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Original Research

Association Between Depression Symptoms and Disability Outcomes in Older Adults at Risk of Mobility Decline

Patricia M. Bamonti, PhD [a,b], **Meaghan A. Kennedy, MD, MPH** [c,d], **Rachel E. Ward, PhD, MPH** [e,f,g], **Thomas G. Travison, PhD** [h,i], **Jonathan F. Bean, MD, MPH** [e,g,j]

[a] *Research & Development, VA Boston Healthcare System, Boston, Massachusetts, United States*
[b] *Department of Psychiatry, Harvard Medical School, Boston, Massachusetts, United States*
[c] *New England Geriatric Research, Education, and Clinical Center, VA Bedford Healthcare System, Bedford, Massachusetts, United States*
[d] *Department of Family Medicine, Boston University School of Medicine, Boston, Massachusetts, United States*
[e] *New England Geriatric Research, Education, and Clinical Center, VA Boston Healthcare System, Boston, Massachusetts, United States*
[f] *Massachusetts Veterans Epidemiology and Research Information Center, Boston VA Healthcare System, Boston, Massachusetts, United States*
[g] *Department of Physical Medicine and Rehabilitation, Harvard Medical School, Boston, Massachusetts, United States*
[h] *Center for Analytic Sciences in Aging, Hinda and Arthur Marcus Institute for Aging Research, Hebrew SeniorLife, Boston, Massachusetts, United States*
[i] *Harvard Medical School, Boston, Massachusetts, United States*
[j] *Spaulding Rehabilitation Hospital, Boston, Massachusetts, United States*

List of abbreviations: *B*, unstandardized β; ICF, International Classification of Functioning, Disability and Health; LLFDI, Late Life Function and Disability Instrument; LLFDI-D, participation component of LLFDI, referred to as "Disability"; LLFDI-F, function component of LLFDI; PHQ-9, Patient Health Questionnaire-9; SPPB, Short Physical Performance Battery.

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KEYWORDS
Depression;
Elderly;
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Abstract *Objective:* To assess the association between depression symptoms and physical functioning and participation in daily life over 2 years in older adults at risk of mobility decline.
Design: A secondary analysis of 2-year observational data from the Boston Rehabilitative Impairment Study of the Elderly.
Setting: Nine primary care clinics within a single health care system.
Participants: Participants (N=432; mean age ± SD, 76.6±7.0y; range, 65-96y; 67.7% women) were community-dwelling adults (>65y) at risk of mobility decline.
Interventions: Not applicable.
Main Outcome Measures: Secondary data analyses of the Late Life Function and Disability Instrument (primary outcome), Short Physical Performance Battery (secondary outcome), and Patient Health Questionnaire-9 (PHQ-9) (predictor). Measures were administered at baseline, 12 months, and 24 months. Participants completed a self-report survey asking about 16 medical comorbidities, and demographic information was collected at baseline.
Results: Participants had an average ± SD PHQ-9 score of 1.3±3.1, ranging from 0 to 24 at baseline. Twenty-nine percent of participants reported a history of depression. Greater depression symptoms were associated with lower physical functioning (unstandardized beta [*B*]=−0.14, SE=0.05, P=.011) and restricted participation (frequency subscale: *B*=−0.21, SE=0.11, *P*=.001; limitation subscale: *B*=−0.45, SE=0.04, *P*<.001) cross-sectionally over 2 years. PHQ-9 was not significantly associated with the rate of change in Late Life Function and Disability Instrument score over 2 years.
Conclusions: Treating depression in primary care may be an important strategy for reducing the burden of functional limitations and participation restrictions at any 1 time. Further research is needed on treatment models to cotarget depression and physical functioning among at-risk older adults.

