Depressive Symptoms and Physical Decline in Community-Dwelling Older Persons

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Context.—Significant symptoms of depression are common in the older community-dwelling population. Although depressive symptoms and disability may commonly occur in the same person, whether depressive symptoms contribute to subsequent functional decline has not been elucidated.

Objective.—To determine whether depressive symptoms in older persons increase the risk of subsequent decline in physical function as measured by objective performance-based tests.

Design.—A 4-year prospective cohort study.

Setting.—The communities of Iowa and Washington counties, Iowa.

Participants.—A total of 1286 persons aged 71 years and older who completed a short battery of physical performance tests in 1988 and again 4 years later.

Main Outcome Measures.—Baseline depressive symptoms were assessed by the Center for Epidemiological Studies Depression Scale. Physical performance tests included an assessment of standing balance, a timed 2.4-m (8-ft) walk, and a timed test of 5 repetitions of rising from a chair and sitting down.

Results.—After adjustment for baseline performance score, health status, and sociodemographic factors, increasing levels of depressive symptoms were predictive of greater decline in physical performance over 4 years (odds ratio for decline in those with depressed mood vs those without, 1.55; 95% confidence interval [CI], 1.02-2.34). Even among those at the high end of the functional spectrum, who reported no disability, the severity of depressive symptoms predicted subsequent decline in physical performance (odds ratio for decline, 1.03; 95% CI, 1.00-1.08).

Conclusions.—This study provides evidence that older persons who report depressive symptoms are at higher risk of subsequent physical decline. These results suggest that prevention or reduction of depressed mood could play a role in reducing functional decline in older persons.

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MAJOR DEPRESSION is relatively rare among older community-dwelling persons, affecting only about 1% to 2% of that population.[1-3] However, a high proportion of community-dwelling elderly persons (12%-20%)[1-3] suffer from significant symptoms of depression below the severity threshold of major depression as defined by the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (*DSM-IV*). These subsyndromal depressive symptoms, often referred to as "depressed mood," are associated with high societal costs due to increased morbidity and high utilization of health services.[1-5] From the perspective of older persons themselves, depressed mood significantly affects their well-being and ability to function.[6,7] Physical disability among depressed persons not only is significantly higher than among nondepressed persons, but also is similar or even greater than the disability found among patients with chronic medical illnesses.[8]

The relationship between depression and physical functioning is a complex one whose specific causal ordering is hard to unravel. Researchers so far have mainly focused on self-reported measures of disability and found that the cross-sectional association between depressed mood and disability seems to hold longitudinally.[1,6,7] Even in longitudinal studies, however, it is difficult to exclude the possibility that disability is a cause rather than a consequence of depressive symptoms. Further, the interpretation is hampered by the possibility that depressed persons may give overly pessimistic appraisals of their functioning and disability.[9] Even when their functional status remains the same, persons who are depressed tend to become more depressed over time and, therefore, may report more physical disabilities.[10,11] Finally, disability measures assess the poorer end of the spectrum of physical functioning but have less ability to distinguish higher levels of physical abilities. Consequently, whether depression affects physical function along its full spectrum remains to be examined.

The growing interest in the heterogeneity of functional ability at older ages has resulted in the need to expand the measurement of physical function beyond the standard self-report measures of disability. Increasingly, functional status has been assessed using objective tests of subjects' performance of standardized tasks and covers the full spectrum of physical functioning. These measures of physical performance provide useful information about older persons not obtained in standard clinical examination[12] and are highly predictive of subsequent disability, falls, institutionalization, and death.[13-16] In addition, performance-based measures appear to be less influenced by personality, cognition, and mood than self-reported measures of disability.[10,11] These characteristics make performance-based measures of physical function very appropriate for a more complete and compelling test of the impact of depressive symptoms on physical decline along the entire spectrum of physical function.

The present study is the first to prospectively examine the impact of depressive symptoms on change in physical performance in an older community-dwelling population. Since it is unknown whether the effect of depressive symptoms is limited to high symptom levels or whether it increases linearly with increasing symptom levels, a continuous measure of depressive symptoms as well as a dichotomous classification of depressed mood are used. In order to rule out confounding by poor physical function, additional analyses are conducted in a relatively healthy subset of older persons initially free of physical disabilities.

