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Longitudinal Association Between Depressive Symptoms and Disability Burden Among Older Persons

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Background. Although depressive symptoms in older persons are common, their association with disability burden is not well understood. The authors evaluated the association between level of depressive symptoms and severity of subsequent disability over time and determined whether this relationship differed by sex.

Methods. Participants included 754 community-living persons aged 70 years or older who underwent monthly assessments of disability in four essential activities of daily living for up to 117 months. Disability was categorized each month as none, mild, and severe. Depressive symptoms, assessed every 18 months, were categorized as low (referent group), moderate, and high. Multinomial logit models invoking *Generalized Estimating Equation* were used to calculate odds ratios and 95% confidence intervals.

Results. Moderate (odds ratio = 1.30; 95% confidence interval: 1.18–1.43) and high (odds ratio = 1.68; 95% confidence interval: 1.50–1.88) depressive symptoms were associated with mild disability, whereas only high depressive symptoms were associated with severe disability (odds ratio = 2.05; 95% confidence interval: 1.76–2.39). Depressive symptoms were associated with disability burden in both men and women, with modest differences by sex; men had an increased likelihood of experiencing severe disability at both moderate and high levels of depressive symptoms, whereas only high depressive symptoms were associated with severe disability in women.

Conclusions. Levels of depressive symptoms below the threshold for subsyndromal depression are associated with increased disability burden in older persons. Identifying and treating varying levels of depressive symptoms in older persons may ultimately help to reduce the burden of disability in this population.

Key Words: Aging—Depression—Disability—Prospective studies—Sex differences.

WHEREAS major depression affects only about 1% to 2% of community-living older persons (1), the prevalence of depressive symptoms that do not meet criteria for major depression in this population is high. Often referred to as "subsyndromal" depression, the prevalence of clinically significant depressive symptoms ranges from 8% to 20% (2) and is associated with an array of adverse outcomes, including the onset and progression of disability in essential activities of daily living (ADLs) (3–5). Several theoretical explanations for why depression is associated with ADL disability have been described (6). Common symptoms of depression such as insomnia and weight gain or loss may have deleterious effects over time, resulting in disability. Depression may also reduce motivation, which, in turn, may lead to poor health behaviors, such as physical inactivity, or hinder the receipt of adequate medical care, including primary and secondary prevention (7). In addition, psychological distress resulting from depression may alter neural, hormonal, or immunological function, thereby increasing susceptibility to disease and subsequent decline in physical health (8).

It is also common, however, for older persons to experience depressive symptoms that fall below the symptom threshold for subsyndromal depression (9,10). Yet, with few exceptions (4,10), prior studies have not evaluated the association between gradations of depressive symptoms on subsequent disability. Furthermore, although severity of disability differs widely across individuals and within the same person over time (11,12), prior studies of depressive symptoms have not considered these important differences in disability severity. Hence, the relationship between increasing level of depressive symptoms and the continuum of disability severity is unknown. In addition, although the association between depressive symptoms and subsequent disability appears to be more pronounced in women than in men(3,13), whether there is a sex difference in the relationship between level of depressive symptoms and the severity of subsequent disability is uncertain.

In the current study, we evaluated the association between increasing level of depressive symptoms and the severity of subsequent disability over time and determined whether this relationship differed between women and men. To accomplish these aims, we used data from a unique longitudinal study that includes monthly assessments of disability for up to 9 years along with serial assessments of depressive symptoms at 18-month intervals.

Methods

Study Population

Participants were members of the Precipitating Events Project, a longitudinal study of 754 nondisabled community-dwelling persons aged 70 years or older (14). The assembly of the cohort has been described in detail elsewhere (14). In brief, potential participants were identified from 3,157 age-eligible members of a health plan in New Haven, Connecticut. The primary inclusion criteria were English speaking and requiring no personal assistance with four essential ADLs, that is, bathing, dressing, transferring from a chair, and walking across a room. The participation rate was 75.2% (14). The Human Investigation Committee at Yale University approved the study.

