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An association between incident disability and depressive symptoms over 3 years of follow-up among older women

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Abstract

BACKGROUND AND AIMS—To examine the impact of new disability on the incidence of depressive symptoms, with 3-year biannual data from The Woman's Health and Aging Study.

METHODS—Subjects (n = 671) were selected if they were independent at baseline in 5 basic activities of daily living (ADLs) and were not depressed (scored < 14 on the Geriatric Depression Scale (GDS; range 0 to 30)). During the follow-ups, worsening of ADL disability (needed help on an increased number of ADLs) and onset of depressive symptoms (GDS score ≥ 14) were defined. For each pair of consecutive interviews in which depressive symptoms was not present in the first interview in the pair, we assessed incidence of worsening disability and depressive symptoms in the second interview of the pair. We also summarized the incidence of depressive symptoms 6 months later among the people who did not develop depressive symptoms at the time they reported a new disability.

RESULTS—Compared with those not developing disability, after adjusting for demographic characteristics, number of diseases, and ADL difficulty level at the moment of onset of the disability, the odds ratio (OR) for developing depressive symptoms at disability onset was 2.2 (95% Confidence Interval (CI): 1.1–4.3). For those developing new disability without depressive symptoms, the adjusted OR for developing depressive symptoms 6 months later was 1.7 (CI: 0.6–4.8).

CONCLUSION—Onset of new disability in basic ADLs had a significant impact on the development of depressive symptoms at the moment of onset. Our results demonstrate that clinicians should carefully evaluate depressive symptoms in patients with new onset of disability.

Keywords

disability; depressive symptoms; older women

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INTRODUCTION

Depression is a common and serious medical condition in older people, and has a considerable influence on functional impairment and disability. The prevalence of depression among disabled people is almost twice that of healthy older adults [1], but the relationship between disability and depression is complex and probably bidirectional. Depressive symptoms at baseline have been associated with poorer physical functioning among older adults after 4 years of follow-up [2], but functional disability may also be an indicator of underlying physical, cognitive, or emotional dysfunction, which may result in the onset of depressive symptoms [2-4]. It has also been suggested that the association between disability and depressive symptoms is due to chronic physical illness and medical conditions, especially in older adults [5,6].

The association between disability and depression among older adults in longitudinal studies has almost always been examined over more than a 1-year time interval [7,8]. Bidirectional relationships between disability and depression have been examined among physically limited older people [9]; it has also been found that disability has greater and quicker effects on depression than the effect of depression on disability during a one-year interval. A single study utilized a 6-month interval to demonstrate that health indicators (functional difficulties in several activities of daily living (ADL) items, medical conditions, and impairments in basic functions) significantly contributed to the prediction of depression at 6 months among a healthy population aged 55 years and older, but the reciprocal effect of depression on health in the following 6 months was not significant [10]. This suggests that differing mechanisms may be at work immediately after the onset of disability and later on in the chronic phase. Although it is clear that elderly individuals with disability are at risk of depression [11], no study has examined whether new or worsening disability affects the onset of depression over the short term, and little is known about the effect of worsening disability on depression among the older population with mild to severe disability.

The purpose of our study was to examine whether onset of worsening disability has an impact on depressive symptoms over a short time interval among older women with mild to severe disability. We hypothesized that the additional burden of disability would have a greater effect on depressive symptoms over the short term (6 months) than the long term (1 year or more). With comprehensive 3-year biannual follow-up data, the Women's Health and Aging Study (WHAS) is particularly suited to test this hypothesis, since it includes both standard measures of depressive symptoms and self-reported and objective data on functional status determined every 6 months over a 3-year follow-up.

METHODS

Study Population

The study population is taken from WHAS I, a longitudinal investigation sponsored by the Laboratory of Epidemiology, Demography, and Biometry of the National Institute on Aging and conducted by The Johns Hopkins Medical Institutions. Baseline data were obtained from November 1992 to February 1995 and biannual evaluations were administered for the following 3 years.

The details of selection criteria and study design have been described in detail. Briefly, a stratified random sample of 6,521 women was selected from the Health Care Financing Administration's Medicare enrollment files for 12 contiguous zip codes in Baltimore, Maryland. A total of 4,137 women participated in screening interviews performed at home. Individuals who reported difficulties in two or more of four domains of physical disability and scored 18 or greater on the Mini Mental State Examination were included in the study.

