & Pitkala, 2003). Blood pressure was measured using an Omron BP760N digital monitor with an upper arm cuff while participants were seated upright. sBP was the average of two measurements. Higher sBP corresponded to poorer cardiovascular health.

Depressive symptoms. Depressive symptoms over the past week were assessed with the 10-item Center for Epidemiologic Studies Depression Scale (CESD; Radloff, 1977), which has been demonstrated to have good internal consistency (Cronbach's alpha = 0.92) and to have reliability and validity comparable to that of the original 20-item measure (Irwin et al., 1999). Responses ranged from 0 (rarely or none of the time) to 3 (most or all of the time). Reverse-scored items were recoded and responses were summed so that higher scores corresponded to more depressive symptoms. The possible range of the CESD-10 is 0 to 30, with a score of 10 or greater indicating the presence of significant depressive symptoms (Andresen et al., 1994).

Race. Race and ethnicity were assessed through self-report. Participants were asked "What race do you consider yourself?" and "Do you consider yourself to be Hispanic or Latino/a?" Categories were dummy coded into two mutually exclusive groups: nonHispanic Whites and nonHispanic Blacks. In order to communicate disparities, Whites served as the reference group.

Covariates. The current study controlled for the following sociodemographic factors and relevant covariates based on known associations with later-life cognition: age (Murman, 2015), sex/gender (Lee et al., 2022), race (Aim 1; Díaz-Venegas et al., 2016), childhood socioeconomic status (SES; Greenfield & Moorman, 2019), and childhood health (Kobayashi et al., 2017). Race was conceptualized as a proxy for exposure to a range of sociocultural experiences and was included as a covariate for Aim 1 to isolate the effect of ACEs. Age was recorded in years at study baseline. Sex/gender was assessed through self-report, and participants identified as "Male," "Female," or "Nonbinary/Other." Only "Male" and "Female" categories were endorsed in the study sample; therefore, sex/gender was a binary variable with females as the reference group. Parental education was used as a proxy for childhood SES (Bowen & González, 2010; Greenfield & Moorman, 2019). Mother and father's years of formal education were assessed through participant's self-report as a continuous variable ranging from 0 to 20 years. Parental education was measured by averaging the total education of the mother and the father. If data was only available for one parent, parental education was that parent's total years of education. The following question assessed childhood health: "Consider your health while you were growing up, from birth to age 16. How was your health during that time?" Participants responded on a scale of (1) "Excellent" to (5) "Poor." Higher scores indicated worse childhood health.

Table 2. Unadjusted bivariate correlations between main variables of interest

Variable	Depressive Symptoms	Systolic Blood Pressure	Global Cognition
Full Sample			
ACEs	.213**	−.002	−.080
Depressive Symptoms	–	.090	−.303**
Systolic Blood Pressure		–	−.134**
Global Cognition			–
NHW			
ACEs	.191**	−.096	−.056
Depressive Symptoms	–	.070	−.216**
Systolic Blood Pressure		–	−.088
Global Cognition			–
NHB			
ACEs	.207**	.049	.003
Depressive Symptoms	–	.046	−.286**
Systolic Blood Pressure		–	.027
Global Cognition			–

ACEs = adverse childhood experiences.
**$p < .01$.

Statistical analysis

Statistical analyses were performed using IBM SPSS v. 27 and the PROCESS macro for SPSS (Hayes, 2017). Unadjusted differences in variables of interest between Black and White participants were assessed with t-tests. A simultaneous mediation model using the PROCESS macro quantified the indirect effects of ACEs on baseline later-life global cognition through depressive symptoms and sBP, while controlling for covariates. Race-stratified mediation models examined how the relationships between ACEs, depressive symptoms, sBP, and global cognition may be different between Black and White participants (Ward et al., 2019). Post hoc analyses investigated indirect effects of ACEs separately on five cognitive domains: episodic memory, executive function, processing speed, language, and visuospatial functioning. Statistical significance was evaluated at $p < 0.05$ for all analyses.