Data Collection

Comprehensive home-based assessments were completed at baseline and subsequently at 18-month intervals for 90 months, whereas telephone interviews were completed monthly for up to 117 months. Deaths were ascertained by review of the local obituaries and/or from an informant during a subsequent telephone interview. Two hundred and eighty-six (37.9%) participants died after a median follow-up of 50 months, whereas 36 (4.8%) dropped out of the study after a median follow-up of 24 months. Data were otherwise available for 99.7% of the 56,813 monthly telephone interviews, with little difference between the decedents (98.9%) and nondecedents (99.6%).

During the baseline assessment, data were collected on demographic characteristics. During each of the comprehensive assessments, data were collected on biomedical factors, lifestyle factors, and antidepressant medication use. Biomedical factors included nine self-reported physician-diagnosed chronic conditions: hypertension, myocardial infarction, congestive heart failure, stroke, diabetes mellitus, arthritis, hip fracture, chronic lung disease, and cancer and cognitive status as assessed by the Folstein Mini-Mental State Examination (MMSE) where MMSE scores range from 0 to 30, with higher scores representing better cognitive status (15). Lifestyle factors included physical activity, as assessed by the Physical Activity Scale for the Elderly (PASE) where PASE scores range from 0 to 400 (16), smoking, and body mass index (BMI), based on self-reported height and weight. Participants who responded that they were current or former smokers were classified as having ever smoked. In addition, during each comprehensive assessment, we collected data on antidepressant medication use. Participants were asked to retrieve all of their medications. If a medication was not retrieved, the interviewer asked to see the participant's medication list. If a list was unavailable, participants were asked to recall medications that they had taken during the prior 2 weeks. All medications, but not the doses or dosing schedule, were recorded and antidepressant medications were subsequently coded based on the American Hospital Formulary system code 28.16.04. Trazodone and Amitriptyline were not coded as antidepressants because they are commonly used for other indications, including sleep and pain(17,18).

Assessment of depressive symptoms.—During each of the comprehensive assessments, the frequency of depressive symptoms in the previous week was assessed with the 11-item Center for Epidemiological Studies-Depression (CES-D) scale (19). Prior studies of older persons have reported test–retest reliability statistics of 0.82 or higher for the shortened version of the CES-D (20,21). Scores were transformed using the procedure recommended by Kohout and colleagues (22) to make it compatible with the full 20-item instrument. Total scores range from 0 to 60, with higher scores indicating more depressive symptoms. At each time point, the level of depressive symptoms was classified as "low" (referent group), defined as a CES-D score from 0 to 9, "moderate," defined as a CES-D score from 10 to 19, and "high," defined as a CES-D score 20 or higher. A cut-point of 20 or higher on the CES-D scale provides a stringent approach to the classification of subsyndromal depression in older persons and increases the specificity for identifying major depression according to Diagnostic and Statistical Manual-IV criteria (23–26). Data on depression were complete for 100% of the participants at baseline and 95%, 93%, 91%, 90%, and 89% of the nondecedents at 18, 36, 54, 72, and 90 months, respectively.

Assessment of disability burden.—Disability in the four essential ADL tasks was assessed during the comprehensive assessments and during the monthly telephone interviews. Complete details regarding the monthly interviews, including formal tests of reliability and accuracy, have been previously described (27). Participants who needed help from another person or were unable to complete an ADL task were considered disabled in that ADL. The burden of disability was classified each month as none (disabled in 0 of the ADLs), mild (disabled in 1 or 2 of the ADLs), and severe (disabled in 3 or 4 of the ADLs) (28).

