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Abstract

Objective

Although increased frequency of physical activity is associated with fewer depressive symptoms in African-Americans, most studies do not focus on a specific type of activity. Identifying the activity can provide helpful

information for designing interventions that focus on depressive symptoms. The objective of this study was to examine the odds of depressive symptoms in relation to walking in African-Americans.

Design and Sample

A secondary analysis was performed on the National Survey of American Life. The sample was made up of community-dwelling African-American women (*n* = 1,903) and men (*n* = 1,075) who did not meet the DSM-IV-TR criteria for depression.

Measures

Walking was measured by self-reported frequency (i.e., *never*, *rarely*, *sometimes*, *often*). Depressive symptoms were measured with the Center for Epidemiologic Studies Depression scale. Logistic regression for complex samples was used to examine the odds of depressive symptoms in relation to walking.

Results

Women who reported often walking had lower odds for depressive symptoms than women who reported never walking (OR = 0.56, 95% CI = 0.38–0.82). Walking frequency was not related to depressive symptoms in men.

Conclusions

Walking frequency is a modifiable risk factor for elevated depressive symptoms in African-American women.

Background

Depression is the leading cause of disability and a major contributor to the global burden of disease (World Health Organization, **2012**). The lifetime prevalence of major depressive disorder in African-Americans is estimated to be 9–13% (Williams et al., **2007**). However, depressive symptoms that do not meet the diagnostic criteria for depression are associated with increased disability, decreased quality of life (Rodríguez, Nuevo, Chatterji, & Ayuso-Mateos, **2012**), and recurrence of major depressive disorder (Meeks, Vahia, Lavretsky, Kulkarni, & Jeste, **2011**). Thus, it is important to reduce elevated depressive symptoms and prevent the increase in depressive symptoms in African-Americans who do not meet the diagnostic criteria for depression.

Increased frequency of physical activity is associated with fewer depressive symptoms in African-Americans (Farmer et al., **1988**). However, studies often do not focus on a specific type of physical activity. Identifying the activity can provide information that would be helpful in designing physical activity interventions to decrease depressive symptoms. A randomized control trial found that adherence to a 24-week walking intervention decreased depressive symptoms in midlife African-American women in one urban environment (Wilbur et al., **2009**), although no mention was made of whether participants met the diagnostic criteria for depression. Conversely, a national longitudinal study found no relationship between walking and depressive symptoms in African-American women who did not meet the diagnostic criteria for depression at baseline (Wise, Adams-Campbell, Palmer, & Rosenberg, **2006**). Neither walking study included men or representative samples, and only one indicated that theory was used to guide the investigation (Wilbur et al., **2009**). As physical activity is hypothesized to relieve depressive symptoms through biological and social mechanisms, theories that consider multiple levels of influence are recommended (Torres, Sampselle, Gretebeck, Ronis, & Neighbors, **2010**). Multilevel ecological theories offer an integrative and broad understanding of the methods by which various factors, including biological and social, together affect well-being (Stokols, **1992**).

Research on the social ecology of health promotion proposes efforts to promote human well-being should be based on an understanding of the dynamic interplay between diverse factors, rather than on analyses that focus exclusively on a single factor (Stokols, **1992**). Social ecology of health promotion has been applied to walking

(Linde et al., **2012**) and depressive symptoms (Katz et al., **2008**) in African-Americans, and was modified for the study reported here to account for biological and social predictors of depressive symptoms in African-Americans. Biological factors included age, family history of depression, body mass index, and disability. Household income was considered a social factor (Stokols, **1992**). Physical activity (Wise et al., **2006**) and depression (Williams et al., **2007**) decrease with age. Family history of depression is a proxy for genetics, which modifies the relation between physical activity and depressive symptoms (Mata, Thompson, & Gotlib, **2010**). Walking is inversely associated with depressive symptoms among the obese, but not the nonobese (Wise et al., **2006**). Disability related to mobility is associated with more depression (Torres, Sampselle, Ronis, Neighbors, & Gretebeck, **2013**). Higher household income is associated with higher physical activity (National Center for Health Statistics [NCHS], **2011**) and lower depressive symptoms (Torres et al., **2013**).