METHODS

Study Population

Data for this study were collected as part of the Established Populations for Epidemiologic Studies of the Elderly (EPESE), a prospective cohort study of older persons supported by the US National Institute on Aging. The eligible population consisted of all persons aged 65 years and older who lived in Iowa and Washington counties, Iowa. The sampling and data collection procedures have been described in depth previously.[17] Between December 1981 and August 1982, 3673 persons, 80% of those eligible, were enrolled in the initial interview. Follow-up interviews were conducted annually for 6 years and again at 10 years.

The sixth follow-up assessment conducted in 1988 is considered the baseline for the analyses presented, as this was the first assessment that included physical performance measures. At that time, 2547 (94.0%) of the 2711 survivors were contacted. Of these, we excluded 278 (10.9%) who were institutionalized; 111 (4.4%) who were unable to participate in the interview because of cognitive or physical impairment and for whom a proxy had to be interviewed; 57 (2.2%) who had to be interviewed by telephone because they left the geographic area; and 68 (2.7%) with missing scores for physical performance (n = 59) or depressive symptoms (n = 9).

Of the 2033 remaining subjects with complete baseline data, 411 (20.2%) died during the next 4 years; 74 (3.6%) were lost to follow-up; 256 (12.6%) were unable to participate in the complete interview because of cognitive or physical impairment and were included in telephone (n = 86) or proxy interviews (n = 170); and 6 (0.3%) had missing performance scores. This left 1286 subjects for whom follow-up data on physical performance were available. These served as the primary subjects of this report. As compared with these subjects, those who were interviewed in 1988 but who were not included in this study were significantly older (80.1 vs 77.7 years), more often men (39.9% vs 31.0%), more often activities of daily living (ADL)–disabled (49.2% vs 30.8%), and had higher mean depression scores (11.8 vs 9.2).

Symptoms of Depression

The presence of depressive symptoms was assessed using the 11-item version of the Center for Epidemiologic Studies Depression Scale (CES-D), a measurement of depressive feelings and behaviors experienced during the past week.[18] Scores of this shorter version were transformed to correspond to the standard 20-item scale using the procedure recommended by Kohout et al.[19] Full details on the use, transformation, and validity of the modified scale have been published.[19] Briefly, for men and women separately, scores were standardized against the 1974-1975 National Health and Nutrition Examination Survey I (NHANES I), by means of the equation $x_t = [(x_s - m_s)\ (sd_t/sd_s)] + m_t$, where x_t is the transformed score; x_s is the participant's raw score; m_s and sd_s are the sex-specific mean and SD of the raw scores in the full sample at the first interview; and m_t and sd_t are the sex-specific criterion mean and SD from the NHANES I. Since the NHANES I study used a large national probability sample, it gave generalizable, national criterion means for the CES-D. The criterion mean (SD) was 7.1 (7.2) for men and 10.0 (9.1) for women.

We used both the continuous CES-D score and a dichotomous classification based on the cutoff score of 20 to identify subjects with depressed mood. Although a CES-D score of 16 is the most commonly used cutoff score in general populations, using a cutoff score of 20 among older persons offers a more stringent approach to the classification of depressed mood, yielding a higher accuracy for the diagnosis of major depression.[20-22] Sensitivities of 72% and 92% and specificities of 94% and 87% for major depression defined according to *DSM-IV* criteria have been reported.[21,22]

Physical Performance

Performance-based tests of physical function included measures of standing balance, walking speed, and ability to rise from a chair. Assessments were carried out in the subjects' homes by specially trained interviewers. For testing standing balance, subjects attempted to maintain their feet in the side-by-side, semitandem (heel of one foot beside big toe of other foot) and tandem (heel of one foot in front of other foot) positions for 10 seconds each. The classification range is as follows: unable (0); able to hold side-by-side position but unable to hold semitandem stand position for 10 seconds (1); able to hold semitandem position for 10 seconds but unable to hold full tandem position for more than 2 seconds (2); able to stand in full tandem position for 3 to 9 seconds (3); and able to maintain full tandem position for 10 seconds (4). To test walking speed, a 2.4-m (8-ft) walk at the subject's normal pace was timed twice, and the faster of the 2 walks was scored according to quartiles of the time required in 3 EPESE populations.[14] Categories were unable (0); at least 5.7 seconds (1); 4.1 to 5.6 seconds (2); 3.2 to 4.0 seconds (3); and 3.1 seconds or less (4). For testing the ability to rise from a chair, subjects were asked to fold their arms across their chests and to stand up from a sitting position and sit down 5 times as quickly as possible. Categories, based on quartiles of the time required in the 3 EPESE populations, were as follows: unable (0); at least 16.7 seconds (1); 13.7 to 16.6 seconds (2); 11.2 to 13.6 seconds (3); and 11.1 seconds or less (4).

