



Published in final edited form as:

*Arch Gerontol Geriatr.* 2012 January ; 54(1): 202–205. doi:10.1016/j.archger.2011.04.001.

## Patterns and correlates of depression in hospitalized older adults

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### Abstract

Depression is often associated with illness or injury requiring acute hospitalization, particularly in older adults. We sought to determine patterns of change in depressive symptoms in older adults from hospitalization to 3 months post discharge and to examine factors associated with depressive symptoms 3 months after discharge. The study included 197 patients aged 65 years or older hospitalized with an acute medical illness. Sociodemographic and clinical measures, including depressive symptoms using the Center for Epidemiologic Study—Depression (CES-D) scale, were collected during the inpatient stay and at 3 months post discharge. Mean age was  $75.3 \pm 7.5$  ( $\pm$ S.D.) years, 59% of the participants were female, 61% unmarried, and 72% had a high school education or more. High depressive symptoms (i.e., CES-D  $\geq 16$ ) were reported in 37% at admission. Of the 8% depressed at follow-up, 81% were also depressed at admission; 19% were new cases of depression. Depressive symptoms 3 months post-hospitalization were significantly associated with follow-up daily living skills ( $p = 0.001$ ) and social support ( $p < 0.0001$ ). Patients with persistent depressive symptoms make up the majority of post-hospitalization depression cases. Post-hospitalization social support and daily living skills appear to be important in the management of follow-up depressive symptoms.

### Keywords

Geriatrics; Mental health; Recovery

## 1. Introduction

Depression can have adverse health effects for many hospitalized older adults. High levels of depressive symptoms are associated with poor treatment adherence, longer lengths of stay (LOS), increase in hospital readmission, and reduced functional status (Pennix et al., 1998; Herrman et al., 2002; Marin et al., 2003; Lenze et al., 2004; Onishi et al., 2004; Sayers et al., 2007; Cullum et al., 2008). Compounding this relationship is the fact that hospitalization can increase depressive symptoms in many older adults. The prevalence of depressive symptoms is as high as 50% among hospitalized older adults (Dunham and Sager, 1994; Diamond et al., 1995; Koenig et al., 1998; Lieberman et al., 1999; Blazer, 2003; Brodaty et al., 2007) yet

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### Conflict of interest statement

None.

is reported to be much lower in persons 3-12 months after hospital discharge (Lieberman et al., 1999; Hammond et al., 2008). The factors associated with this change are poorly understood (Hammond et al., 2008).

Most studies addressing the dynamic nature of hospital-related depression simply report sample prevalence of depressive symptoms at different time-points; e.g. admission, discharge, and/or post-discharge (Jackson and Baldwin, 1993; Dunham and Sager, 1994; Diamond et al., 1995; Koenig et al., 1998; Lieberman et al., 1999; Mast et al., 2004; Onishi et al., 2004; Brodaty et al., 2007; Hammond et al., 2008). While changes in sample prevalence rates capture population-level patterns, this approach does not provide individual-level information regarding the number of patients with persistent symptoms versus those with incident depressive symptoms. Subsequently, it is not possible to identify potentially modifiable factors that may be differentially associated with persistent and incident depressive symptoms following hospitalization.

A better understanding of factors associated with high depressive symptoms post-discharge may provide information that is useful in (1) identifying patients who are vulnerable to post-hospital depression and (2) proactively assessing and treating modifiable risk factors during and after hospitalization. Few studies have assessed these factors in hospitalized older adults (Barefoot et al., 2003; Hammond et al., 2008). Previously, high depressive symptoms were associated with a length of stay  $\geq 4$  days, hospital readmission, and lack of social support one month after discharge (Hammond et al., 2008). However, patients may still be recovering from the initial medical event within 30 days of discharge. A longer follow-up period would provide more time for physical recovery and a different view of factors associated with ongoing or new depression.

