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Older patients' depressive symptoms 6 months after prolonged hospitalization: Course and interrelationships with major associated factors

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ABSTRACT

The aim of this study was to examine the course of depressive symptoms in older patients 6 months following a prolonged, acute hospitalization, especially the interrelationships among depressive symptoms and its major associated factors. For this study, we conducted a secondary analysis of data from a prospective cohort study of 351 patients aged 65 years and older. Participants were recruited from five surgical and medical wards at a tertiary medical center in northern Taiwan and assessed at three time points: within 48 h of admission, before discharge, and 6 months post-discharge. The course of depressive symptoms was dynamic with symptoms increased spontaneously and substantially during hospitalization and subsided at 6 months after discharge, but still remained higher than at admission. Overall, 26.7% of older patients at hospital discharge met established criteria for minor depression (15-item Geriatric Depressive Scale (GDS-15) scores 5–9) and 21.2% for major depression (GDS-15 scores >10). As the strongest associated factors, functional dependence and nutritional status influenced depressive symptoms following hospitalization. Depressive symptoms at discharge showed significant cross-lagged effects on functional dependence and nutritional status at 6 months after discharge, suggesting a reciprocal, triadic relationship. Thus, treating one condition might improve the other. Targeting the triad of depressive symptoms, functional dependence, and nutritional status, therefore, is essential for treating depressive symptoms and improving the overall health of older adults hospitalized for acute illness.

1. Introduction

Depressive symptoms are common in older patients hospitalized for acute illness. The prevalence of depressive symptoms in these patients has been estimated from 8% to 44% (Cullum, Tucker, Todd, & Brayne, 2006), with approximately one-third having moderate to severe depressive symptoms (Pierluissi et al., 2012). Notably, depressive symptoms are a major risk factor for long-term disability and mortality in older patients (Blazer, Hybels, & Pieper, 2001; Hamer, Bates, & Misbra, 2011), even at subthreshold levels (Vahia et al., 2010).

Treating older patients' depressive symptoms, however, is difficult because late-life depression has different etiologies (Tiemeier, 2003). For example, associated factors for depressive symptoms in late life include health condition, functional status, nutritional status, cognitive status, social support, and other psychosocial factors, in contrast to genetic factors for younger adults (Fiske, Wetherell, & Gatz, 2009; Helvik, Skancke, & Selbaek, 2010; Tsai, 2013). This diversity in associated factors might explain why fewer than half of older patients with major depression achieved remission when treated with pharmacotherapy alone (Wilkins, Kiosses, & Ravdin, 2010).

To improve treatment efficacy for depressed older adults, a focused multimodal, non-pharmacological intervention needs to be developed (Naismith, Norrie, Mowszowski, & Hickie, 2012). However, interrelationships first need to be established among major associated factors and depressive symptoms after a critical event such as acute, prolonged hospitalization. In particular, clinical practice should be informed whether major associated factors, such as functional, cognitive, and nutritional scores predict concurrent and subsequent depressive symptomatology or vice versa, over the course of hospitalization. Thus, the aims of this study were to describe the course of depressive symptoms in older patient from acute, prolonged hospitalization to 6 months after discharge and to determine the directional interrelationships among depressive symptoms and their major associated factors using path analysis.

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2. Methods

2.1. Design and setting

This study was a secondary analysis of data from a prospective, interview-based cohort study of factors associated with functional decline in older hospitalized patients. From 24 med-surgical wards at a 2200-bed medical center in northern Taiwan, three surgical (out of 14) and two medical (out of 10) wards were randomly and proportionally selected after cluster sampling. Participants from those five wards were enrolled and evaluated in face-to-face encounters upon admission, before discharge, and 6 months after discharge (at outpatient clinics) by two trained research nurses. The Research Ethics Committee of the medical center approved the study and every participant provided written informed consent for study participation.

2.2. Study sample

Participants were recruited from older patients consecutively admitted to any of the five study medical-surgical wards between August 2004 and May 2006. These five wards generally enrolled patients with nephrology and endocrine medical conditions, as well patients who are scheduled for upper abdominal and urological surgical procedures. Focusing on the most affected, we recruited only older patients who had prolonged hospitalization, defined as the length of stay (LOS) over 5 days. Participants were not recruited if their expected hospital stay was <5 days ($n = 1091$), their Mini-Mental State Exam (MMSE) score was <20 ($n = 43$), were isolated within the infection control protocol ($n = 56$), were intubated or unable to communicate due to profound sensory loss ($n = 140$). Of 439 eligible subjects, 351 were enrolled (response rate 80.0%). The average LOS was 16.6 ± 12.1 days in this sample. The reasons for nonparticipation included not interested ($n = 57$), not feeling well ($n = 20$), and privacy protection ($n = 11$). The participants ($N = 351$) did not significantly differed from the nonparticipants ($n = 88$) in age ($P = 0.30$), gender ($P = 0.72$), and education levels ($P = 0.43$).