Correlations between observers of more than 0.93 for walking speed[23] and test-retest correlations of more than 0.89 for walking speed,[23] 0.73 for rising from a chair,[24] and 0.97 for standing balance[25] have been reported. The 3 test scores in our study were moderately correlated, with Spearman rank correlation coefficients ranging from 0.30 to 0.51. As in previous publications,[14,16] a summary measure of physical performance was developed by summing scores of the 3 tests. The overall performance score ranged from 0 to 12, with higher scores indicating better performance. Change in physical performance was computed

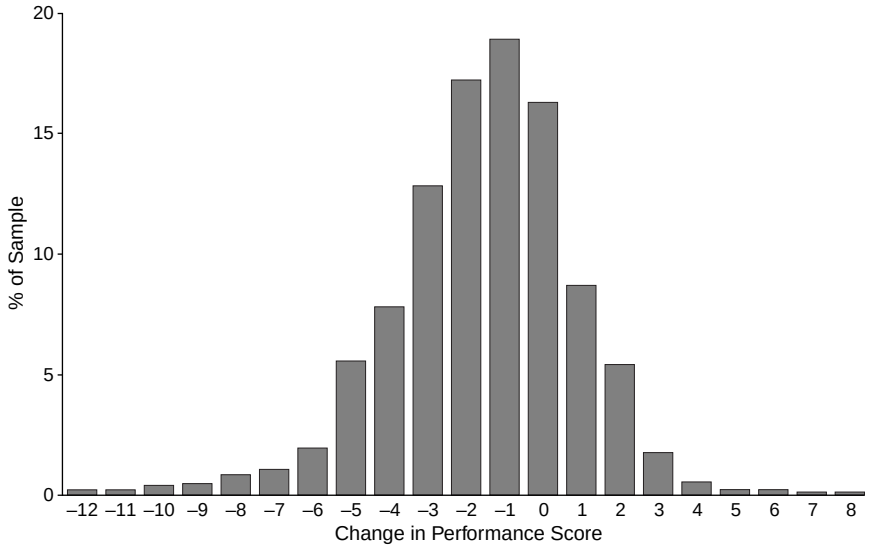

Figure 1.—Distribution of change in physical performance between the 1992 and the 1988 scores.

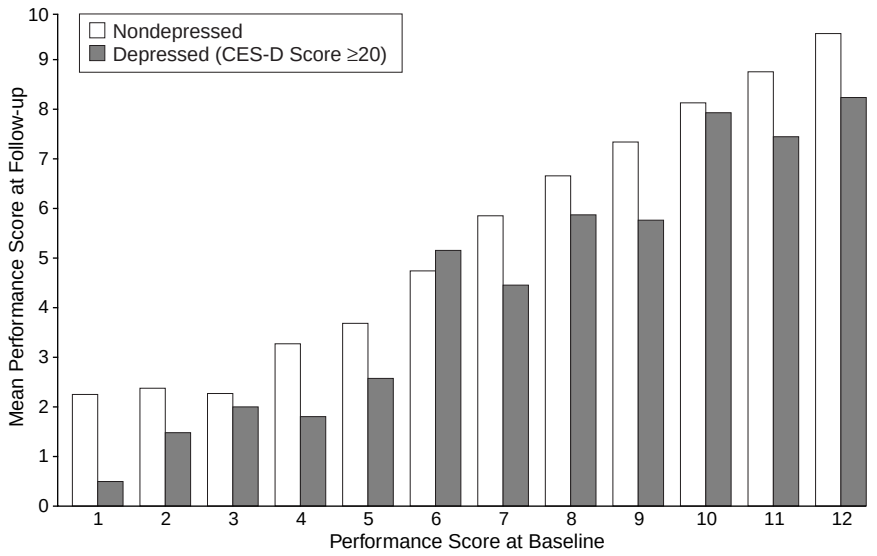

Figure 2.—Mean level of physical performance at follow-up in 1992 according to level of physical performance at baseline in 1988 for depressed (Center for Epidemiologic Studies Depression Scale [CES-D] score ≥20) and nondepressed subjects.