As life expectancy increases, many older adults (age≥65y) are living with multiple chronic conditions and experiencing declines in physical functioning (ie, limitations in performance of functional tasks) and participation in life situations.[1] Older adults with declines in physical functioning and restricted participation are at high risk of adverse outcomes including hospitalization, institutionalization, and mortality.[2,3]

According to the World Health Organization's International Classification of Functioning, Disability, and Health (ICF), an individual's functioning is dynamic, resulting from a complex interplay between health conditions (ie, cardiovascular disease and diabetes), the environment (ie, neighborhood and access to technology), and personal factors (ie, demographics, mental health, and attitudes).[4] Before publication of the ICF in 2001, the term "disability" only referred to deficits in what the ICF referred to as participation.[5] Now, disability is defined as impairment at any level of body functions and structures (ie, physiological functions and anatomical parts of the body), activities (ie, execution of a task or action by an individual), and/or participation (ie, involvement in life situations).[4,5]

As the perspective on function shifts from body structures to activities and participation, psychosocial factors have greater effect.[6] The interplay between psychosocial factors and late life disability outcomes can be characterized well within the 4Ms framework of Age-Friendly Health Systems (Mentation, Mobility, Medication, and What Matters).[7] The Age-Friendly Health Systems is a movement to improve the quality of health care for older adults in the United States. The 4Ms framework was created to specify the evidence-based elements to target in order to provide safe, quality health care to older adults. According to the framework, depression symptoms (ie, Mentation) are common in late life[8] and may differentially affect the level and rate of change of disability outcomes (ie, Mobility), with greatest effect on participation.[6] Participation, which underlies engagement in life roles, assesses the degree to which older adults can engage meaningfully in their lives, thereby also tapping "What Matters" in the 4Ms.

Although previous literature has generally found that depression symptoms are associated with declines in physical functioning[9,10] and the incidence of participation restrictions over time in healthy older adult samples,[11] few studies have examined the association between depression symptoms and physical functioning and participation among older adults who are at risk of mobility decline. Older adults at risk of mobility declines are an important group to study because they are characterized by preclinical disability and are at high risk of incident disability and other adverse outcomes (ie, hospitalization).[2,3,12]

However, we know little about the role of depression symptoms, a critical personal factor, on the level and rate of change in physical functioning and participation in this population. By better understanding predictors of functioning and participation in this higher risk group, we may be better able to develop targeted interventions to maintain or improve functioning over time, consistent with the 4Ms framework. In the present study, we examined whether

depression symptoms predict the level and rate of change of physical functioning and participation in older adults at risk of mobility decline over 2 years of follow-up. We hypothesized that greater depression symptoms would be associated with lower physical functioning and participation (ie, level) at each time point and that depression symptoms would be associated with accelerated declines in physical functioning and participation across 2 years (ie, rate of change).

Methods

Participants

Boston Rehabilitative Impairment Study of the Elderly is a prospective longitudinal cohort study designed to better understand which impairments predict mobility decline and disability progression over 2 years.

Full details of the study design and methods have been previously described.[13] Four hundred thirty participants were recruited based on power calculations (power≥0.8 at medium effect size) for predicting changes in function and disability over 2 years, accounting for 7.5% attrition due to death or loss to follow-up.[13] Patients were recruited between December 2009 and January 2012 from 9 primary care clinics in Boston and Cambridge, Massachusetts. Eligibility criteria included age≥65 years, living within 16-kilometer radius of their primary care clinic, and having ability to understand and communicate in English. Difficulty or task modification with walking one-half mile or climbing 1 flight of stairs was used as a measure of preclinical disability based on prior research demonstrating that individuals with difficulty or task modification in these areas are at high risk of subsequent incident disability.[12] Participants were excluded if they had a Mini-Mental State Exam score of <18,[14] scored <4 on the Short Physical Performance Battery (SPPB),[15] or had significant visual impairment, uncontrolled hypertension, lower extremity amputation, supplemental oxygen use, myocardial infarction, or major surgery in the previous 6 months. The current secondary analyses of the publicly archived data were approved by the Boston and Bedford institutional review boards. During the baseline visit, a nurse practitioner and a research assistant obtained informed consent.[13]

Measures

Outcome assessments were conducted at baseline and at 12- and 24-month follow-ups.

