Original Investigation

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Six-Year Effect of Depressive Symptoms on the Course of Physical Disability in Community-Living Older Adults

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Abstract

Background Late-life depression affects physical health and impedes recovery from physical disability. But whether milder symptoms that occur frequently in the general population increase the risk of developing a disability or decrease the likelihood of recovery remains unclear.

Objective To examine the effect of mild symptoms of depression, assessed by a reduced version (10 items, ranging from 0-10) of the Center for Epidemiological Studies–Depression Scale, on the course of physical disability, assessed by items from the Katz Activities of Daily Living Scale, the Rosow-Breslau Functional Health Scale, and the Nagi Index.

Methods A population-based longitudinal study was conducted, with 6 follow-up interviews of 3434 community-dwelling persons aged 65 years and older in East Boston, Mass.

Results The likelihood of becoming disabled increased with each additional symptom of depression (for the Katz measure: odds ratio, 1.16 per symptom; 95% confidence interval, 1.13-1.19; for the Rosow-Breslau measure: odds ratio, 1.14; 95% confidence interval, 1.11-1.16; and for the Nagi measure: odds ratio, 1.17; 95% confidence interval, 1.14-1.19). As the number of depressive symptoms increased, the likelihood of recovering from a physical disability decreased (for the Katz measure: odds ratio, 0.96; 95% confidence interval, 0.93-0.99; for the Rosow-Breslau measure: odds ratio, 0.86; 95% confidence interval, 0.84-0.89; and for the Nagi measure: odds ratio, 0.89; 95% confidence interval, 0.87-0.91). This effect was not accounted for by age, sex, level of educational attainment, body mass index, or chronic health conditions.

Conclusion Mild depressive symptoms in older persons (those aged ≥65 years) are associated with an increased likelihood of becoming disabled and a decreased chance of recovery, regardless of age, sex, and other factors that contribute to physical disability.

IT IS generally accepted that persons who are in poor physical health are more likely to experience depression.[1-4] The converse, whether depression leads to greater risk of physical disability, is less clear and requires careful longitudinal investigation to distinguish depression that precedes physical disability from depression that may be consequent to the disability. The results of several prospective studies[5-17] suggest that late-life depression of clinical significance (major depression, minor depression, or depressive syndromes) may affect subsequent physical health or impede recovery from physical disability. Mild depressive symptoms are much more common than more severe depression among persons of all ages,[18,19] but their importance for changes in physical health and disability remains unclear.[20,21] This issue is especially relevant to the health of older persons, who are at the highest risk of disability[22] and who experience mild depressive symptoms the most frequently.[6] This study examined whether mild depressive symptoms predicted subsequent disability and recovery from disability during a 6-year period in a defined population of older persons (those aged ≥65 years).

Participants and methods

Study population

The participants in this longitudinal, population-based study were 3809 persons aged 65 years and older, 85% of the age-eligible residents of East Boston, Mass (N = 4485), 1 of 4 centers of the Established Populations for Epidemiologic Studies of the Elderly program.[23] Data were collected at an in-home interview at baseline in 1982 and at up to 6 annual follow-up interviews. The third and sixth interviews were also in the home, and the other interviews were by telephone.

Measures

Mild depressive symptoms that do not meet the diagnostic categories for major depression, minor depression, or depressive syndromes were measured at baseline with a reduced 10-item version of the Center for Epidemiological Studies–Depression Scale (CES-D).[24,25] *Physical disability*, defined as difficulty in performing daily activities that are necessary for functioning independently, was assessed annually using 3 modified self-report measures that emphasize different aspects of the disability process. Six items from the Katz Activities of Daily Living Scale[26] assess the ability to perform basic self-care tasks (bathing, dressing, eating, toileting, walking across a room, and transferring from a bed to a chair). Three items from the Rosow-Breslau Functional Health Scale[27] assess mobility and lower extremity strength (climbing stairs, walking 0.8 km, and doing heavy work around the house). Four items from the Nagi Index[28] assess upper and lower extremity strength and basic motor functions (bending, stooping or crouching, reaching above the shoulders, writing or handling small objects, and pushing or pulling an object like a chair). The measures demonstrated high test-retest reliability in the East Boston study (≥0.77 over 3 weeks),[29] confirming that they are sufficiently stable for use in longitudinal analyses. Using the 3 measures allowed us to examine the effect of depressive symptoms on related, but distinct, domains of late-life disability. Information on age, sex, years of educational attainment, body mass index (calculated as weight in kilograms divided by the square of height in meters), chronic health conditions, and cognitive function was obtained at baseline. Each of these factors has been found to predict disability in previous research.