by subtracting the baseline performance score (1988) from the follow-up score (1992). Change scores among the 1286 respondents ranged from –12 to 8, with a mean change of –1.6 (Figure 1). The physical performance of 863 subjects (67.1% of the total sample) had declined, and 31.1% of those (400 of the total sample) were reported as declining by 3 or more points. However, 215 persons (16.7%) improved their performance scores. For the remainder of the sample (n = 208, 16.2%), 1992 performance scores were equal to their 1988 scores.

Covariates

Baseline sociodemographics included age, sex, marital status, and education. Indicators of baseline health status included smoking status (never, ex-, or current smoker), alcohol intake (an average consumption of 1 or less vs more than 1 drink per day), body mass index (computed as weight in kilograms divided by the square of height in meters), and blood pressure. The latter was measured in a sitting position according to the Hypertension Detection and Follow-up Program protocol[26] and was classified in 4 categories: normotension (systolic blood pressure [SBP], <140 mm Hg; diastolic blood pressure [DBP], <90 mm Hg); borderline systolic hypertension (DBP, <90 mm Hg; SBP, 140-160 mm Hg); isolated systolic hypertension (DBP, <90 mm Hg; SBP, ≥160 mm Hg); and diastolic hypertension (DBP, >90 mm Hg). Prevalent coronary heart disease at baseline was determined by any listed hospital discharge diagnosis *International Classification of Diseases, Ninth Revision* (*ICD-9*)[27] codes from 410 to 414 in the 3 years before baseline listed in the Health Care Financing Administration Medicare Provider Analysis and Review files, by self-report of heart attack at any interview, or by a positive Rose questionnaire[28] for angina assessed at any in-person interview. Prevalent diabetes, stroke, cancer, and lung disease (asthma, chronic bronchitis, or emphysema) were considered present when respondents had ever been told by a physician that they had these diseases or when they had listed hospital discharge diagnoses in the past 3 years for these diseases (*ICD-9* codes 250, 430-434, 140-208, or 491-493, respectively). Prevalent arthritis was determined by self-reported presence of arthritis at any in-person interview. Information about drug use was obtained by interviewers' observation of the containers for all prescription and nonprescription drugs taken over the past 2 weeks. Finally, physical disability was assessed by self-reports of difficulty in mobility (unable to walk a half mile or climb stairs without help), according to the Rosow-Breslau scale,[29] and/or self-reports of difficulty in ADL[30] (unable to bathe, dress, eat, use the toilet, walk across a small room, or transfer from bed to chair without help).

Statistical Analyses

Since change scores of physical performance were continuous and approximately normally distributed (Figure 1), multivariate linear regression models were used to examine the effect of depressive symptoms on change in physical performance. These models included baseline physical performance scores in order to model residualized change (ie, change adjusted for baseline level of performance)[31] and were adjusted for age, sex, cigarette smoking, alcohol intake, body mass index, blood pressure, and prevalent chronic diseases. Separate models examined the effects of both the continuous and dichotomous depression variables in order to evaluate "gradient" vs "threshold" effects.

Logistic regression models were performed to identify the association of depressive symptoms with more substantial, and potentially more significant,

change in physical performance. Those whose performance scores decreased by 3 or more points during follow-up (ie, a decline of at least 2 points more than the median change of –1) were considered as having declined substantially. Those whose performance scores increased by 1 or more points (ie, improved 2 points more than the median change) were considered as having improved. Persons with no substantial change were those with change scores within 2 points of the median change (change scores between –3 and 1). Two sets of odds ratio (OR) estimates indicate the relative odds of being among those who had declined vs those in the no-change group, and the relative odds of being among those who had improved vs the no-change group. All analyses were carried out using the SPSS-Windows statistical package.[32]

Previous EPESE analyses illustrated that lower levels of physical performance predict nursing home admission, mortality and subsequent disability.[14,16] To validate that our definition of substantial decline is associated with clinically meaningful differences in health status, we used the 1988 EPESE data on more than 5000 persons aged 71 years and older to examine the risks of a 3-point difference in physical performance score. After 4 years of follow-up, a 3-point difference was associated with a 1.5-fold increased risk of hospitalization (95% CI, 1.4-1.6), a 2.2-fold increased risk of nursing home admission (95% CI, 2.0-2.5), a 1.7-fold increased risk of mortality (95% CI, 1.6-1.8), and, among those not disabled at baseline, a 3.9-fold increased risk of subsequent disability (95% CI, 3.3-4.5).