Late Life Function and Disability Instrument

The Late Life Function and Disability Instrument (LLFDI) is a self-report measure that assesses functional limitations and participation based on the ICF model.[16] For the Function Component (LLFDI-F), participants are asked about the extent to which they experience limitations in their ability to perform 32 discrete actions or activities without the help of others. Raw scores are summed and transformed into scale scores ranging from 0 to 100, with higher scores reflecting less difficulty. The participation component, referred to as "Disability" (LLFDI-D), includes 2 subscales for frequency and limitation of performing life tasks. Participants respond to 16 items that ask, "How often a life task is performed?" and "To what extent do you feel limited?" Raw scores are summed and transformed to scaled scores ranging from 0 to 100, with higher scores reflecting less participation restriction. The LLFDI is widely used in rehabilitation research and has demonstrated sound validity and reliability as well as sensitivity to change.[17]

Short Physical Performance Battery

The SPPB is a performance-based measure of physical functioning measuring 3 aspects of performance: balance, gait speed, and chair stands. The balance portion requires side-by-side, semitandem, and full-tandem positions for 10 seconds each. Gait speed is calculated by the better of 2 trials of walking on a 4-m course. The chair stands test requires participants to stand 5 times from a chair with arms across their chests. Each test is scored on a 0-4 scale, with 0 indicating an inability to perform the test and 4 indicating the highest level of physical performance. A total score is calculated by the sum of each test, ranging from 0 to 12, with higher scores indicating better physical performance.[15] The SPPB is a widely used measure of physical function in older adults with good reliability and validity.[18]

Patient Health Questionnaire-9

The Patient Health Questionnaire-9 (PHQ-9) is a 9-item self-report measure of depression symptom severity based on the DSM-IV criteria for major depressive disorder.[19] Respondents are asked to report on the frequency of symptoms over the past 2 weeks and respond on a Likert scale ranging from 0 (not at all) to 3 (nearly every day). Scores range from 0 to 27, with higher scores reflecting greater depression symptom severity. Scores ≥10 are indicative of greater likelihood of being diagnosed with major depressive disorder, and scores ≥5 are indicate of at least subthreshold depression. Cutoffs of 0-4 (minimal), 5-9 (mild), 10-14 (moderate), 15-19 (moderately severe), and 20-27 (severe) correspond to severity level.[19] In addition, participants were asked 3 questions related to depression as part of the comorbidity questions: (1) "Do you have this problem?" (2) Did you receive treatment for it?" and (3) "Does it limit your activities?" The PHQ-9 has shown sound reliability and validity as well as diagnostic accuracy in older adult primary care patients.[20,21]

Adjustment variables

Demographic information including age, sex, race, ethnicity, and education were collected at baseline. Participants completed a self-report survey of medical comorbidities.[22] A comorbidity variable was created as the sum of the presence of each comorbidity (ie, heart disease, high blood pressure, lung disease, diabetes, ulcer or stomach disease, kidney disease, liver disease, anemia, cancer, osteoarthritis, back pain, rheumatoid arthritis, neurologic disease, osteoporosis, thyroid disease, and peripheral neuropathy), excluding depression, with a possible range of 0-16.

Statistical plan

Frequency and proportions for categorical variables, and means, SDs, and minimum and maximum values for continuous variables were calculated. Covariates (age, sex, education, and comorbidities) were selected a priori based on research on the ICF model and established correlates of physical functioning and participation.[6,13] To take into account repeated measures for each participant, mixed effects models (SAS PROC MIXED) were used to estimate associations. In the first model, time, PHQ-9 score, and covariates were included as fixed effects. Regression parameters associated with PHQ-9 quantified the cross-sectional association between depression symptoms and outcomes. In the second model, the interaction term was added (time × PHQ-9), and we quantified the association between depression symptoms and the rate of change in outcomes. In both models, we estimated a random intercept for each participant. Limited significance testing was conducted at the 0.05 level. The analysis stipulated an unstructured correlation matrix in modeling the 3 repeated measurements obtained from each participant. To further explore the relation between depression symptoms and level and rate of change of disability outcomes, we conducted a sensitivity analysis using dichotomized PHQ-9 scores at the clinically significant threshold (PHQ-9≥10).[19] In addition, we also conducted a sensitivity analysis on the subgroup of participants who endorsed that depression is a problem at baseline (n=123). Analyses were performed using SAS software, version 8.2.[a]