Results

ACEs, health mediators, & cognition

The full sample reported 2.30 ACEs on average. Breakdowns of individual ACE endorsements and cumulative ACE scores are provided in Supplementary Tables 2 and 3. The full sample had an average sBP of 137.43 mmHg and an average CESD score of 7.98. 34.4% of participants endorsed significant depressive symptoms, and 51.9% of participants reported antihypertensive medication use. Table 2 presents bivariate correlations between the main

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Table 3. Indirect associations between ACEs and global cognition through specified mediators

Mediator	Effect	SE	95% CI
Full Sample			
Depressive Symptoms	−.040	.013	−.066, −.017
Systolic Blood Pressure	−.000	.002	−.004, .005
Black Participants			
Depressive Symptoms	−.074	.025	−.128, −.029
Systolic Blood Pressure.	.005	.009	−.007, .027
White Participants			
Depressive Symptoms	−.031	.018	−.069, .001
Systolic Blood Pressure	.004	.008	−.010, .026

Models were adjusted for age, sex/gender, race (full sample), parental education, and childhood health. ACEs = adverse childhood experiences, effect = completely standardized indirect effect, SE = bootstrap standard error.

variables of interest. In the full sample, individuals that reported more ACEs tended to have more depressive symptoms. Those who reported more depressive symptoms and those that had higher sBP tended to have worse global cognition scores. Bivariate correlations were not observed between ACEs and sBP or between ACEs and global cognition.

Table 3 summarizes results from simultaneous mediation models investigating indirect associations between ACEs and later-life global cognition through depressive symptoms and sBP in the full sample and stratified by race. There was a negative indirect effect of ACEs on global cognition through depressive symptoms in the full sample. Figures 2a–c show the individual a and b paths of the mediation models. As shown in Figure 2a, having experienced more ACEs was associated with more depressive symptoms, and more depressive symptoms were associated with worse global cognition. There was no indirect association between ACEs and global cognition through sBP in the full sample. Specifically, ACEs were not associated with sBP, and sBP was not associated with global cognition.

Race-stratified analyses

As shown in Table 1, there was a small racial difference in ACE exposure, such that Black participants ($M = 2.50$) reported more ACEs than White participants ($M = 2.10$), on average (Cohen's $d = 0.21$). There were moderate differences in depressive symptoms and cardiovascular health, such that Black participants reported more depressive symptoms ($M = 9.04$) than White participants ($M = 6.92$, Cohen's $d = 0.35$) and had higher sBP ($M = 141.42$) than White participants ($M = 133.48$, Cohen's $d = 0.41$), on average. There was a large difference in global cognition between the two groups, such that Black participants ($M = -0.47$) had lower scores compared to Whites (M = 0.57), on average (Cohen's $d = 1.35$).

Correlations among the variables of interest across race are summarized in Table 2. In both racial groups, reporting more ACEs was correlated with more depressive symptoms, and more depressive symptoms were correlated with lower global cognition. These correlations were numerically larger for Black participants than White participants. There were no significant correlations between ACEs and sBP, sBP and global cognition, or between ACEs and global cognition in either group.

As shown in Table 3, race-stratified mediation models revealed a negative indirect effect of ACEs on global cognition through depressive symptoms for Black participants, but not White participants. As shown in Figures 2b and 2c, more ACEs were associated with more depressive symptoms, and more depressive symptoms were associated with worse scores in global cognition in both groups, but these associations were larger among Black participants than White participants. There was no indirect association between ACEs and global cognition through sBP in either racial group.

Post hoc analyses

While the primary aim of the current study was to investigate the effect of ACEs on global cognition, analyzing effects across specific cognitive domains may reveal differential effects of ACEs on specific areas of cognition, which could help point to mechanisms underlying these associations. Exploratory mediation models analyzing the indirect effects of ACEs on five separate cognitive domains through depressive symptoms and sBP revealed similar effects across all individual cognitive domains (Supplementary Table 4). There was a negative indirect effect of ACEs through depressive symptoms on episodic memory, executive function, processing speed, language, and visuospatial functioning in the full sample. These effects were only seen among Black participants in stratified models. There were no indirect effects between ACEs and the five cognitive domains through sBP in the full sample or in either racial group.