RESULTS

The mean baseline age of the study sample was 77.7 years (SD, 4.9), 69% were female, 45% had less than 12 years of education, and only 1 person was black. Baseline CES-D scores ranged from 0 to 53 with a mean of 9.2 (SD, 7.8). In total, 137 persons (10.7%) had CES-D scores above the cutoff of 20 and were considered as having a depressed mood. Depressed persons had lower baseline performance scores than nondepressed persons (6.9 vs 8.3, $P<.001$). Figure 2 shows that, with only 1 exception, for each level of baseline performance, the mean performance score at follow-up after 4 years was lower in depressed persons compared with nondepressed persons.

The decline in performance, adjusted for baseline performance, was significantly greater for the oldest old, the less educated, unmarried subjects, and those with coronary heart disease and lung disease (Table 1). Depressed persons had a greater decline in performance than nondepressed persons (2.36 vs 1.48, $P<.001$). Table 2 shows the results of linear regression models used to examine the relationship between symptoms of depression and change in physical performance with adjustment for baseline performance, age, sex, education, marital status, smoking, alcohol use, body mass index, blood pressure, and presence of chronic diseases. More depressive symptoms at baseline were significantly associated with greater decline in performance during follow-up (for each point of increase on the CES-D, decline was 0.036 greater, $P<.001$). In line with this, depressed mood as assessed by the dichotomous indicator was also predictive of greater decline in performance ($\beta = -0.774$; $P<.001$). In both models, analysis of the residuals did not reveal departures from regression assumptions. The effect of depressive symptoms was consistent for all

Table 1.—Baseline Characteristics of Study Population and Their Association With Change in Physical Performance Score (1992-1988)

Baseline Characteristics	No. (%) of Study Population	Mean Change in Performance*	*P* Value
Age, y			
71-74	416 (32.3)	−1.04	<.001
75-79	456 (35.5)	−1.49	
≥80	414 (32.3)	−2.21	
Sex			
Men	399 (31.0)	−1.41	.09
Women	887 (69.0)	−1.65	
Education, y			
<12	574 (44.6)	−1.75	.02
≥12	712 (55.4)	−1.44	
Marital status			
Married	783 (60.9)	−1.36	<.001
Unmarried	503 (39.1)	−1.91	
Cigarette smoking			
Nonsmoker	953 (74.1)	−1.52	.06
Ex-smoker	269 (20.9)	−1.62	
Current smoker	64 (5.0)	−2.24	
Alcohol use, drinks/d			
<1	1245 (96.8)	−1.59	.47
≥1	41 (3.2)	−1.32	
Body mass index, kg/m^2			
<20	118 (9.2)	−1.90	.33
20 to <25	492 (38.3)	−1.66	
25 to <30	441 (34.3)	−1.45	
≥30	141 (11.0)	−1.47	
Missing	94 (7.3)	−1.53	
Blood pressure			
Normotensive	619 (48.1)	−1.42	.15
Borderline systolic hypertension	454 (35.3)	−1.69	
Isolated systolic hypertension	123 (9.6)	−1.77	
Diastolic hypertension	90 (7.0)	−1.79	
Coronary heart disease			
No	1030 (80.1)	−1.46	<.001
Yes	256 (19.9)	−2.04	
Stroke			
No	1199 (93.2)	−1.56	.31
Yes	87 (6.8)	−1.82	
Diabetes			
No	1136 (88.3)	−1.55	.17
Yes	150 (11.7)	−1.82	
Cancer			
No	1049 (81.6)	−1.57	.77
Yes	237 (18.4)	−1.62	
Lung disease			
No	1031 (80.2)	−1.51	.03
Yes	255 (19.8)	−1.87	
Arthritis			
No	222 (17.3)	−1.45	.39
Yes	1064 (82.7)	−1.60	
Depressed mood (CES-D ≥20)†			
No	1149 (89.3)	−1.48	<.001
Yes	137 (10.7)	−2.36	

*Adjusted for baseline performance score.
†CES-D indicates Center for Epidemiologic Studies Depression Scale.