Statistical Analysis

The baseline characteristics of participants were compared according to their level of depressive symptoms using chi-square tests for categorical variables or the Wilcoxon rank-sum test for continuous variables. For each level of depressive symptoms, we calculated rates of mild and severe disability per 18 person-months of follow-up. Following methods used previously (29), the corresponding 95% confidence intervals were calculated for each rate using bootstrapping samples, that is, uniform sampling with replacement. We then determined the unadjusted and adjusted odds ratios of experiencing mild versus no disability

and severe versus no disability, over time, according to the level of depressive symptoms using generalized multinomial logit models for nominal outcomes invoking *Generalized Estimating Equation* (GEE) with exchangeable correlation structures (30). This analytic strategy accounts for the correlation within participants resulting from collecting repeated measurements over time. Furthermore, using this approach, the relationship between level of depressive symptoms and disability burden is not constrained to a linear association. The odds ratio derived from this type of model represents the average association, over the entire study period, of the level of depressive symptoms on the likelihood of developing disability (mild or severe) in each month. To ensure temporal precedence, that is, depressive symptoms preceding disability, participants had to be nondisabled at the start of an 18-month interval, as determined during the comprehensive assessment. Consequently, intervals were excluded from the analysis only when participants were determined to be disabled at the start of an 18-month interval. To address the relatively small amount of missing data for depressive symptoms, the last prior nonmissing score was carried forward (31). This method has been used previously to evaluate the effect of depression on health outcomes of older persons (32). Multiple imputation with 100 random draws per missing observation was used to impute missing values for each of the four essential ADLs during each month. Following recent recommendations for binary longitudinal data (33), the probability of missingness was first imputed based on a GEE logistic regression model with a prespecified set of eight covariates (available upon request). Using a second set of eight covariates (available upon request), along with the probability of missingness and the values for disability (present or absent) for the four essential ADLs at each of the prior months, values for disability (present or absent) for each of the four essential ADLs were then imputed for each missing month sequentially from the first month to the last month. Given the long duration of follow-up, we included an indicator variable for the specific 18-month interval to account for potential temporal changes in the relationship between level of depressive symptoms and disability burden, as has been done in prior studies (5). The models were sequentially adjusted for demographic characteristics, biomedical factors, lifestyle factors, and antidepressant medication use. With the exception of the demographic characteristics and BMI, these variables were treated as time-dependent covariates. Finally, to test whether the association between level of depressive symptoms and disability burden differed according to sex, we entered an interaction term for level of Depressive Symptoms × Sex into the fully adjusted model.

All statistical tests were two tailed and p values less than .05 were considered statistically significant. The longitudinal models were performed using Survey Data Analysis software version 9.0; all other analyses were performed using Statistical Analysis System software version 9.1.

Table 1. Baseline Characteristics of Participants by Depressive Symptoms

Characteristic	Level of Depressive Symptoms* Low (n = 435)	Moderate (n = 219)	High (n = 100)	p Value†
Age in y, *M* (*SD*)	78.3 (5.2)	78.6 (5.3)	78.6 (5.4)	.78
Women, *n* (%)	249 (57.4)	151 (69.0)	86 (86.0)	<.001
White, *n* (%)	395 (91.0)	200 (91.3)	86 (86.0)	.27
Education in y, *M* (*SD*)	12.4 (2.8)	11.5 (2.9)	11.1 (2.7)	<.001
Chronic conditions, *M* (*SD*)	1.8 (1.2)	2.0 (1.3)	2.1 (1.4)	.001
Cognitive status, *M* (*SD*)‡	27.1 (2.3)	26.4 (2.5)	26.0 (2.8)	<.001
Ever smoked, *n* (%)	277 (63.8)	138 (63.0)	65 (65.0)	.94
Body mass index, *M* (*SD*)	26.5 (4.7)	27.4 (5.5)	27.3 (6.3)	.26
Physical activity score, *M* (*SD*)§	100.8 (62.0)	80.1 (50.5)	62.7 (38.5)	<.001
Antidepressant medication use, *n* (%)	19 (4.4)	22 (10.1)	17 (17.0)	<.001

Notes: *Determined using the Center for Epidemiological Studies-Depression scale; low = score ≤9; moderate = score 10–19; and high = score ≥20.

†Represents overall associations as determined by chi-square or Wilcoxon rank-sum tests.