Disability was assessed by self-report of difficulty in performing 15 tasks in four domains: 1) upper extremity function, 2) mobility and exercise tolerance, 3) higher functional tasks, and 4) basic self-care tasks. Overall, 1,409 subjects met the inclusion criteria. One thousand and two women (71%) agreed to participate in the full study and were followed biannually for up to 3 years.

To examine the impact of worsening disability on depressive symptoms, we selected subjects who were independent in 5 basic activities of daily living (ADLs; getting in and out of bed and chairs, bathing, eating, dressing, using the toilet) and were not depressed, scoring < 14 on the Geriatric Depression Scale (GDS; range 0 to 30) [12] at baseline. Of the 1,002 women, 172 had depressive symptoms, 218 received help in one or more of the 5 basic ADLs, and 331 had neither condition at baseline and were excluded from these analyses. A total of 671 subjects were eligible for the study.

Measurements

Disability—Disability was measured with questionnaires asking whether participants received help in 5 basic ADLs (getting in and out of bed and chairs, bathing, eating, dressing, using the toilet, yes = 1, and no = 0) every 6 months during 3 years of follow-up. At baseline, we started with participants who reported receiving no help in ADLs. During the follow-ups, the onset of worsening disability was defined when subjects with a stable disability level at two previous interviews reported in a subsequent interview that they needed help with an increased number of ADLs.

Depressive symptoms—Depressive symptom was assessed at baseline and every follow-up visit with GDS. At baseline, we started with non-depressed participants who scored < 14 on the GDS. During the follow-ups, the onset of new depressive symptoms was defined as having a GDS score ≥ 14 on a subsequent interview among subjects who had not had depressive symptoms in the two previous interviews.

Covariates—Sociodemographics and health-related characteristics ascertained during the baseline interview were age, race, marital status, education (> high school vs. $\leq$ high school), number of blocks walked and flights of stairs climbed in the past week, overall ADL difficulty, and smoking status (never, former, current). Body Mass Index (BMI) was calculated as weight in kilograms/height in meters squared. An overall ADL difficulty measure was created on the basis of the greatest level of difficulty reported in any one ADL. The levels of difficulty for each measure were 1) no difficulty, 2) little or some difficulty, 3) a lot of difficulty, or 4) inability to carry out the activity. Pain levels (0 to 3) were defined according to location and severity. The categories were 3 = widespread pain, 2 = moderate pain ≥ 1 site, 1 = mild pain at 2 sites, and 0 = no pain or mild pain. The details of the pain categorization have been published previously [13].

Baseline physical performance was measured by the Short Physical Performance Battery (SPPB), which has previously been described in detail [14-16]. It evaluates lower extremity function by means of tests of gait speed, standing balance, and time to rise from a chair five times. For each test, a score of 0 to 4 is assigned according to cut-off points determined in a representative population of older men and women. A summary performance score is created by adding the individual test scores, 12 representing the best performance. The interview and physical performance tests were administered in participants' homes.

The status of 17 chronic conditions at baseline was ascertained through self-report, selected examinations, X-rays, medications, blood tests, medical record reviews, and a questionnaire completed by participants' primary care physicians. The conditions were coronary artery disease (angina pectoris, myocardial infarction), congestive heart failure, peripheral artery

disease, stroke, chronic obstructive or restrictive pulmonary disease, hip fracture, diabetes mellitus, lower-extremity (knee and hip) and hand osteoarthritis, rheumatoid arthritis, disc disease, spinal stenosis, Parkinson's disease, and cancer. The presence of each disease was determined by application of all data to standardized state-of-the-art algorithms and reviewed by trained clinicians. The biannual follow-up interviews measured the same variables as described above, although disease status was by self-report of a physician's diagnosis.

STATISTICAL ANALYSIS

Data organization

To study the short-term impact of worsening disability on depressive symptoms, we observed each participant's status across 7 biannual assessments (baseline and 6 follow-ups) over 3 years. Figure 1 shows the study design for the two different analyses. Among participants who had no disability and no depressive symptoms at baseline, we selected subjects who had the same disability level and no depressive symptoms in the previous two interviews and followed them for the next two interviews. All subsequent pairs of interviews were collected for 3 years. First, we summarized the incidence of worsening disability and looked at the rate of depressive symptoms among participants with worsening disability, compared with that among participants with stable disability level (Table 2). In a second analysis, we summarized the depressive symptom rate 6 months after worsening disability among people not developing depressive symptoms at the time of worsening disability, and compared this rate with the depressive symptoms rate among those who had stable disability (Table 3).