Disability is a process in elderly persons that follows a course that includes restoration and recovery. Models are needed, therefore, that capture disability development and recovery. Markov models[30,31] were used in this study to examine the overall effect of depressive symptoms on the likelihood of a transition from a nondisabled state to disability and from disability to a nondisabled state (recovery) during 6 years of observation. These models calculate the probability of transitions within an annual interval and average the effect across all 5 yearly intervals. They also adjust for gaps of 1 or more years because of missing data, allow for within-person correlation in the likelihood of becoming disabled or recovering from disability, and account for death rather than treat death as missing data. Transitions from disability and nondisability to death are modeled separately within the same model. Conditional on survival of the interval and the disability status at the beginning of the interval, the model then calculates the probability of either developing disability or recovering from disability. The coefficients can be interpreted in the same way as those in logistic regression analyses. In our analysis, all models were adjusted for age and sex, and the assumptions about linearity, interactions, and time-invariance were examined analytically using residual plots.

Whether depressive symptoms contributed to changes in disability status was tested in 3 ways. First, we examined the gradient effect of the number of symptoms on disability transitions to determine if there was a change in risk with each additional symptom. Probabilities of becoming disabled and recovering from disability over the full range of the CES-D items were calculated from the models. Then we grouped the depressive symptoms (1-3, 4-6, and ≥7) and examined whether risk of change in disability status was different for each group, relative to the referent category of having no symptoms. Last, we examined whether, compared with those reporting no symptoms, persons with even low levels of depressive symptoms experienced a change in the risk of developing a disability or recovering from a disability. The level of depressive symptoms was represented with individual indicators for consecutive numbers of depressive symptoms (0, 1, 2, 3, 4, 5, 6, and ≥7).

We next examined the possibility that the effect of depressive symptoms on disability transitions was attributable in part to lower educational attainment, higher or lower body mass index, or the presence of chronic health conditions among those reporting more symptoms. A summary measure of 7 chronic health conditions (hypertension, chronic joint pain, diabetes, cancer, myocardial infarction, stroke, and hip fracture) was constructed, representing major medical conditions that are significantly disabling among older persons. Finally, because we were concerned about the validity of self-report data among persons with significant cognitive impairment, we repeated the models after excluding those with *poor memory performance*, defined as those making 4 or more errors on immediate recall and 6 errors on delayed recall of the East Boston Memory Test.[32]

Results

Participant characteristics

Of the 3809 participants, 3434 (90.2%) had data on baseline depressive symptoms and on at least 1 of the physical function measures for 2 or more years, permitting inclusion in the analysis (**Table 1**). At baseline, the number of depressive symptoms was associated with disability, older age, female sex, and the presence of chronic health conditions ($P \leq .001$). During follow-up, at least 1 change of disability status was experienced by 1107 persons on the Katz measure, by 1744 persons on the Rosow-Breslau measure, and by 1672 persons on the Nagi measure.

Baseline Characteristics of the 3434 Participants With Data on Becoming Disabled and Recovering From Disability

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Baseline Characteristics of the 3434 Participants With Data on Becoming Disabled and Recovering From Disability

Likelihood of becoming disabled

Examining the gradient effect of the number of symptoms on disability status showed that the risk of becoming disabled during each annual interval was affected by age, sex, and baseline level of depressive symptoms. For women at the youngest age in the study (65 years), the estimated probability of becoming disabled was fairly small: 3% on the Katz measure, 12% on the Rosow-Breslau measure, and 11% on the Nagi measure. For each additional year of age, the likelihood of becoming disabled increased by 9% for the Katz measure, 11% for the Rosow-Breslau measure, and 8% for the Nagi measure (**Table 2**). Men were 18% less likely to become disabled than women for the Rosow-Breslau measure and 41% less likely to become disabled than women for the Nagi measure. Depressive symptoms contributed substantially and independently to the risk of disability. For each depressive symptom, the likelihood of disability increased by 16% for the Katz measure, by 14% for the Rosow-Breslau measure, and by 17% for the Nagi measure. The models with grouped depressive symptoms indicated that the likelihood of disability steadily increased with increasing numbers of depressive symptoms on all 3 measures (**Table 3**). **Figure 1** and **Figure 2** summarize the annual probability of becoming disabled for a 65-, a 75-, and an 85-year-old woman and man, respectively. The models with individual indicators for number of symptoms (data not shown) indicated that, compared with having no symptoms, the presence of even 1 depressive symptom significantly ($P \leq .001$) increased disability risk on the Rosow-Breslau measure (odds ratio, 1.20; 95% confidence interval, 1.04-1.38) and the Nagi measure (odds ratio, 1.26; 95% confidence interval, 1.10-1.46).