‡Assessed with the Mini-Mental State Examination.

§Assessed with the Physical Activity Scale for the Elderly.

Results

At baseline, 435 (57.2%) participants had low depressive symptoms, 219 (29.0%) had moderate depressive symptoms, and 100 (13.3%) had high depressive symptoms. Differences across levels of depressive symptoms were observed for all baseline characteristics with the exception of age, race, smoking, and BMI (Table 1). Participants with high depressive symptoms were the most likely to be women and taking antidepressant medications and had the highest number of chronic conditions, fewest years of education, and lowest MMSE and physical activity scores.

As shown in Table 2, the rates of both mild and severe disability among older persons at risk for developing disability increased as the level of depressive symptoms increased. In the unadjusted analysis, only high depressive symptoms were associated with an increased likelihood of experiencing both mild and severe disability versus no disability (Table 3, Model 1). After controlling for demographic characteristics, the association between level of depressive symptoms and disability burden did not change appreciably (Model 2). The addition of the biomedical factors, however, revealed a graded relationship between increasing level of depressive symptoms and mild disability and further strengthened the relationship between high depressive symptoms and severe disability (Model 3). After further adjustment for lifestyle factors (Model 4) and, subsequently, antidepressant medication use (Model 5, fully adjusted model), a graded relationship was observed between increasing level of depressive symptoms and mild disability. Only high depressive symptoms were associated with severe disability (Model 5). Furthermore, all covariates were associated with both mild and severe disability with the

Table 2. Disability Rates per 18 Person-Months Among Older Persons at Risk for Developing Disability

	Mild Disability			Severe Disability		
Level of Depressive Symptoms*	Person-Months	Rate†	95% Confidence Interval	Person-Months	Rate†	95% Confidence Interval
Low	1,887	1.17	1.13–1.21	804	0.50	0.47–0.52
Moderate	1,841	1.95	1.87–2.02	820	0.87	0.83–0.92
High	1,566	2.99	2.90–3.10	1121	2.14	2.03–2.23

Notes: *Participants contributed 29,080, 17,025, and 9,419 person-months of low, moderate, and high depressive symptoms, respectively.

†Rates represent the number of person-months spent in the respective state of disability divided by the total number of person-months contributed by participants at the respective level of depressive symptoms multiplied by 18.

exception of race and smoking status, the latter of which was associated with severe disability only (Model 5).

Because three of the four interaction terms for level of Depressive Symptoms × Sex were statistically significant ($p < .01$; with the exception of high Depressive Symptoms × Sex in the model comparing severe vs no disability), we report the unadjusted and adjusted results according to sex (Table 4). In both the unadjusted and the adjusted models, there was a main effect of sex; women were more likely than men to experience both mild and severe disability, as evidenced by the elevated odds ratios for low depressive symptoms in women compared with men. However, although depressive symptoms were associated with disability burden in both men and women, level of depressive symptoms had a differential effect on men and women in the adjusted model. Whereas the likelihood of experiencing mild disability increased with increasing level of depressive symptoms in women, only moderate level of depressive

Table 3. Association Between Level of Depressive Symptoms and Subsequent Disability Burden