Results

Sample characteristics

At baseline, 430 participants had complete data on the LLFDI. In follow-up, 390 (91%) completed the LLFDI at 12 months, and 360 (84%) completed it at 24 months. Baseline comparisons between those with complete follow-up data and those without for disability outcomes (LLFDI and SPPB) have been described elsewhere.[23]

Baseline characteristics are presented in table 1. When asked about depression on comorbidity questions, 123 participants (29%) reported "having this problem." Of those who reported having depression, 27% reported that it limited their activities, and most (63%) reported having received treatment for depression.

Table 1 Baseline characteristics

Variable	N	Mean ± SD or %	Minimum	Maximum
Age (y)	430	76.6±7.0	65.0	96
Sex				
Men	139	32.3		
Women	291	67.7		
Race				
American Indian or Alaska Native	1	0.20		
Asian	8	1.9		
Black or African American	49	11.4		
More than 1 race	7	1.6		
Other	10	2.3		
White	355	82.6		
Ethnicity				
Hispanic or Latino/a	13	3.0		
Non-Hispanic or Latino/a	416	97.0		
Education				
<High school	54	12.6		
High school	130	30.2		
Any college or vocational school	140	32.6		
Postgraduate	106	24.7		
Chronic conditions (0-16)	415	4.5±2.0	0	11
PHQ-9	430	1.3±3.1	0	24
Minimal (0-4)	402	93.5		
Mild (5-9)	12	2.8		
Moderate (10-14)	6	1.4		
Moderately severe (15-19)	9	2.1		
Severe (20-27)	1	0.23		
Do you have this problem?	123	28.6		
Did you receive treatment for it?	78	63.4		
Does it limit your activities?	33	26.8		
LLFDI-F	430	55.5±7.9	36.1	90.3
LLFDI-D Frequency	430	52.3±5.6	32.9	70.6
LLFDI-D Limitation	430	68.9±11.8	45.7	100

Table 2 Linear mixed effects estimates of the association of depression symptoms and disability outcomes over 2 years

				95% Confidence Limits	
Dependent Variable	Independent Variable	*B*	*P*	Lower	Upper
LLFDI-F	Age (y)	−0.15	.002	−0.25	−0.05
	Gender (reference = men)	−3.72	<.001	−5.21	−2.23
	Education (reference = postgraduate)				
	<High school	−1.01	.327	−3.05	1.02
	High school	−2.77	<.001	−4.37	−1.18
	College graduate	−1.76	.017	−3.21	−0.32
	Comorbidity	−0.81	<.001	−1.04	−0.58
	PHQ-9	−0.14	.011	−0.24	−0.03
	Time	−0.12	.48	−0.24	−0.03
LLFDI-D Frequency	Age (y)	−0.06	.091	−0.13	−0.00
	Gender (reference = men)	2.08	<.001	1.07	3.10
	Education (reference = postgraduate)				
	<High school	−3.34	<.001	−4.76	−1.90
	High school	−2.86	<.001	−3.99	−1.74
	College graduate	−1.83	<.001	−2.85	−0.80
	Comorbidity	−0.32	<.001	−0.49	−0.16
	PHQ-9	−0.21	.001	−0.29	−0.13
	Time	−0.36	.004	−0.61	−0.12
LLFDI-D Limitation	Age (y)	−0.17	.017	−0.32	−0.03
	Gender (reference = men)	−3.90	<.001	−6.12	−1.68
	Education (reference = postgraduate)				
	<High school	−3.20	.059	−6.52	0.12
	High school	−1.43	.280	−4.03	1.17
	College graduate	−0.13	.912	−2.54	2.28
	Comorbidity	−1.28	<.001	−1.70	−0.86
	PHQ-9	−0.45	<.001	−0.66	−0.24
	Time	1.02	<.001	0.34	1.70

Table 2 presents the mixed effects results for each LLFDI component. Generally, older age, multimorbidity, and fewer years of formal education were associated with greater disability. Women reported lower (worse) LLFDI scores than men on average. There was a main effect of time for LLFDI-D, with time from baseline associated with lower (worse) function and limitation scores. Figure 1 displays means and SDs for PHQ-9 and LLFDI scores at baseline, 12 months, and 24 months.