Hypothesis

The purpose of this study was to examine the frequency of walking in relation to depressive symptoms in a nationally representative sample of African-Americans who did not meet the diagnostic criteria for depression while controlling for biological and social factors. Our a priori hypothesis was that increased walking frequency would be associated with lower odds of depressive symptoms.

Methods

Design and sample

A secondary analysis was performed on the National Survey of American Life (NSAL), where cross-sectional interviews were conducted between early 2001 and spring of 2003 (Jackson et al., **2004**). Data obtained from all the interviews are used in the current study. A four-stage national area probability sampling was used (Heeringa et al., **2004**). Stage 1 comprised a stratified probability sample of U.S. households where <10% versus ≥ 10% of household residents were reported to be African-American based on the 1990 census; stage 2 consisted of forming area segments by linking geographically continuous census blocks; stage 3 identified the systematic random samples of housing units contacted in-person by an interviewer; and stage 4 employed a random selection of respondents for study interviews from a complete list of eligible adult members living at the sample housing unit address (Heeringa et al., **2004**). Racial matching of interviewers and respondents was used, with face-to-face interviews lasting an average of 2 hr 20 min (Jackson et al., **2004**). Oral consent was obtained prior to initiating the interview. The Institutional Review Board at the University of Michigan approved the NSAL (Jackson et al., **2004**) and the study reported here.

Measures

Depressive symptoms were measured with the Center for Epidemiologic Studies Depression (CESD) Scale (Radloff, **1977**). The original 20-item CESD was condensed to 12 items in the NSAL. Eleven items in African-American women ($\alpha = 0.80$) and 10 items in African-American men ($\alpha = 0.73$) demonstrated reliability and validity in a previous study on the NSAL (Torres, **2012**) and are the versions used in the current study. A cutoff score of nine for the 11-item CESD in African-American women and eight for the 10-item CESD in African-American men was established in a previous study, with higher scores indicating more symptoms (Torres, **2012**).

Walking was measured with responses to one question from the Americans' Changing Lives questionnaire (Lantz et al., **1998**): “How often did the respondent walk?” Any one of four responses was chosen: *never* (4), *rarely* (3), *sometimes* (2), or *often* (0). Scores were re-coded *never* (0), *rarely* (1), *sometimes* (3), or *often* (4) with higher scores indicating more walking.

Biological factors include age, family history of depression, body mass index (BMI), and level of disability related to mobility. Age was measured categorically: 18–29, 30–39, 40–49, 50–59, and 60+ years. Respondents were

asked whether they had a family history of depression (yes/no). Self-reported weight and height information was obtained to calculate BMI (weight (kg)/height squared (m^2)), which was measured categorically: <18.5 (underweight), 18.5–24.9 (normal weight), 25–29.9 (overweight), and 30+ (obese). Level of disability was measured continuously with three items from the WHO's Disability Assessment Schedule II mobility domain, with higher scores indicating a higher level of disability (Rehm et al., **2006**). If respondents noted that health-related problems caused difficulties in mobility in the 30 days preceding the interview, they were subsequently asked about the level of difficulty in (a) standing for long periods, such as 30 min; (b) moving around inside their home; and (c) walking a long distance, such as a kilometer (i.e., half a mile) (Rehm et al., **2006**). Responses constituted *none* (1), *mild* (2), *moderate* (3), *severe* (4), and *can't do* (5) and were first scored as 0, 0.25, 0.50, 0.75, and 1.0, respectively. They were subsequently transformed to a 0–100 scale (0 = *no impairment*; 100 = *complete impairment*) (Rehm et al., **2006**). Respondents who were not asked these questions due to their excellent health status were given a score of 0 (Rehm et al., **2006**). The Cronbach's alphas were 0.68 for African-American women and 0.76 for African-American men in the current sample. A social factor included was household income, which was measured continuously.