	Odds Ratio (95% Confidence Interval)				
	Model 1 (unadjusted)	Model 2	Model 3	Model 4	Model 5 (fully adjusted)
Mild disability vs no disability					
Level of depressive symptoms*					
Low	1.00	1.00	1.00	1.00	1.00
Moderate	1.02 (0.96–1.08)	1.02 (0.94–1.02)	1.24 (1.14–1.35)	1.37 (1.26–1.50)	1.30 (1.18–1.43)
High	1.25 (1.15–1.35)	1.26 (1.14–1.39)	1.78 (1.60–1.98)	1.85 (1.65–2.06)	1.68 (1.50–1.88)
Time interval	1.35 (1.33–1.37)	1.19 (1.16–1.22)	1.08 (1.05–1.11)	1.07 (1.04–1.10)	1.06 (1.03–1.09)
Age		1.17 (1.14–1.18)	1.18 (1.16–1.20)	1.09 (1.07–1.11)	1.11 (1.09–1.13)
Female sex		1.34 (1.10–1.63)	1.64 (1.35–1.99)	1.39 (1.17–1.66)	1.45 (1.21–1.74)
Race		0.65 (0.48–0.87)	0.93 (0.68–1.26)	1.14 (0.86–1.49)	1.18 (0.89–1.56)
Education (y)		1.01 (0.98–1.05)	1.13 (1.09–1.16)	1.05 (1.02–1.08)	1.06 (1.02–1.08)
Number of chronic conditions			1.24 (1.18–1.30)	1.13 (1.08–1.19)	1.15 (1.10–1.21)
MMSE score†			0.87 (0.86–0.89)	0.87 (0.85–0.88)	0.87 (0.86–0.89)
Smoking status				0.93 (0.78–1.10)	1.08 (0.91–1.29)
Physical activity‡				0.98 (0.97–0.99)	0.98 (0.97–0.99)
BMI				1.00 (0.99–1.01)	0.99 (0.97–0.99)
Antidepressant medication use					1.46 (1.29–1.66)
Severe disability vs no disability					
Level of depressive symptoms*					
Low	1.00	1.00	1.00	1.00	1.00
Moderate	1.03 (0.96–1.11)	1.04 (0.94–1.14)	0.98 (0.84–1.12)	1.22 (1.06–1.40)	1.06 (0.92–1.22)
High	1.59 (1.45–1.75)	1.70 (1.51–1.92)	2.14 (1.84–2.50)	2.58 (2.22–2.99)	2.05 (1.76–2.39)
Time interval	1.53 (1.50–1.57)	1.46 (1.41–1.52)	1.35 (1.29–1.42)	1.26 (1.22–1.32)	1.26 (1.21–1.32)
Age		1.21 (1.19–1.24)	1.19 (1.16–1.21)	1.06 (1.04–1.08)	1.08 (1.06–1.10)
Female sex		1.05 (0.88–1.26)	1.23 (1.00–1.50)	1.18 (0.98–1.42)	1.22 (1.01–1.47)
Race		0.88 (0.65–1.18)	1.34 (0.96–1.87)	1.04 (0.79–1.37)	1.12 (0.85–1.49)
Education (y)		1.01 (0.98–1.04)	1.29 (1.24–1.34)	1.12 (1.08–1.15)	1.11 (1.08–1.15)
Number of chronic conditions			1.63 (1.54–1.73)	1.30 (1.23–1.37)	1.35 (1.28–1.43)
MMSE score†			0.76 (0.74–0.77)	0.76 (0.75–0.78)	0.78 (0.76–0.79)
Smoking status				1.27 (1.05–1.52)	1.46 (1.21–1.77)
Physical activity‡				0.97 (0.96–0.98)	0.98 (0.97–0.99)
BMI				1.00 (0.98–1.01)	0.98 (0.96–0.99)
Antidepressant medication use					2.29 (1.97–2.66)

Notes: BMI = Body mass index; MMSE = Mini-Mental State Examination.

*Determined using the Center for Epidemiological Studies-Depression scale; low = score ≤9; moderate = score 10–19; high = score ≥20.

†Assessed with the MMSE.

‡Assessed with the Physical Activity Scale for the Elderly.

Table 4. Association Between Level of Depressive Symptoms and Subsequent Disability Burden According to Sex