2.3. Data collection and measures

Data on depressive symptoms and its associated factors were collected from 351 participants in face-to-face assessments by two trained research nurses using validated instruments (see below) at three times: admission (T0), before discharge (T1), and 6 months after discharge (T2). Depressive symptoms were measured by the GDS-15 requiring yes/no answers (Yesavage et al., 1982). The summed scores range from 0 (best) to 15 (worst); scores from 5 to 9 are categorized as minor depression, and scores $\geqq 10$ represent major depression (Almeida & Almeida, 1999; Thompson et al., 2011; Wong et al., 2002).

Associated factors for depressive symptoms, which were selected from the literature (Fiske et al., 2009; Helvik et al., 2010; Tam & Lam, 2012; Tiemeier, 2003; Tsai, 2013), included demographics (age, gender, education level, income, and marital status), co-morbidities, medications taken, social support, cognitive status, functional status (performance of activities of daily living [ADL] and role functions; ADL level and functional dependence as two empirical indicators), and nutritional status. Specifically, co-morbidities were assessed by a standardized comorbidity checklist soliciting in 20 self-report conditions including hypertension, diabetes, kidney and lung diseases. The number of comorbidities was used as a proxy for disease burden. In addition, sensory morbidities (visual and hearing impairments), cardiovascular morbidities (coronary heart disease, hypertension, congestive heart failure, and hyperlipidemia), neurological morbidities (stroke and Parkinsonism), and diabetes were further categorized and studied for possible association with depressive symptoms. Medications, i.e., the number of prescription and over-the-counter medications taken currently by participants, were also coded as a numerical variable. Social support was measured by the 6-item Social Support Questionnaire-Short Form (SSQ-SF) (Sarason, Sarason, Shearin, & Pierce, 1987). Cognitive status was measured by the 11-item MMSE (Folstein, Folstein, & McHugh, 1975). ADL level was measured by the 10-item Barthel Index (Mahoney & Barthel, 1965). Functional dependence, defined as needing help from others to perform roles and activities, was measured by the 10-item Enforced Social Dependency Scale (ESDS; Benoliel, McCorkle, & Young, 1980). The ESDS has been used widely, with scores ranging from 10 to 51; higher scores indicate greater functional dependence. Nutritional status was measured by the 18-item Mini-Nutritional Assessment (MNA), the original scoring of which is scaled so higher scores indicate better nutritional status (Guigoz, Vellas, & Garry, 1996). For this study, we re-scaled the MNA so that higher scores indicated poor nutritional status. Thus, higher scores indicated poor status in all measures of our study.

2.4. Statistical analysis

Data were double-checked for accuracy and completeness. Sample characteristics and prevalence of depressive symptoms were analyzed over three time points (admission, discharge, and 6 months after discharge). Interrelationships between depressive symptoms and 12 potential associated factors, including functional status (included ADL level measure by the Barthel Index and functional dependence measured by the ESDS), nutritional status, as well as physiological and cognitive covariates, were examined by path analysis in AMOS. Path analysis has the major benefit of estimating the relative importance of direct and indirect factors so it is robust to examine complex and reciprocal relationships over time (Byrne, 2001; Kline, 2005). Factors for path analysis were selected in three steps. First, we identified factors associated with depressive symptoms at baseline. In this step, 12 variables identified as potential associated factors were evaluated via linear regression. Second, variables significantly associated with baseline depressive symptoms were then regressed with depressive symptoms at each time point, adjusted for demographic covariates. Consistently significant variables at all three time points were then selected for constructing the final model. In the final model building step, depressive symptoms and variables selected in step 2 from all there time points were jointly analyzed. We used path analysis to test a hypothesized directional relationship of depressive symptoms and selected variables over time while controlling for important covariates. To validate the direction of each cross-sectional path, we compared it with an alternative model with reverse direction. If the reverse direction remained significant, the path was correlational (i.e., bidirectional). Goodness of fit was determined by the chi-square value, comparative fit index (CFI), Tucker–Lewis index (TLI), and root mean square error of approximation (RMSEA). Furthermore, parameter values were estimated using maximum likelihood model based on AMOS and data were analyzed using SPSS 17.0 (Chicago, IL, USA) and AMOS 8.0 (Chicago).