The first goal of this study was to describe patterns of change in depressive symptoms in older patients discharged from a medical-surgical unit. We hypothesized that the number of patients with high depressive symptoms would decrease significantly and very few would show new depression at follow-up. A second goal was to identify sociodemographic and clinical factors associated with depressive symptoms 3 months post-discharge. Based on previous literature (Blazer, 2003) we hypothesized that potentially modifiable factors such as lack of social support and limitations in activities of daily living (ADL) at follow-up would predict post-hospitalization depression.

## 2. Subjects and methods

We screened a convenience sample of 403 older patients consecutively admitted to an Acute Care for Elders (ACE) unit. Eligible patients included those aged 65 years and older who were admitted from home with an acute medical event. All patients reported being able to walk across a small room prior to admission. Patients were also screened for cognitive appropriateness by nursing staff as indicated by their ability to respond to basic questions about orientation to person, place, and time.

Interviewers trained in clinical research techniques collected sociodemographic and clinical measures within 48 h of admission. In hospital interviews were performed in a single session. Follow-up interviews were completed 3 months after discharge by telephone. Data were missing for 206 of the eligible patients (follow-up depression,  $n = 37$ ; follow-up social support scores,  $n = 31$ ; admission ADL,  $n = 38$ ; follow-up ADL,  $n = 57$ ; and co-morbidities,  $n = 47$ ). The final sample included 197 older adults with complete data. No significant differences were found for age, race, gender, or co-morbidity between those included and excluded in the analysis. The study was reviewed and approved by the University's institutional review board.

## 2.1. Outcome measure

Depressive symptoms were measured using the CES-D, a self-report scale designed to measure depressive symptoms in community-dwelling and hospitalized older adults (Radloff, 1977; Koenig et al., 1998). The CES-D measure was used both as a continuous scale with a potential range of 0–60 and as a dichotomized variable: a score of  $\geq 16$  was categorized as high depressive symptoms, and  $< 16$  as low depressive symptoms (Radloff, 1977).

## 2.2. Predictor variables

Sociodemographic and clinical variables were assessed by chart review and a face-to-face interview within 48 h of admission. Sociodemographic variables included age (continuous and categorical), gender, ethnicity (white vs. non-white), marital status (married vs. unmarried), and education (continuous in years, and dichotomized as  $< 12$ ,  $\geq 12$  years). Clinical variables included body mass index (BMI) (continuous and categorized  $< 22$ ,  $22$ – $29.9$  and  $\geq 30$ ) and length of stay (continuous and dichotomized as  $\leq 4$  and  $> 4$ ). Co-morbidity was measured using an index scale including previously diagnosed stroke, heart attack, hip fracture after 50, diabetes, arthritis, and cancer; and used as a continuous and as a dichotomized variable, 0 versus  $\geq 1$ .

Functional status was assessed by a 7-item assessment of basic ADL (Katz et al., 1963). Patients were asked if they needed help, either from another person or by the use of a device to complete the following activities: walking across a small room, bathing, grooming, dressing, eating, and getting up from a bed or chair, and toileting. ADL items were rated from 0 to 7 with 0 indicating no limitation and 7 indicating maximal limitation. Social support was measured using the Duke-University of North Carolina Social Support Questionnaire (Duke-UNC SSQ) (Broadhead et al., 1988). The Duke-UNC SSQ measures perception and type of personal social support through a 10-item questionnaire in which individuals rate perceived support on a scale of 1–5. Higher scores indicate higher levels of perceived social support.

**2.2.1. Statistical analysis**—Means  $\pm$  S.D. were reported for continuous variables and proportions for categorical variables. Sociodemographic and clinical variables were analyzed by  $\chi^2$ -tests and stratified by the categorical CES-D score ( $< 16$  vs.  $\geq 16$ ). A  $2 \times 2$  table was created to show changes in the hospitalized sample by the categories of high versus low depressive symptoms.

Multivariate linear regression analysis was used to examine associations between post-hospitalization depression, sociodemographic and clinical variables. Variables were added in blocks. The first model included sociodemographic measures. The second model added clinical measures. Both models controlled for in-hospital depression scores. Model assumptions were tested and met for regression analysis. Statistical significance for all tests was set at  $p < 0.05$  and data were analyzed using SAS (Version 9.1, SAS Institute, Cary, NC).