Analytic strategy

As the NSAL used a multistage sample design involving clustering and stratification, specialized statistical techniques were used to account for the complexity of the design and its associated standard errors (Heeringa & Berglund, **2013**). Weights constructed specifically for the study design and methodology were used in the analysis (Heeringa & Berglund, **2013**). The NSAL weights take into account unequal probabilities of selection, characteristics of nonrespondents, and poststratification (Heeringa & Berglund, **2013**). Weighting for unequal probabilities of selection reduces selection bias (Heeringa & Berglund, **2013**). Nonresponse was accounted for using geographic factors (Heeringa & Berglund, **2013**). Demographic factors such as age, gender, and census region were used to calculate the poststratification weights, ensuring that the distribution of the sample resembled the distribution of the United States on these demographic characteristics (Heeringa & Berglund, **2013**). All of these adjustments resulted in the weighted NSAL sample being representative of the race and ethnic groups in the study (Heeringa & Berglund, **2013**).

Complex survey design measures were used to estimate the variance correctly (Heeringa & Berglund, **2013**). Chi-square and *t* tests for complex samples determined whether the sex difference for each descriptive characteristic was statistically significant. Logistic regression for complex samples was used to compute odds ratios (OR) and 95% confidence intervals (CI) for the association of walking with depressive symptoms while controlling for biological and social factors. Statistical significance was set at $p < .05$ on a two-sided design-based test. Analyses were performed in STATA 10.0 (StataCorp, College Station, TX USA).

Results

The response rate was 70.7% (Jackson et al., **2004**). Of the 3,570 African-Americans in the NSAL, individuals who met the DSM-IV-TR criteria for major depressive disorder ($n = 75$), dysthymia ($n = 23$), or bipolar disorder ($n = 13$) were excluded to focus on health promotion and the prevention of depression. Four hundred eighty-one cases reflected missing data on depressive symptoms or walking, resulting in a sample size of 2,978: 1,903 African-American women and 1,075 African-American men. Ages ranged from 18 to 91 with no differences in age categories between women and men (Table **1**). Compared with African-American men, African-American women were more likely to report a family history of depression, a higher level of disability, and less household income. There were also statistically significant sex differences in BMI and walking. African-American women were more likely to report being underweight ($\chi^2[34] = 8.3$, $p = .0068$) and obese ($\chi^2[34] = 40.4$, $p < .0001$), while African-American men were more likely to report being overweight ($\chi^2[34] = 38.7$, $p < .0001$). African-American

women were more likely to report sometimes walking ($\chi^2[34] = 28.0$, $p < .0001$), while African-American men were more likely to report often walking ($\chi^2[34] = 19.6$, $p = .0001$).

Table 1. Sample Characteristics of African-Americans: The National Survey of American Life, 2001–2003

Variables	**Women (*n* = 1,903)**	**Men (*n* = 1,075)**	***t* (df = 34)**	***p***
	Mean (confidence interval)			
Disability	4.8 (4.1–5.5)	3.6 (2.8–4.3)	6.6	.02
Household income[a]	32,227 (30,024–34,530)	42,530 (38,702–46,357)	40	<.0001
	% (no.)		χ^2 (df = 34)	
Age				
18–29	13.7 (444)	11.5 (250)	0.7	.56
30–39	13.2 (495)	10.3 (242)		
40–49	11.9 (402)	10.4 (241)		
50–59	7.1 (237)	6.3 (163)		
60+	9.1 (325)	6.5 (179)		
Body mass index				
<18.5	1.4 (38)	0.4 (13)	18.0	<.0001
18.5–24.9	14.6 (507)	12.7 (298)		
25.0–29.9	16.9 (565)	18.5 (458)		
30+	22.1 (793)	13.4 (306)		
Family history of depression	559 (16.7)	252 (10.6)	6.6	.0151
Walking				
Never	6.0 (208)	4.3 (111)	8.2	.0002
Rarely	8.5 (297)	6.4 (149)		
Sometimes	15.7 (546)	9.0 (227)		
Often	24.8 (852)	25.3 (588)		

- [a] Top coded at $200,000.

The multivariate OR for depressive symptoms was significantly lower in African-American women who reported often walking compared with African-American women who reported never walking (Table **2**). No significant difference was demonstrated in the OR for depressive symptoms between African-American women who reported rarely or sometimes walking compared with African-American women who reported never walking.