	Men				Women			
	Unadjusted		Adjusted*		Unadjusted		Adjusted*	
	Odds Ratio	95% Confidence Interval	Odds Ratio	95% Confidence Interval	Odds Ratio	95% Confidence Interval	Odds Ratio	95% Confidence Interval
Mild disability vs no disability†,‡								
Level of depressive symptoms§								
Low‖	1.00	—	1.00	—	1.51	1.21–1.87	1.31	1.28–2.15
Moderate	1.20	1.07–1.34	1.63	1.37–1.94	1.42	0.99–2.06	1.59	1.10–2.31
High	0.99	0.82–1.19	0.88	0.67–1.16	1.90	1.22–2.95	2.37	1.49–3.77
Severe disability vs no disability†,¶								
Level of depressive symptoms§								
Low‖	1.00	—	1.00	—	1.79	1.41–2.26	1.66	1.27–2.15
Moderate	1.63	1.43–1.87	2.01	1.59–2.56	1.45	0.88–2.41	1.26	0.71–2.25
High	2.25	1.87–2.72	1.67	1.23–2.27	2.44	1.42–4.13	3.25	2.38–4.46

Notes: *Adjusted for time interval, age (years), sex, race, education (years), number of chronic conditions, Mini-Mental State Examination score, smoking, physical activity, body mass index, antidepressant medication use, and level of Depressive Symptoms × Sex as described in the Methods section.

†The reference group for all comparisons is men with low depressive symptoms.

‡The *p* values for the interaction terms in the models of mild disability versus no disability were <.001 (unadjusted and adjusted results) for sex and moderate depressive symptoms and <.001 (unadjusted and adjusted results) for sex and high depressive symptoms.

§Determined using the Center for Epidemiological Studies-Depression scale; low = score ≤9; moderate = score 10-19; high = score ≥20.

‖Represents the main effect of sex (women vs men).

¶The p values for the interaction terms in the model of severe disability versus no disability were <.01 (unadjusted and adjusted) for sex and moderate depressive symptoms and <.001 (unadjusted) and 0.37 (adjusted) for sex and high depressive symptoms, respectively.

symptoms were associated with an increased likelihood of experiencing mild disability in men. The likelihood of experiencing severe disability was associated with both moderate and high levels of depressive symptoms in men, yet the lack of a dose–response relationship indicated a similar effect on severe disability, regardless of level of depressive symptoms. In contrast, only high depressive symptoms were associated with an increased likelihood of severe disability in women.

Discussion

In this longitudinal study, which included multiple assessments of depressive symptoms and monthly assessments of disability over the course of 9 years, we found that the likelihood of experiencing mild disability increased with successively higher levels of depressive symptoms, whereas the likelihood of experiencing severe disability was elevated only among persons with high depressive symptoms. Furthermore, although depressive symptoms were associated with subsequent disability burden in both men and women, we found that level of depressive symptoms had a differential effect on men and women. Among men, moderate depressive symptoms were associated with mild disability, whereas both moderate and high depressive symptoms were associated with severe disability. Among women, the likelihood of experiencing mild disability increased as the level of depressive symptoms increased, whereas only high depressive symptoms were associated with severe disability.

Among community-living older persons, the association between subsyndromal depression and disability is well established (3,5,26,34). In the current study, we confirmed this association using an CES-D score of 20 or higher to denote subsyndromal depression, as has been done in several prior studies (25,26,35). Yet, relatively little is known about the association between depressive symptoms that fall below the symptom threshold for subsyndromal depression and the development of disability, despite the high prevalence of such depressive symptoms among older persons (9,10,36,37). An earlier community-based study found that depressive symptoms not meeting the criteria for subsyndromal depression, but assessed at only a single point in time, were associated with the development of disability, assessed annually over the course of 6 years (4). These findings, coupled with ours, provide strong evidence that a broad spectrum of depressive symptoms, including those below the threshold for subsyndromal depression, is associated with poor functional outcomes. Hence, recognizing and treating depressive symptoms that are below the threshold for subsyndromal depression has the potential to reduce the subsequent burden of disability among older persons.

The public health impact of disability is substantial, with several studies indicating that the utilization and cost of both formal and informal health care resources increase with worsening disability (38,39). Nonetheless, prior studies of depressive symptoms have not attempted to distinguish between different types of disability severity, despite increasing evidence that the burden of disability varies widely among older persons (3,5,26,34). We found that moderate depressive symptoms were associated with an increased likelihood of developing mild, but not severe, disability, whereas high depressive symptoms were associated with an increased likelihood of developing both mild and severe disability. These findings suggest that the failure to

identify older persons with moderate depressive symptoms may represent a missed opportunity to prevent milder forms of disability through proper management of depressive symptoms. Furthermore, failure to recognize mild and severe disability may obscure the differential association between varying levels of depressive symptoms and this important health outcome.

