

# INFLUENCE OF SPIRITUALITY ON DEPRESSION-INDUCED INFLAMMATION AND EXECUTIVE FUNCTIONING IN A COMMUNITY SAMPLE OF AFRICAN AMERICANS

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African Americans (AAs) are disproportionately affected by cerebrovascular pathology and more likely to suffer from premature cognitive decline. Depression is a risk factor for poorer cognitive functioning, and research is needed to identify factors that serve to mitigate its negative effects. Studies have demonstrated positive influences of spirituality within the AA community. Determining whether spirituality attenuates the effects of depressive symptoms on cognitive functioning and the pathophysiological mechanisms that explain these relationships in AAs is paramount. This study examines the influence of daily spiritual experiences on the relationship between depressive symptoms and cognitive functioning, and how inflammatory markers may partially explain these associations. A sample of 212 (mean age = 45.6) participants completed the Daily Spiritual Experience Scale (DSES), Beck Depression Inventory-II (BDI-II), Trail Making Test A and B (TMT) and Stroop Color and Word Test (Stroop). Blood samples were collected to measure inflammatory mediators (IL-6, IL-1a, TNF-a). Linear regression analyses were used to evaluate associations. Higher BDI-II scores were associated with poorer psychomotor speed and visual scanning, measured by TMT A ( $B=1.49$ ,  $P=.01$ ). IL-6 explained a significant amount of variance in this relationship ( $B=.24$ ,  $CI\ 95\% [.00, .64]$ ). IL-6 also significantly mediated the relationship between depressive symptoms and psychomotor speed and mental flexibility, measured by TMT B performance ( $B=.03$ ,  $CI\ 95\% [.003, .095]$ ). Frequent spiritual experiences among AAs may ameliorate the negative influence of depressive symptoms on cognitive functioning. *Ethn Dis.* 2019;29(2):267-276; doi:10.18865/ed.29.2.267

## INTRODUCTION

Existing research has demonstrated an association between depressive symptoms and cognitive decline in older adults.<sup>1</sup> Depressive symptoms are associated with changes in memory, processing speed, visuospatial processing, and executive functions.<sup>2</sup> Different methodological approaches to examining depressive symptoms and cognitive decline have yielded inconsistent results. Cross-sectional studies have demonstrated a significant association between depressive symptoms and cognitive decline, while other studies have found no association.<sup>3-5</sup> In longitudinal studies, evidence suggests depressive symptoms at baseline predicted future cognitive

decline, with significant associations between chronic or persistent symptoms of depression and declines in attention, memory, general cognitive status, and executive functions,<sup>3,6</sup> although there have been some inconsistencies across studies.<sup>7</sup> Other research has shown depressive symptoms and related executive function impairment may better represent prodromal symptoms of dementia that reflect common causes of these conditions.<sup>8</sup> Therefore, there is a need to investigate these relationships to identify those at highest risk for developing dementia, particularly in African Americans who are more likely than Caucasians to be diagnosed with Alzheimer's disease (AD) and related dementias.<sup>9</sup>

In African American communities, studies on depression have yielded varying results in part because of scant research on diagnostic accuracy and treatment of the disorder.<sup>10</sup> However, once diagnosed African Americans are likely to suffer from more persistent depression and more severe depressive symptomatology.<sup>11</sup> Despite this evidence, there remains a paucity of studies examining the relationship between depressive symptoms and cognitive functioning in African Americans, especially within

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**Keywords:** Depression; Inflammation; Spirituality; Health Disparities; African Americans; Cognitive Function

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community-based samples. Further research on these associations in an African American population and the influence of biological or socio-cultural factors may reveal determinants not previously considered in prior studies, which may contribute to better consistency of findings.