## 3. Results

The sample mean age was  $75.3 \pm 7.5$  years (range 65–100), 59% were female, 61% unmarried, and 72% had 12 years or more of education. The majority of participants (65%) were white. Table 1 includes the sociodemographic and clinical characteristics of the sample stratified by depressive symptom category (CES-D  $< 16$  vs.  $\geq 16$ ). Significant differences were found in depressive symptoms by gender ( $p = 0.03$ ), marital status ( $p = 0.04$ ), race/ethnicity ( $p = 0.003$ ), ADL's ( $p < 0.0001$ ) and social support ( $p < 0.0001$ ). Patients who

were female, white, unmarried, or who had lower social support and higher ADL impairment were significantly more likely to have higher depressive symptoms.

Table 2 shows the pattern of change in depressive symptoms from admission to 3 months post discharge. At admission, 37% reported high depressive symptoms (CES-D  $\geq 16$ ) while 63% reported low depressive symptoms (CES-D  $< 16$ ). At follow-up, only 8% report high depressive symptoms, a significant reduction in prevalence ( $p < 0.0001$ ). In fact, 82% of the patients with high depressive symptoms in hospital moved to the low depressive symptoms category at 3-month follow-up. Among the 16 patients reporting high depressive symptoms at follow-up, 81% had high depressive symptoms during the prior in-hospital assessments. Conversely, among the 181 patients with low depressive symptoms at follow-up, 33% reported high depressive symptoms 3-months earlier in hospital.

Table 3 shows the associations between follow-up depressive symptoms, sociodemographic and clinical variables. After controlling for in hospital depression in Model 1, no sociodemographic characteristics were statistically significant. After adding clinical variables, Model 2 shows that both follow-up ADL score ( $b = 1.04 \pm 0.30$ ,  $p = 0.001$ ) and social support score ( $b = -0.23 \pm 0.06$ ,  $p < 0.0001$ ) were associated with depressive symptoms at follow-up. The variance explained by this model was 34%.

#### 4. Discussion

The goals of this study were to describe change in depressive symptoms in a sample of older patients from acute hospitalization to 3-month follow-up. We also examined factors associated with persistent or new depressive symptoms. Our results can be summarized as follows. More than one third of older patients were categorized with high depressive symptoms while in the hospital. At a 3-month follow-up interview, a majority (82%) of those with high depressive symptoms reported lower depressive symptoms. Of those who were depressed at follow-up, the majority of patients (81%) were also depressed in hospital. Factors significantly associated with high depressive symptoms at 3 month follow-up included low social support and limitations in daily living skills such as bathing and dressing.

The prevalence of high depressive symptoms in our sample (37%) was consistent with previous studies (Jackson and Baldwin, 1993; Koenig et al., 1998; Onishi et al., 2004). In a cross-sectional study of 198 older adults admitted to a geriatric ward in a Japanese university hospital, 39% of patients were classified with high depressive symptoms using the Geriatric Depression Scale (GDS) (Onishi et al., 2004). Using the same scale, 35% of older patients admitted to general and geriatric wards in the United States ( $n = 59$ ) were found to be depressed (Jackson and Baldwin, 1993). Community hospital sampling of older patients suggests that up to 51% have high depressive symptoms using the CES-D scale (Koenig et al., 1998). While these prevalence rates may vary due to methodological difference, depressive symptoms remain an important factor associated with hospitalization and evidence indicates high depressive symptoms are related to increased length of stay, decreased treatment adherence, and hospital readmission (Covinsky et al., 1997; Pennix et al., 1998; Herrman et al., 2002; Marin et al., 2003; Sayers et al., 2007; Cullum et al., 2008).