The results of our study provide additional evidence that the association between depressive symptoms and disability is observed in both older men and women (3,40) and suggest that there may be a sex difference, albeit modest, in the relationship between varying levels of depressive symptoms and the severity of subsequent disability. Specifically, although a broad spectrum of depressive symptoms was associated with severe disability among men, only high depressive symptoms were associated with severe disability among women. It is possible that sex differences in the reporting of depressive symptoms, with men being less apt to report such symptoms (41), may have differentially affected the sex-specific rates of both moderate and severe depressive symptoms in the present study. Whether these differences could have led to the observed difference in the relationship between varying levels of depressive symptoms and the severity of subsequent disability is uncertain but should be the focus of future research.

There are several potential limitations to this study. First, the CES-D does not provide diagnostic criteria for the assessment of clinical depression. Nonetheless, the symptom scale provides useful information for identifying a range of symptom severity within individuals who otherwise would be classified as nondepressed. Because the CES-D includes somatic items (e.g., I could not get "going;" I did not feel like eating, my appetite was poor), it is possible that symptoms of physical illness such as fatigue or weight loss could have been attributed to depression, thereby inflating the CES-D score for some participants (42). To address this possibility, we used a cut-point of 20 or higher on the CES-D, which previously has been recommended to minimize the likelihood of incorrectly categorizing older persons as having severe depressive symptoms (43). Second, although we adjusted for the use of antidepressant medications, information regarding the dose, dosing schedule, adherence, indication, and start of treatment was not available. Because sex differences in the receipt and response to pharmacological and nonpharmacological treatment for depressive symptoms have been reported (44), future research should evaluate whether sex differences in depression treatment may help to explain the sex differences found in the present study. Third, the current study did not evaluate potential mechanisms underlying the relationship between level of depressive symptoms and disability burden. It is possible, for example, that increasing levels of depressive symptoms could lead to reduced levels of physical activity (45), which could subsequently influence disability burden in this population. We found that increased levels of physical activity were associated with a reduced likelihood of experiencing both mild and severe disability. Whether physical activity fully or partially mediates the association between level of depressive symptoms and disability burden in older persons should be the focus of future research. Fourth, we did not account for a prior history of disability in our analysis. This information was not collected during the baseline assessment. In addition, because we excluded 18-month intervals when disability was present during the relevant comprehensive assessment, a prior history of disability would not be available for another 9% of the intervals. Lastly, because our study participants included members of a single health plan, the generalizability of our findings to other older adult populations may be questioned. As previously noted, however (14), the demographic characteristics of our study population, including years of education, closely mirror those of persons aged 70 years or older in New Haven County, which, in turn, are comparable to those in the United States as a whole, with the exception of race. New Haven County has a larger proportion of non-Hispanic whites in this age group than in the United States, 91% versus 84% (46). Furthermore, generalizability depends not only on the characteristics of the study population but also on its stability over time (47). The high participation rate, completeness of data collection, and low rate of attrition for reasons other than death all enhance the generalizability of our findings (47) and at least partially offset the absence of a population-based sample.

Our findings indicate that depressive symptoms among older persons contribute substantially to the burden of disability over time and demonstrate the potential adverse consequences of depressive symptoms that do not reach the threshold for subsyndromal depression. Furthermore, our findings suggest that subthreshold depressive symptoms may be particularly problematic for older men, thereby emphasizing the need to take sex into account when evaluating the relationship between depressive symptoms and severity of disability. More broadly, our findings underscore the complexity of the relationship between depressive symptoms and disability. Identifying and managing a broad spectrum of depressive symptoms in older persons may ultimately help to reduce the burden of disability in this population.

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