As mentioned previously, executive functions decline with age and can be further compromised by de-

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*Exploring relationships among depressive symptomatology, inflammation, executive functioning, and spirituality may identify factors that aid in more appropriate treatment of depression and executive function changes in this community.*

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pressive symptoms, increasing the risk for cognitive impairment and diagnosis of dementia.<sup>2,12</sup> Executive functions are cognitive processes related to inhibition, planning, attention, concentration, and decision-making. They are often considered essential for the instrumental activities of daily living associated with functional independence.<sup>9</sup> Exploring the pathophysiological mecha-

nisms underlying the association between depressive symptoms and executive impairment may help identify biomarkers that increase the risk for dementia-related disorders and potential interventions.

Prior studies have identified potential pathophysiological mechanisms that link depressive symptoms and cognitive impairment.<sup>13</sup> Chronic depressive symptoms have been associated with elevated pro-inflammatory cytokines, including interleukins IL-1, IL-6, and tumor necrosis factor alpha (TNF $\alpha$ ).<sup>14</sup> There is an association between depression and inflammation, such that it is related to stimulation of inflammatory pathways and elevated plasma concentrations of pro-inflammatory cytokines, which act as cellular messengers of the immune system.<sup>14</sup> The sustained activation of these mechanisms wear on the body's resources and cause system-wide damage.<sup>14</sup> When inflammatory cytokines are administered in previously asymptomatic individuals, symptoms are exhibited that are indistinguishable from clinical depression.<sup>15</sup> Depressive symptoms are associated with inflammatory processes, which may damage neuronal substrates that disrupt cognitive functioning.<sup>16</sup> These markers of inflammation are associated with increased risk for cognitive decline, dementias, reduced gray matter volume, and impaired executive functioning.<sup>16,17</sup> Exploring these pathophysiological mechanisms in a predominantly African American cohort will help to elucidate whether these pathways hold true in a non-White population and further contribute to con-

sistency of past research findings.

Finally, it is essential to elucidate potential protective factors amenable to behavioral interventions that serve to maintain optimal executive functioning in the presence of depressive symptoms and reduce the risk for cognitive impairment. For some African Americans, spiritual beliefs and practices are perceived as sources of healing and strength that work in conjunction with medical treatments.<sup>18</sup> Spirituality in the general population may be attributed to a sense of personal transcendence, identified purpose or meaning in life, and a feeling of interconnectedness with a Higher Power (eg, God).<sup>19</sup> This also includes connection to the transcendent (within and outside of oneself), and traveling along the path toward this transcendent, from a place of non-belief to that of devotion and surrender.<sup>20</sup>

Within the African American community, spirituality may manifest specifically through interconnectedness (with God and others), and faith is a mechanism to reframe adversities as conquerable struggles that will lead to personal empowerment.<sup>21</sup> This community typically conceptualizes depression in relation to spirituality and one's individual relationship with God.<sup>18</sup> Their spiritual practices (eg, prayer, singing hymns) serve to strengthen this relationship with God by encouraging practitioners to be receptive to God's message by being emotionally, physically, and spiritually engulfed into the present experience of worship.<sup>22</sup> Thus, spirituality has been found to be a meaningful coping mechanism among African Americans.<sup>23</sup>

Research investigating the impact of spirituality on executive functioning has not examined this association in predominantly African American groups. Spiritual practices have often been used to indirectly measure spirituality; these practices represent processes by which spiritual beliefs and values are integrated into one's life perspective.<sup>24</sup> Clinical investigations of spiritual practices, such as meditation, in Caucasians suggest that they may aid in reduction of anxiety and depression symptoms, which is associated with improved cognitive functioning.<sup>25</sup> Specifically, both higher baseline and increases in frequency of daily spiritual experiences (DSE) predicted a faster resolution of depressive symptoms in adult clinical patients.<sup>20</sup>

Some evidence suggests spiritual practices and contemplative-based interventions may attenuate stress-induced immune system activation and influence expression of inflammatory cytokines.<sup>26</sup> For example, mindfulness meditation has been proposed to reduce activity of major stress axes in the body by reducing emotional reactivity to stressful events.<sup>27</sup> Such changes include reduction of pro-inflammatory processes, viral loads, lower infection rates, increased cell-mediated defense, and increased telomerase activity associated with successful cell aging.<sup>26,27</sup> Previous research identified these benefits in African Americans; however, participants expressed concerns of cultural-spiritual congruence, acceptability in the community, cost-effectiveness, and feasibility of mindfulness-based practices.<sup>22</sup> The use of subjective experiences (eg,