Table 2. Odds Ratios for Depressive Symptoms in Relation to Walking in African-Americans: The National Survey of American Life, 2001–2003

	Women (*n* = 1,903)			**Men (*n* = 1,075)**		
	CESD11 ≥9% (no.)	**OR**	**95% CI**	**CESD10 ≥8% (no.)**	**OR**	**95% CI**
Walking						
Never	13.4 (64)	1.00		10.9 (24)	1.00	
Rarely	16.2 (72)	0.79	0.50–1.25	13.8 (28)	0.87	0.46–1.64
Sometimes	30.0 (144)	0.81	0.54–1.22	21.9 (52)	1.01	0.52–1.97
Often	40.4 (188)	0.56*	0.38–0.82	53.4 (108)	0.81	0.43–1.53
Age						
18–29		1.00			1.00	
30–39		0.98	0.67–1.43		1.08	0.58–2.01
40–49		1.21	0.77–1.90		0.79	0.46–1.36
50–59		0.57*	0.35–0.93		0.90	0.49–1.63
60+		0.40*	0.24–0.66		0.84	0.50–1.41
Family history of depression		2.10*	1.46–3.05		1.59*	1.10–2.28
Body mass index						
<18.5		3.58*	1.43–8.96		0.26	0.03–2.45
18.5–24.9		1.00			1.00	
25–29.9		1.22	0.81–1.82		1.01	0.67–1.53
30+		1.43	0.98–2.07		0.99	0.63–1.56
Disability		1.02*	1.01–1.03		1.02*	1.01–1.03
Household income		*a* *	*b*		*c* *	*d*
		p < .0001			*p* = .0028	

Note. CESD11 = Center for Epidemiologic Studies Depression Scale, 11 items in National Survey of American Life; CESD10 = Center for Epidemiologic Studies Depression Scale, 10 items in National Survey of American Life; OR = odds ratio; CI = 95% Confidence Interval; *$p < .05$; [a]=.999972 OR, [b]=.9999637–.9999802 CI, [c]=.9999855 OR, [d]=.999975–.999996 CI. OR greater than 1 indicates greater odds of more depressive symptoms, while OR less than 1 indicates lesser odds of less depressive symptoms.

The multivariate OR for depressive symptoms was significantly lower in African-American women who were ages 50–59 and 60+ years compared with African-American women who were age 18–29 years. No significant difference was demonstrated in the OR for depressive symptoms between African-American women who were ages 30–39 or 40–49 years compared with African-American women who were age 18–29 years.

The multivariate OR for depressive symptoms was significantly higher in African-American women who reported being underweight compared with African-American women who reported a healthy weight. No significant difference was demonstrated in the OR for depressive symptoms between African-American women who reported being overweight or obese compared with African-American women who reported a healthy weight.

In addition, African-American women had a lower OR for depressive symptoms when they reported higher income, and a higher OR for depressive symptoms when they reported a family history of depression and higher level of disability.

No statistically significant difference was demonstrated in the OR for depressive symptoms in African-American men who reported rarely, sometimes, or often walking compared with African-American men who reported never walking. African-American men had a lower OR for depressive symptoms when they reported higher income and a higher OR for depressive symptoms when they reported a family history of depression and higher level of disability. Neither age nor BMI was associated with depressive symptoms in African-American men.

Discussion

Study findings reveal that African-American women who reported often walking, compared with never walking, had decreased odds of depressive symptoms. The current results are consistent with cross-sectional studies in African-American women showing that decreased frequency of physical activity was associated with increased odds of depressive symptoms (Farmer et al., **1988**), and increased frequency of physical activity was associated with reduced odds of depressive symptoms (Torres et al., **2013**). The current results contradict a prospective study that found no association between walking and depressive symptoms in African-American women (Wise et al., **2006**). Although Wise et al. (**2006**) had a nonrepresentative sample and measured the average number of hours per week spent walking for exercise, the current cross-sectional study comprised a representative sample and did not specify hours per week or the domain of walking, which may explain the contradicting results.