Analysis

Differences in sociodemographic and baseline health status between groups were compared by means of chi-square tests for categorical variables and analysis of variance for continuous variables. The percentage of subjects with worsening disability and depressive symptoms was calculated among subjects who had no disability and no depressive symptoms in the previous interview (Table 2). The percentage of subjects who developed depressive symptoms 6 months after worsening disability was also determined and is summarized in the aggregation of 3 years of follow-ups (Table 3).

Analyses were performed with the Statistical Analysis Software (SAS), version 8.12. Binomial regression models in the GENMOD procedure in SAS were used to evaluate the impact of worsening disability on the incidence of depressive symptoms. The GENMOD procedure has a function that identifies subjects in the dataset, and responses from different subjects are assumed to be statistically independent, whereas responses within subjects are assumed to be correlated. The procedure takes into account the correlations of replicated subjects entered into the dataset.

In each two-visit pair, we compared depressive symptom rates between subjects with stable disability (reference group) and subjects with worsening disability. The models were first adjusted for baseline age, and then for baseline covariates such as race, education, and marital status, number of diseases, number of blocks walked and flights climbed for during the past week, systolic blood pressure, smoking status, pain level, and BMI at baseline. Lastly, the models included variables collected at the first of the paired interviews, GDS scores, overall ADL difficulty, and SPPB scores. Cases with self-report of heart disease events (myocardial infarction, congestive heart failure, angina) at the first of the paired interviews were excluded from the final analysis.

RESULTS

Overall, 671 participants who reported no need of help in 5 basic ADLs and who did not meet the definition of depressive symptoms at baseline were included in the study population (Table 1). The study group had significantly more education, fewer chronic diseases, greater physical activity level in walking and climbing, better SPPB score, and reported less difficulty in performing ADLs than those who were excluded.

Table 2 shows the number of participants who had an eligible pair of consecutive interviews at each follow-up round. A total of 2,621 pairs of consecutive interviews from all follow-up rounds were available, and among those, 231 worsening disability events occurred (9%). The incidence of depressive symptoms was 7% in subjects with worsening disability between two interviews and 3% in those with stable disability during the interval between the consecutive interviews (six months).

Table 3 shows depressive symptom rates 6 months after worsening or stable disability among participants who had not developed depressive symptoms between the two visits. The rate of new depressive symptoms at the subsequent follow-up visit was 6% among subjects with worsening disability during the previous interval and 3% among those with stable disability. In a model that used all rounds of data and adjusted for multiple confounders, women with worsening disability were more likely to develop depressive symptoms at the time of worsening disability compared with those who remained stable (OR:2.2, 95% CI: 1.1-4.3). The odds ratios (OR) for new depressive symptoms 6 months after worsening disability not accompanied by depressive symptoms was 1.6, but did not reach statistical significance (95% Confidence Interval (CI): 0.6-4.8).

DISCUSSION

The impact of worsening disability on depressive symptoms among older women with mild to severe disability living in the community was examined at the same time as subjects reported worsening disability, and then 6 months later. We found that older women who reported worsening disability were almost two times more likely to develop depressive symptoms at the same time, compared with those who did not report worsening disability. Although the participants who developed worsening disability but did not have depressive symptoms at that time were also more likely to report new depressive symptoms in the subsequent follow-up compared with those who had stable disability, the depressive symptom rate was lower and no longer statistically significant. Therefore, we have evidence that the impact of disability on depressive symptoms may occur in a shorter time than the previously reported interval, 1 year or more. To our knowledge, this study is the first to examine the short-term impact of worsening disability onset on depressive symptoms in the older population. Our findings have important implications for treatment and screening efforts, in that disability has a strong short-term impact on depressive symptoms and therefore older adults who report new or worsening disability need to be screened for depression.

Previously, most studies found a link between the long-term impact of disability on depression [3]. However, the evidence of an immediate effect of new or worsening disability on depression has not been clearly examined. Several other studies have reported similar results to ours, concluding that disability has a significant impact on depression, rather than depression having an impact on disability[9,17,18]. However, most of those studies measured disability at baseline and followed depression status over time, and the time intervals to measurement of depression were generally 1 year or longer. Our finding - of the immediate impact of new or worsening disability on depressive symptoms - was overt at a 6-month interval, and clearly

shows that the impact of worsening disability within 6 months of its onset was significantly greater than the impact of worsening disability after an additional 6 months.