Sensitivity analyses

Robustness of findings was assessed with the following sensitivity analyses: (1) separating the ACEs measure into household dysfunction and abuse, (2) covarying for season of testing, and (3) analyzing antihypertensive medication use separately as a covariate and as a moderator. Detailed results are provided in the Supplementary Materials. Notably, when separating the ACE predictor into household dysfunction and abuse, there were no indirect effects between abuse and global cognition. There was a negative indirect effect between household dysfunction and global cognition through depressive symptoms in the full sample ($\beta = -.042$, CI [−.069, −.019]), in Black participants ($\beta = -.076$, CI [−.131, −.030]), and in White participants ($\beta = -.034$, CI [−.072, −.002]). These indirect effects were numerically larger than those in the original models. Results did not differ when including season of testing or antihypertensive medication use as covariates. Antihypertensive medication use did not moderate associations between ACEs, depressive symptoms, sBP, and global cognition.

Discussion

This study aimed to extend the literature on the associations between ACEs and cognitive function in older adults by investigating indirect effects of ACEs on global cognition through depressive symptoms and cardiovascular health in a health disparities framework. We found that ACEs were indirectly associated with lower later-life global cognition through depressive symptoms but not sBP. We observed racial disparities in the level of ACEs, depressive symptoms, sBP, and global cognition, and associations between ACEs, depressive symptoms, and global cognition were stronger among Black participants than White participants. Post hoc analyses revealed these findings to extend across five separate cognitive domains, which may suggest broad underlying neuropathological mechanisms.

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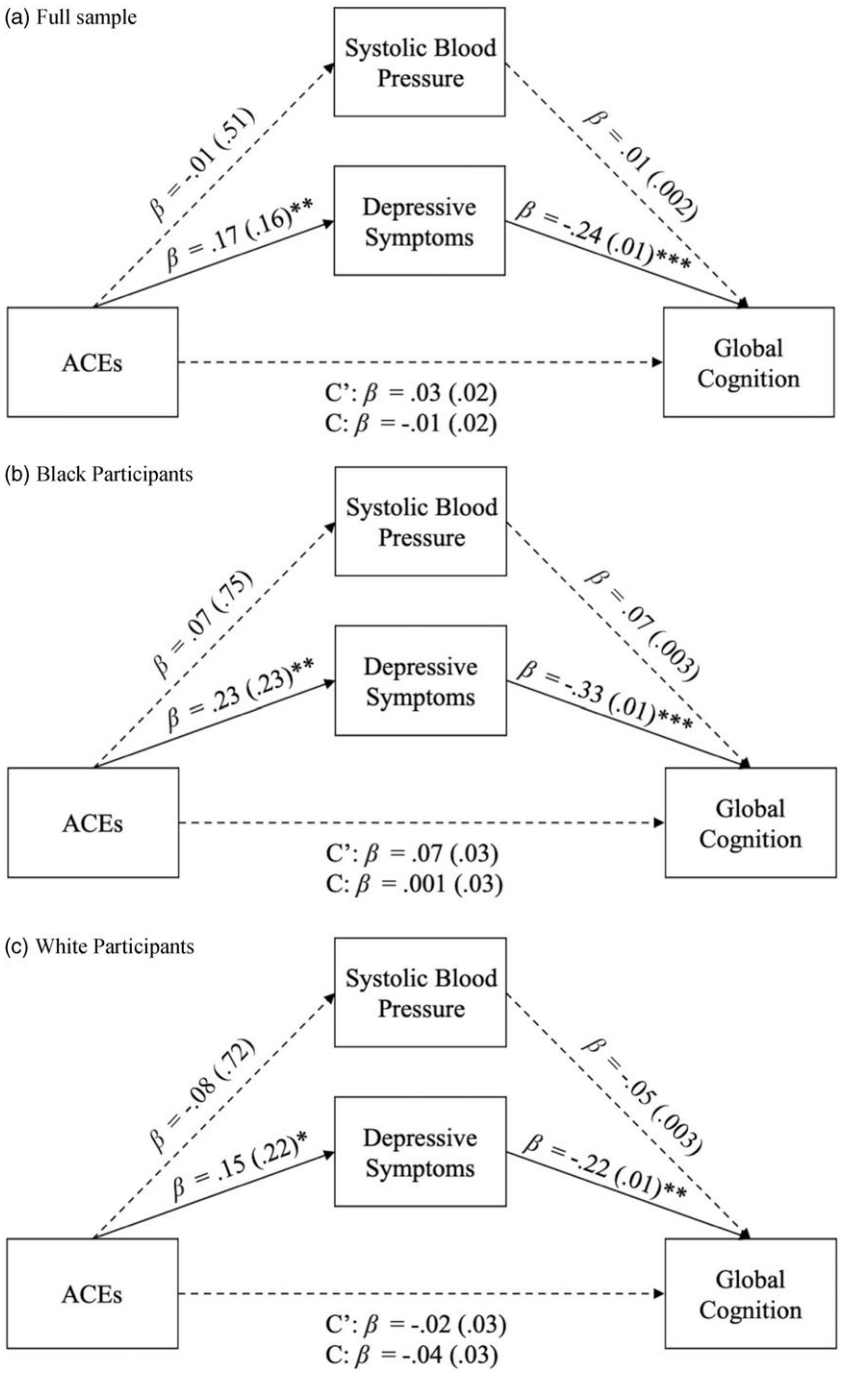

