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Physical functioning among mid-life women: Associations with trajectory of depressive symptoms

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ABSTRACT

During midlife, physical functioning limitations emerge and depressive symptoms are highly prevalent. We examined the relationship between physical functioning and depressive symptoms in the Michigan Study of Women's Health Across the Nation (SWAN) cohort of mid-life women (n = 377). Seven performance-based physical functioning measures quantifying strength, balance, coordination, flexibility and range of motion and perceived physical functioning, assessed with the SF-36 physical functioning sub-score, were included. The Center for Epidemiological Studies Depression Scale (CES-D) identified concurrent depressive symptom trajectory from 2000/2001 through 2005/2006 and history of depressive symptoms from 1996/1997 through 1999/1900. Longitudinal mixed-effects regression modeling was used to evaluate relationships. Median age of participants was 50 years. As age increased, higher CES-D scores were associated with performance-based functions including slower timed walk sit-to-stand, and stair climb after adjusting for five-year history of depressive symptoms and relevant covariates. As age increased, those with higher CES-D scores were more likely to have perceived limitations in physical functioning, though the association was weak. History of depressive symptoms was not significant in any model. These findings suggest that higher concurrent depressive symptoms are modestly associated with slower movement and a perception of poorer functioning. In contrast, history of depressive symptoms played little or no role in current physical functioning of mid-life women. When evaluating physical function, women's current mental health status should be considered.

Limitations in physical functioning have been defined as restrictions in performing fundamental physical actions used in daily life by one's own age-sex group (Verbrugge & Jette, 1994). Typical performance-based physical functioning measures include timed walk, stair climb and measures that reflect strength, aerobic capacity, flexibility, balance and/or coordination. Alternatively, respondents are asked to rate their perceived difficulty or limitations in specific activities such as climbing stairs or walking several blocks. The midlife, between 40 and 60 years, has been identified as a time when women become increasingly vulnerable to diminishing physical functioning (Pope, Sowers, Welch, & Albrecht, 2001; Sowers, Pope, Welch, Sternfeld, & Albrecht, 2001).

Elevated depressive symptoms and depressive disorder are highly prevalent among women at mid-life, occurring about twice as frequently in women compared to men (Kessler, McGonagle, Swartz, Blazer, & Nelson, 1993). The reported frequency of high depressive symptoms was 26% in mid-life women in the Seattle Mid-life Women's Health cohort (Woods & Mitchell, 1997) and 23% in the Study of Women's Health Across the Nation (SWAN) cohort of mid-life women (Bromberger et al., 2007). Women aged 45–54 may have a higher prevalence of depressive symptoms than younger or older women (Burt & Stein, 2002; Freeman, Sammel, Lin, & Nelson, 2006).

Limitations in physical functioning in the elderly have been associated with depressive symptoms (Lenze et al., 2005; Penninx, Deeg, van Eijk, Beekman, & Guralnik, 2000). Among the 5888 Cardiovascular Health Study participants aged 65 and older (Lenze et al., 2005), physical functioning declined over a three-year period except among participants with consistently fewer depressive symptoms – they did not experience a decline.

Links between depressive symptoms and decline in physical functioning are likely complex and probably at least in part, bidirectional. Potential effects of depressive symptoms on physical functioning outcomes may exist via immune system pathways (Cesari et al., 2004; Taaffe, Harris, Ferrucci, Rowe, & Seeman, 2000), which could directly impact muscle and strength (Goodman, 1991,

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1994; Schaap, Pluijm, Deeg, & Visser, 2006). Additionally, long-term activation of the hypothalamic–pituitary–adrenal (HPA) axis, associated with chronic depression, could lead to compromised physical function (Penninx et al., 2009) through its impact on abdominal obesity and related sequelae (Björntorp & Rosmond, 2000). Finally, in addition to the characteristic motor slowing effects of depressive symptoms (Marin, Firinciogullari, & Biedrzycki, 1993; Pier, Hulstijn, & Sabbe, 2004; Sachdev & Aniss, 1994), other potential mechanisms could include increased pain associated with inflammation and higher sensitivity to it in depressive states (Bair, Robinson, Katon, & Kroenke, 2003).