The association of depressive symptoms with disability in this study may be confounded by other factors, such as disease onset during follow-up [19]. However, our findings are consistent with those of Zeiss [17], suggesting that the relationship between health status and depressive symptoms are explained by the effect of disease on functional status. The immediate effect of new or worsening disability on depressive symptoms among those who previously had stable status, in both depressive symptoms and disability, remained, even after adjusting for the number of diseases at baseline, major medical events that occurred over follow-up (congestive heart failure, myocardial infarction, angina), SPPB score, and overall ADL difficulty at the time of follow-up. Therefore, our study suggests that, although disease may influence the relationship between disability and depressive symptoms, it is not strong enough to eliminate the association independently. Since our study population already had several chronic conditions at baseline losing independence in daily living may have had a stronger influence on our study population than changes in chronic disease status. In our study, it was not possible to examine the disability-depression relationship in a healthier population, and further research may need to examine this issue.

People who developed new disability toward the end of the follow-up period may have been healthier than those who dropped out or died before 3 years of follow-up. This may actually have reduced the impact of new or worsening disability on depression, when all the pairs of observations are combined. However, our result was significant, even after all disability onsets throughout the follow-ups were combined, providing evidence that the result of a short-term impact of disability on depression among older disabled women was robust. Since WHAS only focused on mildly to severely disabled older women, we cannot exclude the possibility that the association between disability and depression may have arisen because this was a selected population. However, our analyses were restricted to WHAS participants who did not have ADL disability at baseline. Another concern is that we assessed disability and depression at the same time, after 6 months, for the second interview of a pair. Although it is unlikely in this short interval, that subjects first became depressed and then depression caused the disability, our study cannot prove that depression did not come first, as we measured disability and depression at the same time.

Lastly, the disability measure relied on subjects' self-reports. Disability focused on independence in ADL tasks, asking whether subjects received help in performing 5 basic ADLs, which may be more reliable than asking about difficulty levels. The questionnaire we used is commonly applied to measure ADLs in older populations [5,6,20,21]. To account for health status better, we adjusted the final model, using measures of physical activity and objective physical performance level, and the results remained significant.

We were able to look at the immediate impact of new disability onset on depressive symptoms by using 3 years of biannual follow-up to examine pairs of consecutive interviews, an approach that has not been used in other studies. Specifically, we were able to capture necessary data every 6 months and, by using all variables - such as physical performance level, overall ADL difficulty level, and other health conditions in each follow-up - we were able to standardize each pair of two consecutive interviews by adjusting for the conditions at the onset of the interval. We were also able to include those variables in the final model. Therefore, our analyses were able to adjust finely for multiple markers of health status at the onset of each interval. Lastly, we found that new-onset disability has a short-term impact on depressive symptoms within 6 months but, if depressive symptoms do not develop at that time, there is a lesser impact after 6 months. These results therefore suggest that, if people do not have depressive symptoms within 6 months of disability onset, they are at less risk of developing depressive symptoms

subsequently. It is possible that those with early-onset depression may go on to suffer chronic depression. Our finding suggests that clinicians need to screen carefully for depression when older people living in the community report new disabilities. Further research, to follow both disability and depression after shorter time intervals, may be needed to confirm our results.

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Table 1
Baseline Sociodemographic Characteristics of Selected Study Group and Subjects Excluded From Study

	Total (n =1002)		Study Group (n =671)		Excluded Subjects (n = 331)	
		n (%)		n (%)		
Age		1002				
	65-74	(39)	268 (40)		120 (36)	
	74-84	(31)	208 (31)		103 (31)	
	85+	(30)	195 (29)		108 (33)	
Ethnicity		1002				
	White	(71)	484 (72)		229 (69)	
	Black	(28)	184 (27)		100 (30)	
	Others	(0.5)	3 (0.5)		2 (0.6)	
Married		1002				
		(21)	142 (21)		69 (21)	
Education > High School		1002				
		(18)	142 (21)		38 (11)	
Chronic Diseases ≥2		1002				
		(60)	366 (55)		233 (70)*	
Mobility Difficulty		1000				
		(77)	477 (71)		291 (88)*	
Physical Activity		938				
	Low	(91)	605 (92)		248 (88)*	
	Middle	(8)	44 (7)		32 (11)	
	High	(1)	8 (0.01)		1 (0.004)	
ADL [†]		1002				
	No difficulty	(35)	290 (43)		60 (18)*	
	A little/some difficulty	(33)	248 (37)		87 (26)	
	A lot of difficulty	(32)	132 (20)		184 (56)	