Relation between depression symptoms and physical functioning and participation

Greater intensity of depression symptoms was consistently associated with lower (worse) cross-sectional physical function and restricted participation. After controlling for covariates, a 1-point interindividual difference in PHQ-9 (signifying greater intensity of depression symptoms) was associated with 0.14 point lower LLFDI-F score (P=.010), 0.21 point lower LLFDI-D Frequency score (P=.001), and a 0.45 point lower LLFDI-D limitation score (P<.001). Details are provided in table 2.

As assessed by the interaction term, there was little to no evidence that depression symptoms were associated with alterations in the rate of change of physical disability or participation (LLFDI-F: B=0.04; SE=0.06, P=.480; LLFDI-D Frequency: B=−0.05; SE=0.05, P=.270; LLFDI-D Limitation: B=−0.09; SE=0.12, P=.470).

There is a possibility that results may differ with performance-based assessment. Thus, post hoc analyses with the SPPB, a performance-based measure of physical functioning used as a secondary outcome in the parent study, was performed. A similar pattern of results emerged with a nonsignificant interaction, time × PHQ-9 (B=−0.01; SE=0.02, P=.610). A significant main effect was found with a 1-point interindividual difference in PHQ-9 associated with 0.04 lower SPPB total score.

Sensitivity analyses

Sensitivity analyses were conducted to explore the association between depression symptoms and level and rate of change in physical function and participation when PHQ-9 scores were dichotomized at the clinically significant threshold (PHQ-9 score≥10). Clinically significant depression was associated with significantly lower scores on LLFDI-F and LLFDI-D (LLFDI-F: B=−1.68; SE=0.79, P=.030; LLFDI-D Frequency: B=−2.34; SE=0.60, P<.001; LLFDI-D Limitation B=−4.83; SE=1.59, P=.002). Similar to the continuous analyses, as assessed by the interaction term (time × PHQ dichotomized), clinically significant depression was not associated with rate of change in physical functioning or participation. Among 123 participants who endorsed “having (depression) as a problem at baseline,” no significant time × PHQ-9 effects were found. Main effects emerged that replicated