Our findings are also consistent with other studies showing that depressive symptoms significantly decrease post-discharge; however, the prevalence in our sample dropped more sharply. Of those that were initially depressed in our sample, 82% report low depressive symptoms at follow-up. In comparison, researchers studied 151 older patients admitted to an acute cardiac hospital unit, 50% of those originally categorized as depressed were re-categorized as not depressed at a 1 month follow-up (Hammond et al., 2008). In a small

sample ( $n = 51$ ) of patients admitted to an inpatient rehabilitation unit, 11% reported no further depression by discharge as compared to admission (Diamond et al., 1995). The variations in observed prevalence patterns may be due to differences in measures (GDS vs. CES-D), time of assessment (discharge vs. 1–3 month follow-up), type of setting (inpatient rehabilitation center vs. ACE unit) or patient diagnoses (hip fracture, stroke and cardiac vs. general medical). Taken together, however, these studies suggest a decreasing trend in depressive symptoms from hospitalization to follow-up.

Of particular interest is the categorical change in depressive symptoms from admission to 3 month follow-up. While the overall prevalence of high depressive symptoms dropped from 37% to 8%, changes within categories are important to acknowledge. Of the 8% with follow-up depression, 81% were depressed in hospital and 19% report new depressive symptoms. Mast et al. (2004) assessed categorical change in depression in 100 geriatric rehabilitation patients; 40% of patients with in-hospital depression were still depressed at 6-month follow-up and 10% of patients without in-hospital depression became depressed by 6-month follow-up. High proportions of persistent depression and new depression in both studies highlight the need for closer assessment of depressive symptoms in hospital and structured mental health care after discharge. The ACE unit provided an interdisciplinary team approach to patient care that included active family involvement in hospital care and discharge planning and this may have contributed to the decrease in persons with high depressive symptoms at 3 month follow-up compared to previous studies (Mast et al., 2004; Hammond et al., 2008).

We found low social support and higher ADL limitations were associated with post-discharge depression, both of which have been associated with depression in previous studies (Covinsky et al., 1997; Pennix et al., 1998; Herrman et al., 2002; Barefoot et al., 2003; Cullum et al., 2008; Hammond et al., 2008). Of interest is the potentially modifiable nature of these variables. ADL and social support limitations can be addressed during hospitalization and through post-hospitalization after care in order to protect those vulnerable to persistent or new depression that may lead to hospital readmission. This is an important area for future research.

Limitations of this study should be noted. First, we did not collect data on previous history of depression or prescribed anti-depressant medications in hospital. As a result, we could not control for the potential effect of medications accounting for the decrease in depressive symptoms. Studies show that depressive symptoms are often undiagnosed and under-treated in older adult populations, therefore the likelihood of receiving new treatment for depression during a hospital stay less than 4 days is low (Covinsky et al., 1997; Dalby et al., 2008). However, further study is warranted on the impact of anti-depressant medication as a predictor of change in depressive symptoms in this population. Finally, our sample was limited to patients hospitalized at an academic medical center and receiving treatment on an ACE unit and the results may not generalize to other hospitalized older adults.

In conclusion, while over one third of our sample reported high depressive symptoms during hospitalization, significantly fewer participants reported high depressive symptoms at the three-month follow-up interview. Of those that were depressed at follow-up, the majority of persons (81%) were also depressed in hospital. Lower social support and limitations in basic daily living skills were found to be associated with high depressive symptoms at three-month follow-up. Further research is necessary to better understand the persistence of depressive symptoms associated with hospitalization (or hospital readmission) and the effect of treating modifiable risk factors across the continuum of care.

## Acknowledgments

This work was supported by the National Institutes of Health (K12-HD055929, R01-AG031178, R03-HD058216, T32-HD007539); and the National Institute on Disability and Rehabilitation Research (H133F090030). The sponsors had no role in the design, methods, subject recruitment, data collections, analysis, or preparation of the manuscript.

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**Table 1**

Sociodemographic and clinical characteristics of the sample by depressive symptoms during hospitalization, *n* (%).