Figure 2. Individual paths of indirect associations between ACEs and global cognition through specified mediators. Models were adjusted for age, sex/gender, race (full sample), parental education, and childhood health. Solid lines depict statistically significant associations. ACEs = adverse childhood experiences, β = standardized coefficient (standard error), C' = direct effect, C = total effect. * $p < .05$, ** $p < .01$, *** $p < .001$.

ACEs, depressive symptoms, cardiovascular health, & cognition

Previous literature has shown that ACEs negatively impact cognitive function in childhood through their effects on brain development (Bick & Nelson, 2016; Hart & Rubia, 2012; Teicher et al., 2003). Additionally, cross-sectional and longitudinal research has found ACEs to be associated with worse cognitive outcomes in later-life (Geoffroy et al., 2016, Korten et al., 2014, Radford et al., 2017; Ritchie et al., 2011; Tani et al., 2020). However, some studies have not identified an association between overall ACE exposure and later-life cognition (Gold et al., 2021). A primary contribution of the present study is its demonstration of an indirect relationship between more ACEs and lower late-life global cognition through late-life depressive symptoms. This relationship is consistent with separate lines of prior literature which suggest that ACEs are associated with more depressive symptoms (Felitti et al., 1998) and more depressive symptoms are associated with worse late-life cognitive outcomes (Zahodne et al., 2014). Additionally, ACEs have been found to be associated with faster cognitive decline in the context of late-life depressive symptoms, suggesting depressive symptoms may be an important underlying mechanism (Korten et al., 2014). Results from the present study further demonstrate that the indirect effect of depressive symptoms may reflect global effects on brain integrity, as depressive symptoms mediated the relationship for multiple cognitive domains.

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These global changes in later-life cognition may reflect broad changes in brain and cognitive development as a result of ACEs. Specifically, childhood maltreatment has been associated with reduced brain volumes in temporal, frontal, parietal, and occipital regions (Bick & Nelson, 2016), as well as worse performance on measures of general intelligence, memory, attention, response inhibition, and emotion discrimination in children (Hart & Rubia, 2012). Furthermore, previous literature suggests that ACEs may increase risk for depression by dysregulating neuroendocrine stress response systems, such as the hypothalamic-pituitary-adrenal (HPA) axis (Cohen et al., 2006; Heim et al., 2004; Penza et al., 2003). Additionally, psychological stress may increase risk for depression by promoting inflammatory responses through proinflammatory cytokines and complex interactions with the HPA axis (Raison et al., 2006). Previous literature has also suggested that dysregulated HPA axis response, measured by cortisol reactivity to psychosocial stress, may increase risk of cognitive impairment in older adults (de Souza-Talarico et al., 2020). Furthermore, depression has been associated with a wide range of fluid cognitive abilities, including episodic memory, executive function, attention, and processing speed (Hammar & Ardal, 2009; McDermott & Ebmeier, 2009). Given the cross-sectional nature of the present study, the temporal relation between later-life depressive symptoms and cognition cannot be definitely demonstrated (Fairchild & McDaniel, 2017); therefore, additional longitudinal research is needed to better understand this directionality and to demonstrate causal mediation between ACEs and later-life cognition through depressive symptoms.