"I feel thankful for my blessings") that involve a general connection to the transcendent may be a broader measure of spirituality that is culturally relevant to this population.<sup>22</sup>

Our study used descriptions of thoughts and feelings related to the transcendent that occur in the midst of daily living and reflect a level of spiritual awareness embedded in emotional and cognitive processes integral to the individual's life perspective.<sup>24</sup> Exploring relationships among depressive symptomatology, inflammation, executive functioning, and spirituality may identify factors that aid in more appropriate treatment of depression and executive function changes in this community.

In summary, we investigated whether severity of depressive symptomatology was associated with executive functioning in an African American community sample (study aim 1), and whether inflammation mediates this relationship (study aim 2). Furthermore, we examined whether frequency of spiritual experiences moderates the relationship between depressive symptoms and executive functioning, and whether they moderate this relationship as it occurs via inflammation (study aim 3).

## METHODS

### Participants

A community sample of 212 African Americans was recruited as part of a larger, cross-sectional study conducted in conjunction with the National Minority Organ Tissue Transplant Education Program (MOTTEP) at the Howard Univer-

sity School of Medicine from 2005-2007. The study entitled *The Psychoneuroimmunological Risk Factors in Renal Health and Disease* examined the effects of psychoneuroimmunological factors on renal health in African Americans; study protocol has been described elsewhere.<sup>28</sup>

### Procedure

Participants were recruited through flyers at Howard University Hospital, local health fair advertisements, and screened by phone. Exclusion criteria included current physical, emotional, or drug abuse, and a previous psychiatric diagnosis. Participants reported to the former General Clinical Research Center (GCRC), provided consent prior to participation, and completed various psychosocial and neurocognitive measures administered by trained graduate students including: the Beck Depression Inventory (BDI-II), Daily Spiritual Experiences Scale (DSES), the Trail Making Test (TMT) and Stroop Color and Word Test (Stroop). During this visit, nurses administered the venipuncture procedure used to collect participants' blood serum in order to determine IL-1a, TNF- a, and IL-6 levels. Participation took an average of four hours, with monetary compensation provided upon completion.

### Measures

#### *Beck Depression Inventory-II*

The BDI-II is a well-validated questionnaire assessing self-reported depressive symptomatology. Higher scores on the 21-item questionnaire indicate greater severity of depres-

sive symptoms. Participants are instructed to rate the severity of various symptoms from 0 to 3. Overall scores are highly correlated with clinical diagnoses of depression.<sup>29</sup>

#### *Daily Spiritual Experiences Scale*

This 16-item scale is a direct assessment of common, everyday life experiences.<sup>24</sup> The DSES measures an individual's perception of the transcendent in daily life, personal interaction and intimacy, as well as attitudes of compassion, mercy, and spiritual longing. The first 15 items are answered on a modified Likert scale measuring frequency of experiences from (1) many times a day to (6) to never. The last scale item ("In general, how close do you feel to God?") has four response categories: (1) as close as possible; (2) very close; (3) somewhat close; or (4) not close at all, with lower scores indicating higher levels of spirituality.<sup>24</sup>

#### *Trail Making Test*

The trail making test (TMT) has two timed parts. In TMT A, participants quickly connect numbers in consecutive order without lifting their pen from the paper. TMT B requires participants to quickly connect numbers and letters consecutively, by alternating between the two sequences. Completion times are scored for each task part, such that higher scores reflect poorer performance. Both parts require psychomotor speed, scanning, and complex attention; however, TMT B also requires cognitive flexibility.<sup>30</sup>

#### *Stroop Color and Word Test*

The Stroop Color and Word Test (Stroop) is a measure of inhibition.