3. Results

3.1. Participants

The study sample ($N = 351$) was relatively diverse in age, gender, educational level and income status, while most participants were married. As expected, co-morbidity burden was high

Table 1
Sample demographics ($N = 351$).

		Frequency	%
Age, mean (SD)		71.9 (5.7)	
	65–69	143	40.7
	70–74	93	26.5
	≥75	115	32.8
Gender			
	Male	195	55.6
	Female	156	44.4
Education, years			
	Illiterate	89	25.4
	1–6	138	39.3
	≥7	124	35.3
Monthly income, NTD[a]			
	<5000	17	4.8
	5001–10,000	188	53.6
	10,001–20,000	106	30.2
	20,001–30,000	39	11.1
Marital status			
	Unmarried	88	25.1
	Married	224	63.8
Comorbidities burden			
Number of comorbidities,[b] mean (SD)		4.1 (1.8)	
Sensory morbidities[c]	Yes	264	75.2
Cardiovascular morbidities[d]	Yes	305	86.9
Neurological morbidities[e]	Yes	36	10.3
Diabetes	Yes	107	30.5

Notes:
[a] NTD, New Taiwan Dollars; 1NTD = 0.03 USD.
[b] Comorbidities were solicited in 20 conditions including hypertension, coronary heart disease, congestive heart failure, hyperlipidemia, stroke, diabetes, kidney disease, lung disease, gastrointestinal disease, osteoporosis, arthritis, hip fracture, spinal cord disease, cancer, dementia, Parkinsonism, pressure ulcer, visual impairment, hearing impairment, and others.
[c] Sensory morbidities included visual and hearing impairments.
[d] Cardiovascular morbidities included hypertension, coronary heart disease, congestive heart failure, and hyperlipidemia.
[e] Neurological morbidities included stroke and Parkinsonism.

with mean number of comorbidities being 4.1 ± 1.8. Details of the sample characteristics are presented in Table 1.

3.2. Course of depressive symptoms

Depressive symptoms spontaneously and substantially increased during hospitalization, subsided at 6 months after discharge, but were still worse than at admission baseline. Overall, 26.7% of older patients met GDS-15 criteria for minor depression (scores 5–9) and 21.2% for major depression (≧10) by hospital discharge. At 6 months after discharge, 23.3% and 24.3% of older patients still experienced significant minor and major depressive symptoms, respectively (Table 2). Furthermore, following a prolonged hospitalization, 37.7% of new cases of depression were identified at discharge. Although remission of depression was noted, 8.7% of new cases of depression developed by 6 months after discharge.

3.3. Pathway model estimation

Among 12 associated factors for depressive symptoms (age, gender, education, income, marital status, co-morbidity, medications taken, social support, cognitive status, ADL level, functional dependence, and nutritional status), four factors (social support, cognitive status, functional dependence, and nutritional status) were significantly associated with baseline depressive symptoms (regression coefficients with $P < 0.05$). Two of the four selected factors (functional dependence and nutritional status) were found to be consistently associated with depressive symptoms in all three time points, and were further adopted for constructing the final model while controlling for important covariates (include demographics, social support, and cognitive status).

Fig. 1 presents a final path diagram for depressive symptoms, nutritional status and functional dependence. The 14 solid-line pathways represent significant longitudinal (six lag effects with horizontal arrows and two cross-lagged effects with diagonal arrows) and cross-sectional (six correlations with vertical arrows) relationships among the three factors. We tested the alternative models with reverse direction to further validate the direction of each cross-sectional path (results not shown). The results support that the directions of these cross-sectional paths could go both ways and the relationships are indeed correlational in nature.

Specifically in longitudinal relationships, lag effects were found among all three factors suggesting that status within each health domain predicts future status within that domain. Furthermore, two significant cross-lagged effects were found in the post-discharge phase, suggesting that older patients with more depressive symptoms before discharge were more likely to experience deteriorations in functional dependence (0.25) and nutritional status (0.16) at 6 months after hospital discharge. Although cross-sectional relationships were substantiated in the final path model, the direction of the association fails to pass the validation tests suggesting that functional dependence and nutritional status correlated with depressive symptoms and nutritional status correlating the degree of depressive symptoms in older patients during and after hospital discharge.

4. Discussion

For older patients, depressive symptoms increased spontaneously and substantially during hospitalization, and subsided by 6 months after discharge but were still worse than at admission

Table 2
The course of depressive symptoms from hospitalization to 6 months later ($N = 351$).