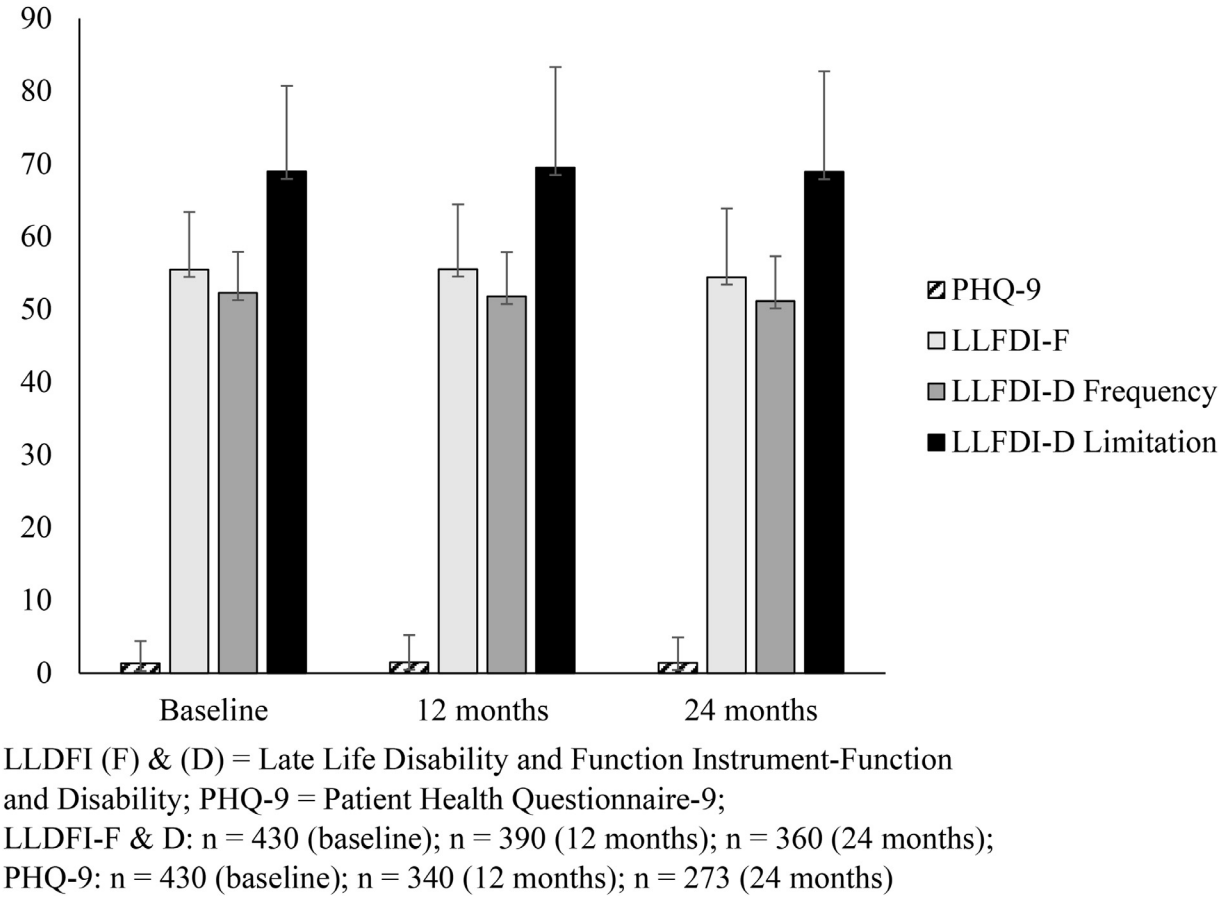

Fig 1 Average scores of depression symptoms and disability outcomes over 2 years.

the larger sample (supplemental appendix S1; available online only at http://www.archives-pmr.org/).

Discussion

In this longitudinal study of older adults at risk of mobility decline, greater depression symptoms were associated with worse physical functioning and participation at each time point over 2 years of follow-up but were not associated with the rate of change in outcomes. The current findings both confirm and contrast prior studies in healthy older adults. Findings are consistent with a prior study of older, healthy, biracial adults in which depression scores were associated with overall physical performance but were not associated with decline over 5 years.[24] Yet, the current findings conflict with several past investigations that found that depression symptoms are associated with declines in physical functioning[9,10,25] and participation[26-28] in healthy older adult samples.

Several possible reasons exist for mixed results. First, our sample was remarkably free of depressive symptoms, which limited variability in scores and may have dampened our ability to detect a signal between depression symptoms and disability outcomes. Nonetheless, if there was a sharp trend among individuals with greater depression, it would likely be detected, even if small. Second, the assessment period was limited to 2 years. It is possible that a prospective association exists but was not captured because of the length of follow-up.[29] Third, the current study relied on self-reported physical functioning and participation. However, post hoc analyses showed no effect of depression on the rate of change in performance-based physical functioning.

Thus, in a sample of older adults who are at risk of mobility decline, depression may not be the most important predictor of declines in disability outcomes but rather is associated with disability outcomes at each time point. Depression symptoms may exert a greater effect on declines in disability outcomes among patients who have a current diagnosis of depression.[11,26,27,30,31] It may also be that depression has greater effect among individuals who have already experienced participation restriction onset given the reciprocal association between participation and depression.[28,29]

Consistent with prior studies, women had significantly worse physical functioning and restricted participation at each time point.[32] Given that women have a longer life expectancy, lower physical functioning in women than in men is likely because men who survive are by and large healthier overall.[32] Similarly, expected patterns of results were found for education and comorbidity with lower education and greater number of comorbidities associated with lower physical functioning and restricted participation.