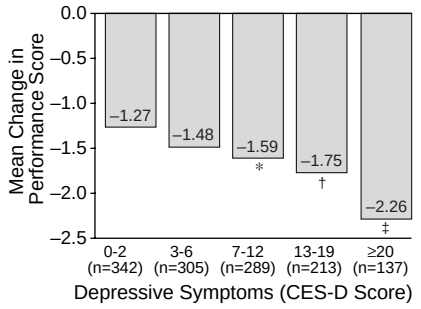

Figure 3.—Adjusted mean change in physical performance score (1992-1988) according to level of depressive symptoms. Mean change in performance score is adjusted for baseline performance score, age, sex, education, marital status, cigarette smoking, alcohol use, blood pressure, body mass index, and presence of coronary heart disease, stroke, diabetes, cancer, lung disease, and arthritis. Asterisk indicates $P<.10$; dagger, $P<.05$; double dagger, $P<.001$. P for trend = .001. P values indicate statistically significant differences in mean change in performance score when compared with the lowest level of depressive symptoms (Center for Epidemiologic Studies Depression Scale [CES-D] score of 0-2).

Table 2.—Linear Regression Model Showing Association of Depressive Symptoms With Change in Physical Performance Score (1992-1988)*

	Regression Coefficient (SE)	P
Total cohort (N = 1286)		
Depressive symptoms (continuous CES-D score)	−0.036 (0.008)	<.001
Depressed mood (CES-D ≥20): yes vs no	−0.774 (0.207)	<.001
Persons with no disability in 1988 (N = 976)†		
Depressive symptoms (continuous CES-D score)	−0.031 (0.010)	.002
Depressed mood (CES-D ≥20): yes vs no	−0.646 (0.253)	<.001
Persons with no disability in 1988 and 1992 (N = 728)†		
Depressive symptoms (continuous CES-D score)	−0.022 (0.010)	.03
Depressed mood (CES-D ≥20): yes vs no	−0.432 (0.280)	.13

*Adjusted for baseline performance score, age, sex, education, marital status, cigarette smoking, alcohol use, body mass index, blood pressure, and presence of coronary heart disease, stroke, diabetes, cancer, lung disease, and arthritis. CES-D indicates Center for Epidemiologic Studies Depression Scale.
†Considers activities of daily living disability as well as mobility disability.

Table 3.—Logistic Models Showing Association of Depressive Symptoms With Substantial Decline or Improvement in Performance Score (1992-1988)*

	Decline vs No Change		Improve vs No Change	
	OR (95% CI)	P	OR (95% CI)	P
Total cohort†				
Depressive symptoms (CES-D score)	1.02 (1.01-1.04)	.003	0.97 (0.95-0.99)	.02
Depressive mood (yes vs no)	1.55 (1.02-2.34)	.04	0.50 (0.28-0.92)	.03
Persons with no disability in 1988‡§				
Depressive symptoms (CES-D score)	1.03 (1.00-1.05)	.02	0.98 (0.95-1.00)	.14
Depressed mood (yes vs no)	1.63 (0.97-2.75)	.06	0.73 (0.35-1.52)	.40
Persons with no disability in 1988 and 1992‡‖				
Depressive symptoms (CES-D score)	1.03 (1.00-1.06)	.03	0.99 (0.96-1.02)	.38
Depressed mood (yes vs no)	1.83 (0.90-3.75)	.09	0.81 (0.32-1.99)	.64

*Adjusted for other significant predictors: baseline performance, age, sex, marital status (for improvement), prevalent coronary heart disease, and lung disease (for decline). CES-D indicates Center for Epidemiologic Studies Depression Scale. "Substantial decline" is defined as a change score of −3 or lower; "improvement," a change score of 1 or higher; and "no change," a change score between −3 and 1.
†Of the total cohort, 400 declined, 671 were unchanged, and 215 improved.
‡Considers activities of daily living disability as well as mobility disability.
§Of the persons with no disability in 1988, 294 declined, 512 were unchanged, and 170 improved.
‖Of the persons with no disability in 1988 and 1992, 169 declined, 415 were unchanged, and 144 improved.