Table 2.

Effect of Depressive Symptoms on the Likelihood of Becoming Disabled for the 3434 Participants

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Effect of Depressive Symptoms on the Likelihood of Becoming Disabled for the 3434 Participants

Table 3.

Odds Ratios for Disability and Recovery (for Men and Women) at Various Levels of Depressive Symptoms Compared With Persons With No Depressive Symptoms

Persons With No Depressive Symptoms

Figure 1.

The probability of becoming disabled for a 65-, a 75-, and an 85-year-old woman. Assessments were performed over the range of the Center for Epidemiological Studies–Depression Scale (CES-D) by items from 3 measures: A, the Katz Activities of Daily Living Scale; B, the Nagi Index; and C, the Rosow-Breslau Functional Health Scale. Shaded area indicates population mean. Data were from a population study.

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The probability of becoming disabled for a 65-, a 75-, and an 85-year-old woman. Assessments were performed over the range of the Center for Epidemiological Studies–Depression Scale (CES-D) by items from 3 measures: A, the Katz Activities of Daily Living Scale; B, the Nagi Index; and C, the Rosow-Breslau Functional Health Scale. Shaded area indicates population mean. Data were from a population study.

Figure 2.

The probability of becoming disabled for a 65-, a 75-, and an 85-year-old man. Assessments were performed over the range of the Center for Epidemiological Studies–Depression Scale (CES-D) by items from 3 measures: A, the Katz Activities of Daily Living Scale; B, the Nagi Index; and C, the Rosow-Breslau Functional Health Scale. Shaded area indicates population mean. Data were from a population study.

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Likelihood of recovering from a disability

Recovery from a disability was frequent. The probability of recovering by the next year in the youngest women (aged 65 years) was 50% for the Katz measure, 32% for the Rosow-Breslau measure, and 38% for the Nagi measure. The likelihood of recovery was 25% higher for men on the Rosow-Breslau measure and 40% higher for men on the Nagi measure ($P \leq .001$) (Table 4). For men and women, the likelihood of recovery on each of the 3 measures decreased by 3% to 6% with every year of age. Depressive symptoms contributed independently to a reduction in the likelihood of recovery. The likelihood of recovering decreased by 4% to 14% for every additional depressive symptom on the 3 measures; this effect was independent of the effects of sex and age. The analysis of

annual probability of recovering for a 65-, a 75-, and an 85-year-old woman and man, respectively. The models with individual indicators for number of depressive symptoms showed that even 1 symptom impaired recovery on the Rosow-Breslau measure (odds ratio, 0.77; 95% confidence interval, 0.65-0.92) (data not shown).

Table 4.

Effect of Depressive Symptoms on the Likelihood of Recovering From a Disability for the 3434 Participants

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Effect of Depressive Symptoms on the Likelihood of Recovering From a Disability for the 3434 Participants

Figure 3.

The probability of recovering from a disability for a 65-, a 75-, and an 85-year-old woman. Assessments were performed over the range of the Center for Epidemiological Studies–Depression Scale (CES-D) by items from 3 measures: A, the Katz Activities of Daily Living Scale; B, the Nagi Index; and C, the Rosow-Breslau Functional Health Scale. Shaded area indicates population mean. Data were from a population study.

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Figure 4.

The probability of recovering from a disability for a 65-, a 75-, and an 85-year-old man. Assessments were performed over the range of the Center for Epidemiological Studies–Depression Scale (CES-D) by items from 3 measures: A, the Katz Activities of Daily Living Scale; B, the Nagi Index; and C, the Rosow-Breslau Functional Health Scale. Shaded area indicates population mean. Data were from a population study.