Depressive symptoms	Admission $n = 351$	Discharge $n = 334$[a]	6 months post-discharge $n = 300$[b]
GDS-15 score, mean (SD)	4.7 (3.5)	7.6 (3.7)	5.9 (4.1)
No depression (GDS-15 < 5), *n* (%)	212 (60.4)	78 (23.4)	157 (52.3)
Minor depression (GDS-15 5–9), *n* (%)	94 (26.8)	131 (39.2)	70 (23.3)
Major depression (GDS-15 ≧ 10), *n* (%)	45 (12.8)	125 (37.4)	73 (24.3)
New case of depression[c]	–	126 (37.7)	26 (8.7)
Remission of depression[d]	–	12 (3.6)	90 (30.3)

Notes:
[a] The reasons for attrition at discharge were death ($n = 16$) and withdrew consent ($n = 1$).
[b] The reasons for attrition at 6 months after were death ($n = 44$), withdrew consent ($n = 3$), intubated at the time of follow-up assessment ($n = 3$), and isolated for tuberculosis ($n = 1$).
[c] New case of depression refers to the attainment of a higher categorization of depressive symptoms (i.e., up from no depression to minor or major depression).
[d] Remission of depression refers to the attainment of a lower categorization of depressive symptoms (i.e., down from major to minor depression or down from minor to no depression).

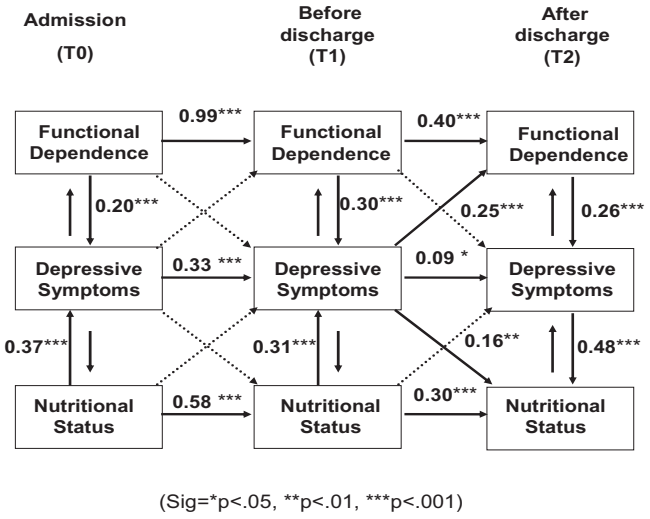

Fig. 1. A pathway model of the effects of functional dependence and nutritional status on depressive symptoms with time-constant predictors. *Notes*: 1. This proposed pathway model adjusted for demographic variables (age, gender, levels of education and income, and marital status) and two important covariates including social support and cognitive status. 2. Single-headed arrows display hypothesized directional relationship. All of the paths were estimated. After controlling for covariates, some paths became nonsignificant and were presented as the dotted lines. The 14 solid-line pathways with standardized regression coefficients along the paths represent significant relationships. 3. All cross-sectional paths (vertical arrows) were further marked with reverse arrows when the reverse directions of paths were significant in the validation analyses. 4. This final model had a good fit (chi-square = 2.342, TLI = 0.914, CFI = 0.953, RMSEA = 0.062).

baseline. By hospital discharge, 26.7% of older patients met GDS-15 criteria for minor depression (scores 5–9) and 21.2% met criteria for major depression ($\geqq$10). At 6 months after discharge, 47.6% of older patients still experienced significant depressive symptoms (23.3% and 24.3% met criteria for minor and major depression, respectively). These findings are consistent with reports that higher levels of depressive symptoms associated with hospitalization of older patients have a dynamic course and interventions are indicated for treating worsening or persistent depressive symptoms (Cole, 2012). We however, did not collect treatment or readmission data after hospital discharge so it is unclear whether these patients with significant depressive symptoms had been treated or whether any new hospitalization occur which might accelerate depressive symptoms during follow-up.