Parameters Number	Total 197	CES-D <16 125	CES-D ≥ 16 72	<i>p</i> <
Age (years)				
65–74	103 (52.3)	63 (50.4)	40 (55.6)	0.49
≥75	94 (47.7)	62 (49.6)	32 (44.4)	
Males	80 (40.6)	58 (46.4)	22 (30.6)	0.03
Females	117 (59.4)	67 (53.6)	50 (69.4)	
Whites	127 (64.5)	71 (56.8)	56 (77.8)	0.003
Non-Whites	70 (35.5)	54 (43.2)	16 (22.2)	
Married	76 (38.6)	54 (43.2)	22 (30.6)	0.04
Unmarried	121 (61.4)	71 (56.8)	50 (69.4)	
Education				
<12 years	55 (27.9)	37 (29.6)	18 (25.0)	0.48
≥12 years	142 (72.1)	85 (70.4)	54 (75.0)	
BMI				
<22	32 (16.2)	17 (13.6)	15 (20.8)	0.27
22–29.9	95 (48.2)	65 (52)	30 (41.7)	
≥30	70 (35.5)	43 (34.4)	27 (37.5)	
Co-morbidities				
None	38 (19.3)	23 (18.4)	15 (20.8)	0.68
≥1	159 (80.7)	102 (81.6)	57 (79.2)	
LOS				
≤4 days	135 (68.5)	85 (68.0)	50 (69.4)	0.83
>4 days	62 (31.5)	40 (32.0)	22 (30.6)	
ADL limitation				
None	125 (63.9)	93 (74.4)	32 (45.4)	0.0001
Any	72 (36.5)	32 (25.6)	40 (55.6)	
Duke-UNC SSQ				
Mean ± S.D.	49.15 ± 7.6	51.2 ± 5.4	45.6 ± 11.3	0.0001*

Notes: All analyzes are  $\chi^2$ -test, except indicated by \*, which was a Student's *t*-test.



**Table 2**

Number of persons (and %) with high and low depressive symptoms during hospitalization and at 3-month follow-up ( $n = 197$ ).

Person Status	<i>n</i> (%)
Persons with high depressive symptoms (CES-D $\geq 16$ ) in-hospital and at 3-month follow-up	13 (7%)
Persons with low depressive symptoms (CES-D $<16$ ) in-hospital and at 3-month follow-up	122 (62%)
Persons with high depressive symptoms (CES-D $\geq 16$ ) in-hospital and low depressive symptoms (CES-D $<16$ ) at 3-month follow-up	59 (30%)
Persons with low depressive symptoms (CES-D $<16$ ) in-hospital and high depressive symptoms (CES-D $\leq 16$ ) at 3-month follow-up	3 (1%)

**Table 3**

Sociodemographic and clinical variables associated with the 3-month post-hospitalization CES-D total score (continuous) ( $n = 197$ ).

Variables	Model 1		Model 2	
	$b \pm \text{S.E.M.}$	$p <$	$b \pm \text{S.E.M.}$	$p <$
Hospital CES-D total	$0.28 \pm 0.04$	0.0001	$0.16 \pm 0.04$	0.001
Age <sup>a</sup>	$0.03 \pm 0.06$	0.40	$-0.02 \pm 0.06$	0.82
Men (vs. women)	$-0.09 \pm 0.97$	0.68	$-0.07 \pm 0.92$	0.93
White (vs. non-white)	$0.40 \pm 1.01$	0.08	$0.53 \pm 0.96$	0.54
Married (vs. unmarried)	$-2.16 \pm 0.99$	0.03	$-1.69 \pm 0.95$	0.10
Education <sup>a</sup>	$-0.003 \pm 0.15$	0.98	$-0.01 \pm 0.14$	0.93
BMI <sup>a</sup>			$-0.12 \pm 0.07$	0.07
Co-morbidities <sup>a</sup>			$-0.11 \pm 0.37$	0.80
Follow-up ADL sum score <sup>a</sup>		$1.04 \pm 0.30$	0.001	
Follow-up Duke-UNC SSQ <sup>a</sup>		$-0.24 \pm 0.06$	0.001	
$R^2$	0.21		0.34	

<sup>a</sup>Measured as continuous variable.