Study limitations

There are several limitations of the current study. This is a secondary analysis of data from a longitudinal study that was not designed to comprehensively assess depression and is limited to a self-report screener. Although 29% of participants reported having depression as a problem at baseline, the sample was relatively free of depressive symptoms based on the PHQ-9 scores. Administration of the PHQ-9 as an assessment tool provides adequate sensitivity and specificity in primary care samples[19]; therefore, results are interpreted in the context of a patient population who are well managed for depression. Indeed, of the 123 participants who reported having depression, most (63.4%) reported receiving treatment. We believe that our sample, drawn from an academic-affiliated medical center that did not specifically sample for participants with depression, resulted in a sample with remarkably well-managed depression in primary care. Results may have differed had we sampled participants with greater depression symptoms and/or those meeting clinical criteria for depression.[31] Similarly, comprehensive information on treatment of depression (eg, psychotherapy and/or medications) would enable accounting for the role of treatment of depression on physical functioning and participation over time.[31]

Moreover, there were missing data at follow-up on the PHQ-9, which was not a primary outcome of Boston Rehabilitative Impairment Study of the Elderly. Of the 430 participants at baseline, 273 (63.5%) had complete data at 12 months and 262 (61.0%) had complete data at 24 months. In post hoc analysis, we compared baseline characteristics between participants with and without follow-up PHQ-9 scores. Participants without follow-up data were older (77.4y vs 76.0y, P=.03), less likely to have college or postgraduate schooling (17.9% vs 39.3%, P=<.001), and had worse depression symptoms (1.9 vs 0.97, P=.008), worse physical function (LLFDI-F: 54.2 vs 56.3, P=.005; SPPB: 8.1 vs 9.1, P<.001), and worse participation restriction (LLFDI-D Frequency: 50.7 vs 53.2%, P<.001). They did not differ from participants with follow-up assessments by sex, race, or LLDFI-D Limitation score. Results should be interpreted with this in mind given the association between missingness and baseline scores, which can bias results.

Although results did not support a significant effect of depression symptoms on the rate of change in physical functioning and disability, the absence of a finding, which we believe is in large part due to the low PHQ-9 scores and reduced variability in our sample, emphasizes the critical need for adequate detection and treatment of depression in primary care. Our sample was well managed for depression in primary care; however, older adults remain undertreated nationally.[33] Innovative models combining rehabilitation science, psychology, and geriatric medicine (Age-Friendly 4Ms) would bolster intervention approaches to promote maintenance of physical functioning and mood in older adults at risk of mobility decline with clinically significant depression symptoms.[6] However, there are few promising interventions that target predisability and depression concurrently, with the limited number of randomized controlled trials focused on older adults who are already disabled.[34-36] Integrated interventions that combine physical therapy and/or occupational therapy with behavioral activation, a brief, evidenced-based therapy for depression, would enable targeting function and depression in the same intervention, with the aim of preventing incidence of disability.[37,38]

Conclusions

The current findings show that depression symptoms are associated with poorer disability outcomes cross-sectionally but there was no evidence of prospective association between depression symptoms and rate of change in disability outcomes. Future research is needed in older adult samples who are at high risk of disability with concurrent clinically significant depressive symptoms in order to understand the prospective association between depression symptoms and disability outcomes. Building on future observational studies, intervention development is needed earlier in the disablement process focused on holistically addressing the Age-Friendly 4Ms that concurrently target mobility and depression.

Supplier

a. SAS software, version 8.2; SAS Institute.

Corresponding author

Patricia M. Bamonti, PhD, Research & Development Service, VA Boston Healthcare System, 150 South Huntington Avenue, Boston, MA 02130. *E-mail address:* Patricia.Bamonti@va.gov.

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