In the present study, we proposed an underlying theoretical pathway in which functional dependence and nutritional status, both are well-known correlates of depressive symptoms, influenced depressive symptoms for older hospitalized patients. Our findings indicate that older patients' health following hospitalization is a complex process, with three health domains (depressive symptoms, functional dependence, and nutritional status) often simultaneously or temporally influencing each other. Three points are of interest. **First**, greater functional dependence and lower nutritional status are cross-sectionally correlated with elevated depressive symptoms during and following hospitalization. **Second**, all three health domains show lagged effects on subsequent measures in the same domain. **Third**, effects of previous depressive symptoms on subsequent functional dependence and nutritional status further suggest a reciprocal interrelationship. Although both cross-sectional and longitudinal relationships between variables (i.e., all solid lines) are substantiated in the proposed model, in the validation analyses when the alterative models were tested for cross-sectional association, we found evidence in favor of a bidirectional correlation between both functional dependence and nutritional status and depressive symptoms. Collectively, these findings suggest a triadic relationship among depressive symptoms, functional dependence, and nutritional status in older patients and that treating depressive symptoms can improve function and nutrition in the post-discharge phase.

In fact, awareness of greater functional dependence and deteriorating nutritional status may cause depressive symptoms as a psychological reaction to the loss of functioning. In addition, analysis of population-based data (N = 2524) indicates that older patients with nutritional deficiencies such as lack of folic acid tend to have more depressive symptoms than those with adequate nutritional status (Beydoun, Shroff, Beydoun, & Zonderman, 2010). Supplementation with folic acid and vitamin B12, as the adjunctive treatment has been shown to improve mood in patients with major depression (Ford et al., 2010). Along the same line, the presence of depressive symptoms has been significantly associated with diet quality (Kuczmarski et al., 2010; Tsai, Chang, & Chi, 2011), food insufficiency (German et al., 2011), and malnutrition (Smoliner, Norman, Wanger, Hartig, & Lochs, 2009). As deteriorated nutritional status and functional dependence may be an early sign rather than a risk factor for depressive symptoms, the temporal relation between nutritional status/functional dependence and depressive symptoms in older patients needs to be further tested.

Nevertheless, the presence of depressive symptoms by discharge may negatively impact older patients' subsequent functional dependence and nutritional status by decreasing their motivation to maintain healthy and self-care behaviors such as adequate eating, physical rehabilitation, and engaging in role activities. Treating one condition might improve another so targeting this triad with a multimodal intervention along with necessary pharmacological therapy might not only more effectively treat depressive symptoms but also improve overall function and nutrition in older adults following an acute hospitalization for medical and surgical services. In fact, multimodal interventions, such as the Modified Hospital Elder Life Program comprising early ambulation, nutritional assistance, and orienting communication was shown in a pilot trial to ameliorate older surgical patients' depressive symptoms by hospital discharge (Chen et al., 2011). These results should be verified in randomized trials, but argue for further development and testing of such multimodal interventions to manage depressive symptoms in older hospitalized patients.

4.1. Strengths and weaknesses of the study

A major strength of our study is that it examined the course of depressive symptoms and their interrelationships with functional dependence and nutritional status, adjusted for important covariates, in a large sample of older patients from prolonged, acute hospitalization to 6 months afterward. The study had important limitations. First, there are debates as whether depressive symptoms preceded functional dependence and nutritional status in this model rather than the direction we have proposed. Indeed, assumption relative to temporal order, non-recursive paths, and causal direction at the same time point in path analysis is a prior decision. It is therefore possible that the direction of the association may be reversed. In fact, we could not statistically rule out the reverse paths in the validation analyses. Clearly, all three domains have complex etiologies and are interacted so the causal relationships are difficult to assert. In addition, given that our study design was observational, causal interpretations in this regard are limited. Second, 12 potential associated factors were examined, as suggested in the literature, but the possibility of undetected factors (for example, caregiver issues) cannot be excluded. Third, the sample was selective

because we recruited participants from one medical center with inclusion criteria of expected LOS > 5 days, able to communicate, and have no screened cognitive dysfunction, which might limit the generalizability of our findings. Lastly, our categorization and identification of depression and depressive symptoms were based on GDS-15 scores and not diagnostic interviews. This limitation is minimized by the widespread use of the GDS-15 and other depression rating scales to reliably measure depressive symptoms and depression using cut-off scores in lieu of structure-based clinical diagnosis. Nevertheless, the strengths of our investigation are its longitudinal design, large sample of older hospitalized patients including both medical and surgical patients, and use of validated measures.

5. Conclusion

Depressive symptoms in older hospitalized patients represent an entity that merits clinical vigilance (Cole, 2012). Targeting the triad of depressive symptoms, functional dependence, and nutritional status may maximize treatment success for depressive symptoms and potentially improve older patients' quality of life. The burden is now on clinical researchers to rigorously test the effects of preventive and therapeutic triadic interventions on this devastating medical foe.

Conflict of interest statement

None.

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