The tasks consist of reading lists of words that are color names, naming the ink colors of Xs in another list, and, for the color-word task, naming ink colors of words while ignoring the written color names. The color-word task tests inhibition, the ability to suppress the urge to perform an automatic, primary response in order to provide a deliberate, secondary response.<sup>31</sup> The Stroop interference score reflects degree of inhibition and was calculated using the Golden method.<sup>31</sup>

#### *Inflammatory Cytokines*

Non-fasting blood samples were drawn and serum immediately prepared prior to storing at -70 Celsius until use. Serum, which is free of white and red blood cells, as well as clotting factors, ensures successful and reproducible measurements of cytokine levels. Once clotted, blood samples were centrifuged and aliquoted into vials that were stored at the GCRC until Quest Laboratories collected the samples. Serum samples were examined for levels of IL-1a, TNF-a and IL-6 by enzyme-linked immunosorbent assays (ELISA) and quantified by a microplate spectrophotometer. Cytokine levels are optimally measured within the blood serum; it cannot be reproducibly detected in other bodily fluids.<sup>32</sup>

#### **Statistical Analyses**

Descriptive statistics were calculated for all study variables. Further sociodemographic data have been previously published.<sup>28</sup> Covariates were selected based on relevant literature and confirmed with bivari-

ate correlational analyses. Variables were square root *or log* transformed to correct for skewness before being entered into the analyses. To improve ease of translation, prior to any analyses, scores on the DSES were reversed such that higher scores reflected higher levels of spirituality. The sample size was sufficient to detect a medium effect size based on the number of study variables.<sup>33</sup>

Linear multiple regression models were used to examine relationships among severity of depressive symptomatology, serum levels of inflammatory cytokines, and frequency of daily spiritual experiences. To address the first study aim, which was to determine whether severity of depressive symptomatology was associated with executive functioning performance, Block 1 of the sequential linear regressions included covariates (ie, age and years of education) and predictor variables (ie, BDI-II). BDI-II scores were added in Block 2. A mediation and moderation software package, PROCESS,<sup>34</sup> was used to compute moderation and mediation models for aims 2 and 3. To address aim 2, whether inflammation was a mediator in the relationships between depressive symptomatology and executive functioning, this software follows bootstrapping methods that use 1000 iterations and computes confidence intervals to test the null hypothesis. To address aim 3, whether frequency of spiritual experiences moderated the relationship between severity of depressive symptoms and executive functioning, products of severity of depressive symptoms and frequency of spiritual experiences were computed

**Table 1. Study group characteristics, N=212**

	M	SD
Age	45.6	11.56
Education, in years	13.81	2.39
BDI-II Total	8.13	8.21
Stroop Interference Score	-1.17	10.17
Trail Making A	38.02	13.95
Trail Making B	92.89	51.78
Daily Spiritual Experiences Scales total score-reversed	36.09	12.21
IL-1a	51.83	33.91
IL-6	2.98	4.27
TNF-a	2.01	1.89
		%
Sex (females)		51.6
Individual Income		
< \$10,000		25.1
\$10,001- \$20,000		15.6
\$20,001- \$30,000		18.5
\$30,001- \$40,000		12.8
\$41,001- \$50,000		11.8
\$50,001- \$65,000		7.1
\$65,001- \$80,000		5.2
> \$80,000		3.8

M, mean; SD, standard deviation; IL-1a, interleukins-1A; IL-6, interleukins-6; TNFa, tumor necrosis factor alpha.

to represent the interaction between these variables. Executive functioning was then regressed onto predictor variables, interaction terms, and covariates. The Johnson-Neyman technique was applied to probe the effect of depressive symptomatology on executive function task performance at each level of the continu-

ous moderator, frequency of spiritual experiences. The index of moderated mediation was calculated using the bootstrapping method to test the null hypothesis of the indirect path from the interaction term to the outcome variables via the mediator and was used to assess whether frequency of spiritual experiences moderated

the relationship between severity of depressive symptoms via its influence on inflammatory mechanisms.