3 components of the summary performance score: the CES-D score predicted change in standing balance ($\beta = -0.020$, $P<.001$), change in walking speed ($\beta = -0.014$, $P<.001$), and change in ability to rise from a chair ($\beta = -0.0051$, $P = .02$). Use of antidepressant drugs (mostly amitriptyline) was significantly higher ($P = .003$) among persons with depressed mood (10.2%) than among nondepressed persons (4.4%). However, antidepressant use was not associated with change in physical performance, and additional adjustment for this variable did not change the results of the regression models.

For a graphical presentation of the gradient effect of depressive symptoms, the CES-D score was divided into 5 levels whereby the highest level corresponded with the depressed mood category (≥20) and the remainder of the scores were divided into 4 roughly equal subgroups: 0 to 2, 3 to 6, 7 to 12, and 13 to 19. Adjusted mean changes in performance by level of depressive symptoms are illustrated in Figure 3. This graph illustrates that increasing levels of depressive symptoms are associated with greater physical decline (P for trend = .001). When compared with the reference group of persons with the lowest level of depressive symptoms (mean, −1.27), a greater performance decline was not only observed for persons with CES-D scores of 20 or more (mean, −2.26, $P<.001$), but also for those with scores of 13 to 19 (mean, −1.75, $P<.05$) and scores of 7 to 12 (mean, −1.59, $P<.10$). An additional regression model that used both the continuous CES-D score and the CES-D squared term showed no significant improvement in the prediction of change in performance, demonstrating that the relationship between depressive symptoms and decline in performance is not curvilinear.

To obtain a picture of the effect of depressive symptoms free of the possible confounding effect of poor physical functioning, analyses were repeated among the 976 persons who had no ADL or mobility disability at baseline in 1988 (Table 2). Again, the continuous CES-D score and the indicator of depressed mood were significant predictors of declined physical performance ($\beta = -0.031$, $P = .002$ and $\beta = -0.646$, $P<.001$, respectively). Even after a further restriction to those without disability at baseline and at follow-up in 1992, a similar, although slightly weaker, picture emerged. A higher CES-D score was significantly associated with change in performance ($\beta = -0.022$, $P = .03$), and depressed mood was marginally associated ($\beta = -0.432$, $P = .13$). The absence of interaction between depressive symptoms and disability was confirmed by the nonsignificant interaction ($P = .72$). To rule out other possible interactions, additional analyses were stratified by sex, education, marital status, smoking behavior, and presence of chronic disease, but the effect of depressive symptoms was found to be consistent across subgroups (data not shown).

The effect of depressive symptoms on more substantial change in physical performance was studied in 2 sets of multivariate logistic regression analyses. In addition to depressive symptoms, covariates predictive of substantial change in performance were included in the final models. For substantial decline (ie, decline of at least 3 points), the covariates were as follows: baseline performance (OR, 1.21; 95% confidence interval [CI], 1.14-1.28); age (OR, 1.07; 95% CI, 1.04-1.10); prevalent coronary heart disease (OR, 1.73; 95% CI, 1.09-2.07); and prevalent lung disease (OR, 1.50; 95% CI, 1.09-2.07). Table 3 shows that after adjustment for these covariates a higher CES-D score significantly increased the risk of being among those who had substantially declined vs those in the no-change group (OR, 1.03; 95% CI, 1.01-1.04). Likewise, the dichotomous indicator demonstrates that depressed persons were 1.55 times more likely than nondepressed persons to de-

cline substantially in performance after 4 years. Results were similar after excluding persons with physical disabilities at baseline and follow-up.

Only a few covariates were associated with improvement in performance. They are baseline performance score (OR, 0.82; 95% CI, 0.92-0.99); age (OR, 0.94; 95% CI, 0.92-0.99); and being unmarried (OR, 0.56; 95% CI, 0.39-0.81). After adjustment for these variables, both a higher CES-D score and having a depressed mood significantly decreased the odds of being among those who had improved (OR, 0.97; 95% CI, 0.95-0.99; and OR, 0.50; 95% CI, 0.28-0.92, respectively).

COMMENT

Our study provides evidence that depressive symptoms in older persons predict subsequent decline in physical performance after a 4-year period. Although decreased levels of performance were most pronounced in older persons with significant depressed mood, among the less severely depressed persons, the level of symptoms of depression also showed a gradient of risk for subsequent physical decline. The results were similar when the analyses were restricted to subjects without physical disability. Thus, in older persons at the high end of the functional spectrum, depressive symptoms were also predictive of subsequent decline in physical performance.