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The probability of recovering from a disability for a 65-, a 75-, and an 85-year-old man. Assessments were performed over the range of the Center for Epidemiological Studies–Depression Scale (CES-D) by items from 3 measures: A, the Katz Activities of Daily Living Scale; B, the Nagi Index; and C, the Rosow-Breslau Functional Health Scale. Shaded area indicates population mean. Data were from a population study.

An examination of the interaction effects of age and sex on the relation between depressive symptoms and disability showed that mild depressive symptoms equally affected the probability of developing or recovering from a disability for men and women and across all age groups. Educational level and body mass index did not alter the effect of depressive symptoms on disability transitions. Chronic health conditions explained about 16% (range, 7%-25%) of the association of depressive symptoms with changes in disability. As expected, coefficients for depressive symptoms were reduced but remained significant ($P \leq .001$). Only the effect on recovery from disability according to the Katz measure was reduced to a nonsignificant level ($P = .08$). Examining the effect of each chronic condition separately did not appreciably change the effect of depressive symptoms on change in disability status.

The results of omitting poor memory performers on the East Boston Memory Test indicated that the effect of depressive symptoms on disability status was not an artifact of significant cognitive impairment. Because information about disability in subsequent years was obtained from proxies in some cases, we restricted the analysis to self-reported disability, and the findings were essentially unchanged.

Comment

The results of this study suggest that depressive symptoms significantly affect the risk of becoming disabled or remaining disabled (not recovering) across the entire range of symptoms in community-living older adults. These effects are largely independent of factors that contribute to physical disability: level of educational attainment,[5,33-37] body mass index,[33,35,38] chronic health conditions,[22] and significant cognitive impairment.[39] The results also suggest that even low levels of depressive symptoms at baseline may impair daily function 6 years later.

The co-occurrence of disability and depression has been recognized in several cross-sectional studies[40-43] and is usually thought to represent depressed mood due to the burdens of chronic disease and disability. Investigating the opposite relation, whether depression leads to impaired physical function, has been difficult, especially because it requires longitudinal studies of substantial duration to be sure that one is not observing merely the coincidence of chronic disease and depressed mood. Several longitudinal studies[5,6,8,12-17] have reported that more severe forms of depression lead to increased risk of subsequent disability. Small studies[9-11] have found that clinical depression decreases the chances of recovery. The relation of mild depressive symptoms to subsequent disability has been examined infrequently.[6,20] Broadhead and colleagues[6] found that persons with 2 or more symptoms of depression had 1.55 times greater risk of disability at 1-year follow-up than asymptomatic persons. Bruce and colleagues[20] studied high-functioning adults aged 70 through 79 years and found that mild depressive symptoms predicted disability at 2.5 years of follow-up.

The central strengths of the study are use of data from a carefully defined population of older persons, a large sample size, and long duration of follow-up, with annual measurement of disability status. The relation of depressive symptoms and disability has been studied previously in the Established Populations for Epidemiologic Studies of the Elderly population.[16,21] Our analysis differs from those analyses in 2 important ways. First, we focused on the entire range of depressive symptoms, not just on the most severe symptom levels. Second, we examined the development of disability and recovery from disability simultaneously to understand more completely the role of depressive symptoms in the disability process. As is typical in population-based, epidemiological studies, our measure of chronic health conditions was imperfect, as it relied on self-reports of

mostly independent of underlying physical health status. It is unlikely that nonresponse bias limits the interpretation of the study's results. A separate analysis showed that approximately 13% of the nonparticipants resembled participants in demographic, health, and social characteristics.[44] Using the shorter form of the CES-D may have compromised the results. However, the 10-item form used in this study is strongly correlated with the original CES-D (r = 0.88).[24] Internal consistency reliability of the 10-item form (Cronbach α = .80) is comparable to internal consistency estimates of the original CES-D (Cronbach α = .80-.90).[24,40] The 20-item CES-D and the modified shorter versions are robust in samples of community-living older adults.[45]

The mechanisms by which depressive symptoms may lead to disability remain undefined. Feelings of discouragement and hopelessness may reduce willingness to attempt tasks that a person is otherwise capable of performing. Depressed feelings may interfere with maintaining proper nutrition and participating in health promotion and maintenance activities.

Disability is a major public health problem that greatly affects the quality of older persons' lives and requires substantial health care expenditures. Mild depressive symptoms are common and potentially responsive to low-risk interventions, such as supportive therapy and other psychosocial interventions.[46] Trials of rigorous design and adequate size to investigate whether such interventions lower the risk of disability deserve serious consideration.

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