Few studies have examined the association between depressive symptoms and physical functioning in persons younger than age 65. Using longitudinal data from the Michigan SWAN cohort of mid-life women, aged 46–56, we hypothesized that greater evidence of depressive symptoms would be associated with poorer performance-based and perceived physical functioning outcome measures. While self-report physical functioning measures capture an individual's perception of their ability, performance-based measures may identify early deficits in functioning (sometimes referred to as "pre-clinical disability") which may be particularly pertinent in midlife when substantial deficits in functioning are not common.

Methods

Sample

Participants are from the Michigan site of the Study of Women's Health Across the Nation (SWAN). SWAN is a multisite, multiethnic longitudinal study of women at midlife established to characterize the health of women as they approach and traverse menopause. The study design and recruitment for SWAN have been described (Sowers et al., 2000). Briefly, a screening survey of women assessed eligibility for SWAN between November 1995 and October 1997. Eligibility criteria included being aged 42–52, having an intact uterus, having had at least one menstrual period and no use of reproductive hormones in the previous 3 months, and self-identifying with a site's designated race/ethnic groups. All women were either premenopausal or early perimenopausal. Each site recruited white women and a sample of a predetermined minority group. In 1995, African American and white women in two suburban communities near Detroit, Michigan were recruited via a household census of two nearby suburban communities. The Michigan site of the SWAN longitudinal cohort study enrolled 543 premenopausal women in 1996 and the participation rate at baseline among women eligible for the cohort study was 59%. Forty percent were Caucasian and 60% were African American, with sampling probabilities to reflect the underlying population.

At the fourth follow-up visit in 2000/2001, this site added a broad range of physical functioning measurements to the standard SWAN battery of measurements. At this visit, six women had died and a total of 384 women were still participating in the study. This report includes physical functioning data from 2000/2001 through 2005/2006. A total of 377 of these 384 participants contributed physical functioning data at one or more time points and comprise the analytical sample for this report. Approval for conducting the study was obtained from the University of Michigan Institutional Review Board, and written informed consent was obtained from participants.

Measurements

The timing of data collection for each variable is described in Table 1. Annual data on performance-based physical functioning and covariates were available beginning in 2000/2001, and perceived physical functioning data were available biannually starting in 2000/2001. Depressive symptoms trajectory, our primary exposure, included annual measurements from 2000/2001 through 2005/2006. History of depressive symptoms based on annual data collected in SWAN core from 1996/1997 to 1999/2000 was included as a covariate in all models.

Performance-based physical functioning measures

Physical functioning, our outcome of interest, was assessed with seven performance-based measures. Research staff were trained according to a standard protocol and retrained annually to ensure that measured results were consistent across staff and over time.

Strength

Quadriceps strength was measured with a portable isometric chair which replicates the chair designed for the Dynamics of Health, Aging and Body Composition Study (Goodpaster et al., 2001). Quadriceps strength was quantified as torque (Nm), the product of force and torque arm length. Results from three successful trials were averaged. To measure grip strength (kg), a participant was seated in a chair with her forearm at a 90-degree elbow bend and hands placed with fingers and thumb parallel to her body. Three efforts from the dominant hand were averaged for each participant. Higher values suggest greater grip strength. Grip strength has been shown to have good discrimination across the range of physical function, including in younger, high-functioning persons (Curb et al., 2006).

Timed walk and timed stair climb

Each participant was timed (in seconds) in two purposeful walks down a 40-foot carpeted corridor, and the average time was used for the timed walk variable. For the stair climb, participants were

Table 1
Timing of data collection for dependent and independent variables.

	96/97	97/98	98/99	99/00	00/01	01/02	02/03	03/04	04/05	05/06
Physical functioning										
Performance-based physical functions[a]					X	X	X	X	X	X
Leg strength (also a performance-based function)						X	X	X	X	X
SF-36 PF score					X		X		X	
Depressive symptoms, based on CES-D score										
History of depressive symptoms[b]	X	X	X	X						
Trajectory of depressive symptoms					X	X	X	X	X	X
Additional covariates(e.g., demographic variables, pain)					X	X	X	X	X	X

[a] Grip strength, forward reach, 2-lb lift, stair climb, timed walk, sit-to-stand.
[b] Data from the CES-D, which was administered 4 times prior to collection of the physical performance measures, were used to create a variable representing history of depressive symptoms.