Behavioural Factors	n	m (SD)
Body Mass Index	1002	28.3 (6.5) 28.3 (6.4) 28.4 (6.8)
Systolic Blood Pressure, mmHg	1002	141.0 (23.5) 140.8 (22.8) 141.5 (24.7)
Summary Performance Score	980	5.9 (3.3) 6.8 (3.0) 4.2 (3.1)*
No. of Diseases	1002	2.0 (1.4) 1.8 (1.4) 2.3 (1.5)*

Behavioural Factors	n	m (SD)
No. of blocks walked	920	8.2 (17.2)
Flights of stairs climbed	918	20.0 (25.7)
Former/Current Smoker, n,(%)	1002	469 (46.8)
n = number of subjects, m = mean, SD = standard deviation		315 (31.4)
		154 (15.4)

* p < 0.05 comparing study group with excluded subjects

[†] Disability Status- Mobility: self-reported difficulty walking a quarter-mile (i.e., 2-3 blocks) or climbing up 10 steps ADL: self- reported difficulty transferring from/into a bed or chair, bathing or showering, walking across a small room, dressing, eating, or using toilet.

Table 2

Rate and Odds Ratios of Developing Depressive Symptoms at the Moment of Onset of Worsening Disability

Onset of Depressive Symptoms At Time of Worsening Disability				
Round of Onset	Onset of Worsening Disability (%)	Onset of Depressive Symptoms among Stable Disability (%) (Reference)	Onset of Depressive Symptoms among Worsening Disability (%)	Logistic regression Odds Ratio (CI)
Round 2	42/438 (9.6)	22/396 (5.6)	4/42 (9.5)	1.7 (0.6-5.4)
Round 3	41/467 (8.8)	11/426 (2.6)	4/41 (9.8)	4.5 (1.3-15.0)
Round 4	30/438 (6.9)	11/408 (2.7)	1/30 (3.3)	1.2 (0.1-10.0)
Round 5	39/446 (8.7)	6/407 (1.5)	2/39 (5.1)	3.2 (0.6-17.0)
Round 6	41/418 (9.8)	14/377 (3.7)	4/41 (9.8)	2.7 (0.8-8.8)
Round 7	38/414 (9.2)	11/376 (2.9)	1/38 (2.6)	0.8 (0.1-6.7)
SUM cases	231/2621 (8.8)	75/2390 (3.1)	16/231 (6.9)	2.2 (1.1-4.3)*

CI = Confidence Interval

* Final model of Proc Genmod, adjusted for age, ethnicity, education, marital status, number of diseases, number of blocks walked and flights climbed in the past week, previous ADL disability status, previous GDS score, pain level, SPPB score, BMI, physical activity, systolic blood pressure, and smoking status.

Table 3

Rate and Odds Ratios of Developing Depressive Symptoms 6 Months after Worsening Disability among Women not Developing Depressive symptoms at Time of Worsening Disability

Onset of Depressive Symptoms 6 months After Worsening Disability				
Round of onset / Subsequent Round	Onset of Worsening Disability (%)	Onset of Depressive Symptoms among Stable Disability (%) (Reference)	Onset of Depressive Symptoms among Worsening Disability (%)	Logistic regression Odds Ratio (CI)
Round 2-3	28/348 (8.1)	7/320 (2.2)	0/28 (0)	-
Round 3-4	38/427 (8.9)	10/389 (2.6)	3/38 (7.9)	2.9 (0.7-11.3)
Round 4-5	23/399 (5.7)	5/376 (1.3)	2/23 (8.7)	6.7 (1.1-7.1)
Round 5-6	31/392 (7.9)	13/361 (3.6)	1/31 (3.2)	0.8 (0.1-6.7)
Round 6-7	28/380 (7.4)	10/352 (2.8)	3/28 (10.7)	3.7 (0.9-14.7)
SUM cases	148/1946 (7.6)	45/1798 (2.5)	9/148 (6.1)	1.6 (0.6-4.8)*

CI = Confidence Interval

* Final model of Proc Genmod, adjusted for age, ethnicity, education, marital status, number of diseases, number of blocks walked and flights climbed in the past week, previous ADL disability status, previous GDS score, pain level, SPPB score, BMI, physical activity, systolic blood pressure, and smoking status.