## RESULTS

Descriptive statistics were calculated to assess study group characteristics (Table 1). In addressing the first study aim, which was to determine whether severity of depressive symptomatology was associated with executive function performance, BDI-II scores were significantly associated with TMT A scores (B=1.49, P=.01), such that greater severity of depressive symptoms was associated with poorer task performance (Table 2). This relationship was not significant with Stroop interference scores or scores on TMT B.

In addressing aim 2, whether inflammation was a mediator in the relationship between depressive symptomatology and executive function, IL-6 significantly mediated the relationship between severity of depressive symptomatology and performance on the TMT A (B=.2361, CI 95% [.0068, .6411]) and the TMT B (B=.0331,

**Table 2. Cognitive test scores regressed on depression through inflammatory cytokines after adjustment for age and education**

	Direct Effects		Indirect Effects								
	BDI-II		IL-1a			IL-6			TNF-a		
	B	SE	B	95% CI		B	95% CI		B	95% CI	
			LL	UL	LL	UL	LL	UL	LL	UL	
Inhibition											
Stroop interference	.71	.44	-.01	-.20	.10	-.11	-.43	.02	.02	-.04	.20
Complex attention, cognitive flexibility, psychomotor speed/scanning											
TMT A	1.49 <sup>a</sup>	.58	.08	-.36	.03	.24	.01	.64	.58	-.04	.28
TMT B	.07	.09	-.01	-.05	.01	.03	.003	.10	.00	-.01	.03

B, unstandardized coefficients; SE, standard error values; BDI-II, Beck Depression Inventory-II; TMT A, Trail Making Test A; TMT B, Trail Making Test B; IL-1a, interleukins-1A; IL-6, interleukins-6; TNFa, tumor necrosis factor alpha; LL, lower limit; UL, upper limit  
a. P<.05

**Table 3. Cognitive test scores regressed on depression and spirituality, after adjustment for age and education**

	BDI-II x DSES Total- Reversed					
	B		SE		Scores	
Inhibition						
Stroop interference	-.05		.04		48.16 <sup>a</sup>	
	23.95		36.06			
	B	SE	B	SE	B	SE
	-.21	.68	-.82	.46	-1.8	-2.4
Complex attention, cognitive flexibility, psychomotor speed/scanning						
TMT A	.03		.05		48.02 <sup>a</sup>	
	24.04		36.03 <sup>a</sup>			
	B	SE	B	SE	B	SE
	1.12	.94	15	.63	1.8	.83
TMT B	-.00		.01		48.18	
	24.07		36.12			
	B	SE	B	SE	B	SE
	.13	.15	.1	.1	.07	.13

B, unstandardized coefficients; SE, standard error values.

a. P<.05

CI 95% [.0027, .0949]) (Table 2).

In addressing aim 3, whether frequency of spiritual experiences moderated the relationship between severity of depressive symptoms and executive functioning, higher DSE scores moderated the relationship between depressive symptomatology and Stroop interference and TMT A scores, but not TMT B scores (Table 3). However, interaction terms included in the model were not significant. Greater DSE scores were associated with better Stroop performance and lower reported depressive symptomatology. Greater DSE scores were also associated with better TMT A performance and lower reported depressive symptomatology. Frequency of spiritual experiences exerted a moderating effect on the indirect pathway through IL-6 between depressive symptomatology and

performance on the TMT A, identified by use of the Johnson-Neyman technique. The same was found for TMT B (Table 4). Significant moderated mediation effects of TMT A scores were detected at a DSE score of 35.58 and higher, such that these scores were associated with better TMT A performance, lower serum levels of IL-6, and lower reported depressive symptomatology (B=.25, CI 95% [.0082, .7722]). Better TMT B performance was also associated with DSE scores of 35.67 and higher (B=.03, CI 95% [.0003, .1452]), lower serum levels of IL-6 and lower reported depressive symptomatology.