There was no difference in the OR for depressive symptoms in African-American men who reported walking rarely, sometimes, or often compared with those who reported never walking. The current results contradict the cross-sectional literature found on African-American men that shows that decreased frequency of physical activity was associated with increased odds of depressive symptoms (Farmer et al., **1988**), and increased frequency of physical activity was associated with decreased odds of depressive symptoms (Torres et al., **2013**). Previous research did not focus on a specific type of physical activity, while the current study focused on walking. Perhaps, walking was not at a high enough intensity to improve fitness in African-American men. Physical activity may need to improve fitness to prevent an increase in depressive symptoms (Dishman et al., **2012**) in men, although no studies focus exclusively on African-Americans. In contrast, walking may sufficiently prevent an increase in depressive symptoms in African-American women as a large percentage of African-American women are obese, and higher BMIs are associated with lower exercise capacity (Lavie, Kuruvanka, Milani, Prasad, & Ventura, **2004**).

African-American women were more likely to report a family history of depression, being underweight, an increased level of disability, and decreased household incomes—all of which were all associated with more depressive symptoms in African-American women. Only a family history of depression, increased level of disability, and decreased household income were associated with more depressive symptoms in African-American men. These results reinforce the importance of stratifying results by sex. In addition, this difference

demonstrates that a social ecology of health promotion model was beneficial in selecting potential confounders a priori.

A unique finding in the current study was that the reported underweight variable was associated with increased odds of depressive symptoms in African-American women. Previous studies did not measure BMI (Farmer et al., **1988**), measured BMI continuously (Torres et al., **2013**), or did not include a separate category for self-reported underweight participants (Wise et al., **2006**). Further studies examining the mental health of underweight African-American women are needed.

There are several limitations worth noting. Generalization of these results is limited to community-dwelling adults living in the United States who identified themselves as African-American and did not meet the diagnostic criteria for depression. Due to the cross-sectional design, it is not possible to determine causality. However, by excluding clinically depressed individuals, the possibility that depressive symptoms influenced walking (Roshanaei-Moghaddam, Katon, & Russo, **2009**) was minimized. In addition, the association between walking and depressive symptoms in African-Americans may have been confounded by unmeasured biological factors (Stokols, **1992**) such as brain-derived neurotrophic factor (Mata et al., **2010**), social factors (Stokols, **1992**) such as social support (Torres et al., **2010**), and environmental factors such as neighborhood safety (Torres et al., **2010**; Wilbur et al., **2009**) and national region (Torres et al., **2010**). Attempts were made to account for genetic influences by measuring family history of depression, which was, as expected, associated with depressive symptoms. The exclusion of social support was based on the fact that the NSAL does not measure social support specific to physical activity. Previous analyses in the same sample did not find any associations among neighborhood safety or national region with depressive symptoms (Torres et al., **2013**). All measures were based on self-reported data. Finally, frequency of walking in the NSAL was measured via one question without established psychometrics or reference to a time frame, intensity, duration, or domain, such as walking for occupation, transportation, or leisure.

Despite these limitations, the current study has much strength. The NSAL sample comprises a nationally representative sample of African-Americans (Jackson et al., **2004**). Matching race/ethnicity among interviewers and respondents was conducted in the context of face-to-face interviews. A specific type of physical activity was examined, that is, walking. Evidence supported the validity and reliability of the CESD in the NSAL (Torres, **2012**). And finally, the study was guided by a theoretical model that was useful in identifying predictors of depressive symptoms and confounders in the relation between walking and depressive symptoms (Stokols, **1992**; Torres et al., **2010**).

Prevention of depression is a major public health concern. Public health nurses play a central role in preventing depression by developing and disseminating health promotion and disease prevention programs. Findings suggest that walking frequency is a modifiable risk factor for elevated depressive symptoms in African-American women who do not meet the diagnostic criteria for depression. Public health nurses can identify African-American women who do not meet the diagnostic criteria for depression, but have or are at risk for elevated depressive symptoms—specifically, those who report a family history of depression, an increased level of disability, and being underweight. Programs that focus on increasing walking frequency may benefit African-American women who are not depressed, but have or are at risk for elevated depressive symptoms.

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