Sensitivity analyses in the present study suggest that household dysfunction may be more relevant to later-life mental and cognitive health than abuse, but estimation of the association between abuse and cognition may have been limited by the use of a single, heterogeneous item combining multiple distinct forms of abuse. This result may also reflect selection bias, such that older adults who have experienced childhood abuse and have poor cognitive function may be less likely to participate in research. Further research is needed to understand mechanisms underlying the effect of abuse on later-life cognition and why this may differ from the effects of other types of ACEs.

In the present study, we did not find any indirect associations through sBP. It may be that depressive symptoms are more directly related to ACEs and/or later-life cognition. Indeed, compared to sBP, depressive symptoms were more strongly associated with both ACEs and global cognition in the full sample and when stratifying by race in the current study. This may be because ACEs may have a stronger effect on structural and functional brain changes, which may have proximal effects on depressive symptoms but not sBP. Furthermore, although we did not find a correlation between depressive symptoms and sBP, prior research has shown depressive symptoms to be a risk factor for cardiovascular disease (Zhanget al., 2018). Therefore, modeling these factors as simultaneous mediators may have reduced our ability to detect an effect through sBP.

The present findings point towards potential intervention targets to reduce cognitive impairment and cognitive disparities in later life. At a structural level, interventions could reduce ACE exposure by strengthening financial support for families and by promoting family-focused work policies (Centers for Disease Control and Prevention, 2019; Cooney et al., 2022). At an individual level, interventions could aim to reduce ACE exposure through parental stress management, parenting skills approaches, childcare, and mentoring programs (Centers for Disease Control and Prevention, 2019; Crouch et al., 2019). Additionally, interventions could aim to promote resilience among individuals that have experienced ACEs by focusing on factors such as perceived control or adaptive coping strategies. Individuals with lower perceived control are more likely to develop depressive symptoms in the context of stress (Grote et al., 2007; Zaheed et al., 2021), and individuals that use avoidant coping, as opposed to approach-oriented coping, have higher levels of depressive symptoms (Seiffge-Krenke & Klessinger, 2000). Therefore, mitigating the occurrence and severity of depressive symptoms by increasing coping resources could indirectly mitigate the negative effect of ACEs on later-life cognition. This approach may be especially useful for individuals that have already experienced adversity in early life for which direct interventions to prevent ACEs are not practical.

Racial disparities

In the present study, we found level differences and differences in the strength of associations between ACEs, depressive symptoms, and later-life global cognition across older Black and White adults. Specifically, we found an indirect effect of ACEs on global cognition through depressive symptoms for Black participants, but not White participants. Moreover, having experienced more ACEs was more strongly associated with more depressive symptoms, which was associated with worse cognition for Black participants than White participants. These findings are consistent with previous literature which has found higher levels of ACEs to have a stronger negative impact on mental health for Black adults than White adults (LaBrenz et al., 2020) and more depressive symptoms to be more strongly associated with worse episodic memory and executive functioning for Black adults than White adults (Zahodne et al., 2014). While not measured in the present study, the differential impact of ACEs on depressive symptoms and cognition between Black and White adults may reflect more chronic exposure to these stressors.

Together, these findings of racial disparities in ACEs and physical and mental health are consistent with the model of cumulative disadvantage, which postulates that racially patterned disadvantages early in life may put Black individuals at greater risk for additional adversity, accumulating and compounding over time (Ferraro & Kelley-Moore, 2003). These results underscore the importance of early intervention to interrupt risk pathways to racial disparities in cognitive aging. Such interventions could include place-based initiatives to improve education, employment opportunities, housing and neighborhood conditions, policy reform (such as for discriminatory incarceration), and/or more thorough training for health professionals on the effects of structural racism on health (Bailey et al., 2017).