## DISCUSSION

Our study investigated the relationships among depressive symp-

tomatology, executive functioning, spiritual experiences, and pro-inflammatory cytokines in an African American community sample. To our knowledge, no prior studies have examined these relations in African Americans. Our results showed greater severity of depressive symptoms was associated with poorer visual scanning and psychomotor speed. Furthermore, IL-6 mediated this relationship, and greater frequency of spiritual experiences were associated with lower severity of depressive symptomatology, lower serum levels of IL-6, and better visual scanning and psychomotor speed. These findings support existing evidence highlighting the importance of spirituality and other culturally relevant factors as meaningful coping mechanisms within this population.<sup>18, 21-23</sup>

**Depressive Symptomatology and Executive Functioning**

Greater severity of depressive symptoms was associated with poorer visual scanning and psychomotor speed, but not inhibition, cognitive flexibility, or complex processing. The full range of these impairments in executive functions has been identified in clinically depressed populations; however, given that the exclusionary criteria for this study included past psychiatric diagnosis and the sample would not be considered clinically depressed on average, these participants were not experiencing the level of neuroinflammation (and subsequent damage) associated with prolonged psychologically distressing states.<sup>16,17</sup> Compared with community samples, clinical samples often exhibit greater impairment as damage to correlates of more basic functions from neuroinflammation radiates to higher

*Our results showed greater severity of depressive symptoms was associated with poorer visual scanning and psychomotor speed.*

cortical function regions.<sup>15,16</sup> Given this reasoning, it is not unusual that our study group's performance only reflects impairment in certain executive functions (ie, visual scanning,

**Table 4. Cognitive test scores regressed on depression and spirituality through IL-6, after adjustment for age and education**

	BDI-II x DSES Total- Reversed x IL-6					
	B		SE		Scores	
Inhibition						
Stroop interference	-.00				.01	
	23.69		35.59		47.49	
	B	SE	B	SE	B	SE
	-.03	.09	-.06	.09	-.09	.13
Complex attention, cognitive flexibility, psychomotor speed/scanning						
TMT A	.01				.02	
	23.85		35.58 <sup>a</sup>		47.36 <sup>a</sup>	
	B	SE	B	SE	B	SE
	.14	.94	.25	.17	.36	.28
TMT B					-.00	
	23.82		35.67 <sup>a</sup>		47.52 <sup>a</sup>	
	B	SE	B	SE	B	SE
	.02	.03	.03	.02	.05	.03

IL-6, interleukin-6; BDI-II, Beck Depression Inventory-II; TMT A, Trail Making Test A; TMT B, Trail Making Test B; DSES, Daily Spiritual Experience Scale; B, unstandardized coefficients; SE, standard error values.  
a. P<.05.

psychomotor speed) that do not require as much coordination of attentional resources as others (eg, mental flexibility or complex processing), yet still require sustained attentional control and goal-directed behavior for successful task performance.<sup>30</sup>

**IL-6 as a Mediator**

IL-6 explained a significant amount of variance in the relationship between depressive symptomatology and performance on the TMT A. IL-6 also significantly mediated the relationship between BDI-II scores and performance on the TMT B. These results provide further evidence of the validity of the role of elevated pro-inflammatory cytokines as mechanisms of dysfunction and damage to neural structures induced by prolonged psychological

distress in African American samples.<sup>16,17</sup> IL-1a and TNF-a did not mediate any associations between depressive symptom severity and executive function performance. There are a variety of pro-inflammatory cytokines (eg, TNF-a, whose actions relate to liver metabolism; IL-1a, whose actions relate to cell injury and apoptosis<sup>14</sup>); this diversity reflects the various changes that occur during inflammatory responses.<sup>15</sup> The specific actions of IL-6 may have more targets within neural correlates of executive functioning.<sup>15,16</sup> Maier and Watkins<sup>14</sup> proposed that chronic elevation of pro-inflammatory cytokines leads to a neural cascade of altered mechanisms and resulting behavioral changes, similar to behaviors present during clinical depression. This provides further

understanding of reported executive functioning deficits, specifically the strong association between depression and executive functioning.<sup>2</sup>