Our results are compatible with findings by others that depressive symptoms were associated with subsequent self-reported physical disability.[1,6,7] However, by using a battery of physical performance tests that covers the entire spectrum of physical functioning, we demonstrate that the effect of depressive symptoms is not limited to physical disability, but that depressive symptoms also predict physical decline outside the disabled range. Since performance-based measures have been shown to be less biased by mood, cognition, and personality aspects than by self-reports of physical disability,[10,11] our findings provide additional, more compelling evidence for a link between depressive symptoms and subsequent physical decline. Our results complement another set of population-based research data indicating that poor physical function is a risk factor for the onset of depressive symptoms.[33,34] These 2 bodies of research suggest that depression and poor physical function are mutually reinforcing, causing a progressive downward spiral in the physical and psychological health of older persons.

Researchers have hypothesized both biologically mediated pathways and psychological mechanisms for a link between depressive symptoms and physical function. Animal and human studies found that psychological distress causes neural, hormonal, and immunological alterations. By increasing the sympathetic tone, decreasing vagal tone, and causing immunosuppression, depressed mood may enhance susceptibility to disease and result in decreased physical health in general.[35-37] Also, persistent somatic symptoms of depression, such as fatigue or sleeplessness, may worsen the health status over time. Via psychological mechanisms, depressed mood may impede recovery processes by discouraging persons from obtaining adequate medical attention and rehabilitation; following treatment regimens; or engaging in healthy lifestyles, such as exercising, not smoking, and maintaining healthful eating habits. Data collected in the first EPESE interview in 1982 provided some evidence for physical activity as one of the mechanisms in the link between depression and physical decline: depressive symptoms were significantly associated with less engagement in walking, gardening, and vigorous exercise activities during the last month. Future studies should further examine to what extent reduced engagement in physical activities explains the greater physical decline in older depressed persons. Furthermore, depression may limit cognitive capacities and may cause a tendency to amplify physical symptoms such as fatigue and pain.[38] This psychological conduct may undermine the effort needed to maintain physical function over time.

Some alternative explanations should be given as well. Depressive symptoms may represent an adjustment reaction to subclinical symptoms or disease that, in themselves, would place subjects at greater risk for subsequent physical decline. In addition, performance measures reflect not only what a person is physically capable of doing but also what a person is willing or motivated to do. However, since we used longitudinal data with adjustment for level of performance at the time that depression was measured, it is not likely that our findings are explained by a reduced motivation to perform among the depressed subjects. Finally, the depression and physical decline link may be due to a third factor (such as organic brain dysfunctions) that is related to both conditions.

Physical function is an integral component of achieving and maintaining independence in ADL and a major contributor to the overall health status of elders. Lower levels of physical performance strongly predict institutionalization, death, and subsequent disability. In line with others,[24,39] our findings suggest that physical decline reflects multiple factors, including older age, disease status, and psychosocial factors. In contrast to most other significant predictors, depression is a potentially modifiable and preventable condition. Therefore, prevention and treatment of depressive symptoms may be one of the most effective targets for interventions aimed at reducing physical decline and increasing the number of years during which older people are free of disability. Although such interventions might be more feasible and cost-effective if limited to the most depressed persons, our findings suggest that there may not be a need to limit these efforts strictly to those who meet certain criteria for depressive disorders. The risk association between depressive symptoms and physical decline seems to represent a continuum along the entire spectrum of physical function. Even outside the disabled range, a higher level of depressive symptoms increases the risk for subsequent decline in physical performance.

As opposed to major depression defined by *DSM-IV* criteria, depressed mood is very common in the older general population, affecting more than 10% in our cohort. Unfortunately, depressed mood in older persons is often unrecognized,[40,41] and the treatment approach when diagnosed is unclear. Although more appropriate care for depressed mood, consisting of increased counseling and use of appropriate antidepressant medications, has been shown to be cost-effective in terms of commensurate improvements in older persons' health and well-being per dollar spent,[42] few formal clinical trials have been conducted. Our data suggest that such trials may be useful to see whether treatment of depressed mood may prevent the process whereby depressive symptoms and physical dysfunctions interact to cause a progressive downward spiral in the health status of older persons.

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