Limitations, strengths, & future directions

The cross-sectional nature is a limitation of the current study as it does not show the impact that ACEs may have on changes in cognition. However, racial disparities in ADRD are more strongly driven by racial differences in cognitive level than in rates of cognitive change (Manly & Mungas, 2015). Prior research in this area highlights the importance of focusing on pathways that may contribute to disparities in cognitive level, which likely reflects the cumulative effects of life-course experiences on cognitive development. Additionally, our analyses did not account for cumulative exposure to high sBP, which may have affected our ability to detect an effect. Furthermore, sBP is only one indicator of cardiovascular

https://doi.org/10.1017/S1355617723000474 Published online by Cambridge University Press

health; therefore, cardiovascular health should not be fully ruled out as a potential mediator between ACEs and later-life cognition. Lastly, the current study analyzed concurrent measurements of depressive symptoms, sBP, and cognition, which may limit our understanding of the effect of ACEs across the life course. Future research incorporating longitudinal cognitive data, additional indicators of cardiovascular health, and intermediate measurements of mediators would clarify the associations between ACEs and cognition over the lifespan.

Additional limitations include how ACEs were measured in this study. First, a retrospective measure of ACEs may be subject to recall biases, which may over- or underestimate the prevalence of ACEs and their effect on health outcomes (Reuben et al., 2016). However, the influence of current mood on retrospective reports of childhood experiences has been reported to be weak and less evident for the reporting of specific experiences than for global ratings (Yancura & Aldwin, 2009). Second, our predictor did not measure the chronicity or appraisal of adverse events, which may differentially drive the underlying associations between ACEs and cognition (e.g., via stress pathways; Morris et al., 2021). Third, our measure did not query overt neglect; indeed, child neglect has been shown to be associated with mental and cognitive health across the life course (Geoffroy et al., 2016). Lastly, using a combined measure of ACEs may suppress differences in the impact that individual events have on cognition, as different events may have positive, negative, or null effects on cognition (Gold et al., 2021; Ritchie et al., 2011). Thus, future studies using prospective, more fine-grained measures of ACEs, which incorporate assessment of the chronicity and appraisal of adverse events, are warranted to better understand their driving mechanisms.

While the current study investigates two potential mechanisms of the associations between ACEs and later-life cognition, future studies could further explore other potential mediators, such as social relationships during adulthood. Further research should also consider contextual factors related to structural racism, such as neighborhood environment and access to health care resources, given the racial disparities documented in this and other studies. Understanding how structural racism may contribute to ACE exposure and the impact of ACEs on health would clarify the sources of racial disparities and help to identify effective intervention targets.

Strengths of the current study include the use of a comprehensive neuropsychological battery to investigate global cognition, as well as clinically relevant cognitive domains (Sachdev et al., 2014). This design allowed for the distinction between global and domain-specific associations in our predictors of interest, and such a design can inform future research on potential underlying mechanisms. Additionally, this study includes the use of a racially balanced and socioeconomically diverse sample of older Black and White adults. This allows our results to be more generalizable and mitigates statistical concerns related to unequal variances due to disproportionate sample sizes. This also allowed for examination of racial differences in the associations between ACEs and later-life cognition, which has not been extensively explored. Finally, the current study included a comprehensive set of covariates, which allowed us to separate the impact of ACEs from other confounding factors known to influence cognitive aging.

Conclusions

In conclusion, our findings extend the literature on mechanisms underlying the lasting cognitive impact of ACEs and their role in late-life cognitive disparities. Specifically, depressive symptoms may mediate the negative effect of ACEs on later-life cognition, and this effect may be stronger for Blacks than Whites. With the addition of future longitudinal research, these findings have the potential to inform the development of targeted and culturally relevant interventions to reduce late-life cognitive morbidity and racial disparities in dementia that may arise from life-course exposure to structural racism.

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1017/S1355617723000474.

Acknowledgments. This work was supported by the University of Michigan Department of Psychology and the National Institute on Aging (grant numbers P30AG059300, P30AG012846, P30AG024824, P30AG053760). Laura Zahodne was supported by: National Institute on Aging [AG070951, AG067506, AG057510, AG059300, AG054520]. Afsara Zaheed was supported by the Ruth L. Kirschetein predoctoral National Research Service Award from the National Institute on Aging of the National Institutes of Health (Award Number F31AG067717). Ketlyne Sol was supported by: National Institute on Aging [P30AG059300; K01AG073588], National Center for Advancing Translational Sciences [KL2TR002241; UL1TR002240], National Institute of Nursing Research [U01NR020556], and the Antonia Lemstra Fund at the Michigan Alzheimer's Disease Resource Center.

Competing interests. None.

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https://doi.org/10.1017/S1355617723000474 Published online by Cambridge University Press