### **Spirituality as a Moderator**

Greater frequency of spiritual experiences was associated with better inhibition, as well as lower reported severity of depressive symptomatology. While none of these interaction terms were statistically significant, larger samples may reveal that specific frequency ranges exist for reaping cognitive and mood-related benefits from spiritual experiences. These trends are echoed when examining the moderation of spiritual experiences on inflammatory mechanisms (ie, IL-6) that may partially explain the association between severity of depressive symptomatology and performance on the TMT A and TMT B. Significant moderated mediation effects were found, such that higher DSE scores were associated with less severe depressive symptomatology, lower levels of IL-6, and better performance on these tasks.

Overall, the results provide evidence that frequent daily spiritual experiences are associated with lower inflammatory responses and less severe depressive symptomatology, which are, in turn, associated with better executive function performance. These findings support previously observed salutogenic effects of spirituality on perceived stress and immune function as a result of spiritual experiences.<sup>26,27</sup> This evidence supports the need to include cultural environment when evaluating the potential benefits of spirituality in clinical settings for African Ameri-

cans and in evaluating what type of experiences may be most influential.

### **Study Limitations**

The greatest limitation to this study is its limited sample size. In order to establish these distinct and unique relationships as common between African American communities, a larger and regionally heterogeneous sample must be obtained. The cross-sectional design of this study also limits conclusions that can be drawn due to its correlational nature, rather than the elucidation of mechanisms possible in a longitudinal design. Similarly, there is a limited range of depressive symptomatology severity among study participants. Including clinical and non-clinical populations would provide a fuller understanding of the nature of depression-related cognitive impairment in African Americans. Additionally, previous research suggests that depression scales measuring dispositional depressive styles better capture the chronicity of stress that characterizes depression in African Americans rather than the depressive state measure used in this study.<sup>35</sup> Thus, the BDI-II may not accurately measure depressive symptoms in this population, despite its widespread use in clinical settings. Another limitation is the lack of data describing specific spiritual and religious beliefs of participants. The literature on spiritual and contemplative practices benefits in stress reduction broadly addresses daily practices in a way that supersedes specific religious dogma or spiritual beliefs.<sup>24</sup> However, future studies could benefit from such collection for comparative

studies exploring the affects of different practices and perspectives. Lastly, this type of study has not been conducted with any other racial/ethnic populations to determine if the effect of spirituality on IL-6 is widespread.

### **CONCLUSIONS**

Frequent spiritual experiences among adult African Americans in this sample were associated with lower severity of depressive symptoms and better executive function performance. More studies should consider exploring spiritually based, or at least culturally relevant, interventions to maintain executive functioning in depressed African Americans at risk for impairment. Given the personal nature of one's spirituality, and the stigmas associated with openly admitting and seeking mental health treatment within this community,<sup>10,18</sup> researchers must approach this topic with caution and respectful sensitivity. These findings also support existing evidence for salutogenic effects of spiritual and contemplative practices on immune system dynamics.<sup>26,27</sup> Interventions aimed at increasing frequency of daily spiritual experiences may aid in preserving neurocognitive performance among those who are exposed to greater amounts of physiological and psychological stress.

#### **CONFLICT OF INTEREST**

No conflicts of interest to report.

#### **AUTHOR CONTRIBUTIONS**

Research concept and design: Herren, Mwendwa, Callender, Campbell; Acquisition of data: Callender, Campbell; Data analysis and interpretation: Herren, Levy, Mwendwa;



Manuscript draft: Herren, Burris, Levy, Kirk, Banks, Jones, Beard, Mwendwa; Statistical expertise: Herren, Levy; Acquisition of funding: Callender, Campbell; Administrative: Burris, Kirk, Banks, Jones, Beard; Supervision: Levy, Mwendwa, Callender, Campbell

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