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ORIGINAL RESEARCH

Prevalence and associated factors of depressive symptoms among elderly inpatients of a Chinese tertiary hospital

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Background: Depression in the elderly is a serious and often underdiagnosed psychiatric disorder that has been linked to adverse outcomes in the hospital setting. This study aims to evaluate the prevalence of depressive symptoms and associated factors among elderly hospital inpatients.

Methods: The cross-sectional study included 411 consecutively hospitalized patients aged 60 years and older. Participants were evaluated within 48 hours of admission using an interviewer-administered questionnaire including the Geriatric Depression Scale and comprehensive geriatric assessment to provide basic demographic and clinical information.

Results: Most of the participants were male (64.5%), with a mean (SD) age of 75.9 (8.1) years between 60 and 97 years. The prevalence of depressive symptoms was 32.8%. Univariate analysis showed significant associations between depressive symptoms and older age, female gender, lower body mass index, number of chronic diseases, impaired family function, impaired cognition, malnutrition, increased frailty, and decreased ability to perform activities of daily living. After logistic regression, variables that remained significantly associated with depression were cognitive decline (odds ratio =1.97, 95% CI: 1.09–3.55), poor family function (odds ratio =2.01, 95% CI: 1.10–3.66), and frailty (odds ratio =5.07, 95% CI: 1.95–13.20). Depressive symptoms were independently associated with prolonged hospital length.

Conclusion: Depressive symptoms were prevalent among hospitalized elderly and independently associated with cognitive decline, poor family function, and frailty. Therefore, it is essential to screen for depression and perform a comprehensive geriatric assessment in these patients to identify and manage depressive symptoms.

Keywords: depressive symptoms, aged, inpatients, prevalence, comprehensive geriatric assessment

Introduction

Mental disorders are among the most prevalent chronic diseases of the elderly worldwide, with depression being one of the most common psychiatric disorders in this population.[1,2] Depression in the elderly is associated with severe adverse health outcomes including disability,[3] mortality,[4] and reduced quality of life.[5] It also leads to higher care burdens for family members and caregivers.[6]

Previously reported estimates of the prevalence of depression among older populations depend on many factors including methodology, diagnostic criteria, and characteristics of the samples. A meta-analysis study revealed that the median prevalence rate of depressive disorders in the world for the elderly population was 10.3%, with interquartile range varying between 4.7% and 16.0%.[7] A higher prevalence of

depressive symptoms has been reported in studies involving hospitalized elderly, ranging from 10% to 56%, especially when geriatric inpatients have medical conditions such as stroke or heart failure.[8–13] Despite this higher prevalence, depression is not often diagnosed or properly treated in medical settings.

The existing studies indicated that hospitalized elderly with poor functional capacity[9] were more likely to be affected by depression, and patients with severe medical diseases[14] had the highest prevalence rate. Other common risk factors for inpatient geriatric depression were low education level,[9] number of comorbidities,[8] female gender,[8] unmarried status,[8] lower income,[8] sleep disturbance,[14] undernutrition,[15] and poor cognitive functioning.[16]

Comprehensive geriatric assessment (CGA), a systematic approach aiming to assess physical functioning, comorbidity, nutrition, cognition, frailty, and emotional status in elderly patients, has widely been conducted in geriatric departments after patients have been hospitalized. Extensive studies have provided strong evidence that a geriatric intervention guided by CGA increased patients' likelihood of being alive and in their own homes at 3–12 months follow-up and decreased the likelihood of being admitted to a nursing home.[17–19]

The aim of the present study was to determine the prevalence of depressive symptom and associated factors among hospitalized elderly. In addition, we have evaluated the association between depressive symptom and other CGA domains.

Methods
Study participants
This was a cross-sectional study approved by the Ethics in Research Committee of the Chengdu Fifth People's Hospital. From January 2015 to August 2017, we enrolled a consecutive series of patients aged 60 years and older who were admitted to the geriatric wards of Chengdu Fifth People's Hospital, which was also the Chengdu-Montpellier Geriatric Center. Study participants were excluded if they were diagnosed with severe cognitive dysfunction, hearing impairment, severe cardiopulmonary diseases, reduced level of consciousness, crucial organ failure, or other unstable medical illnesses. Baseline demographic characteristics and depressive symptoms were recorded and assessed by the main researchers during face-to-face interview using a general questionnaire. Laboratory results, hospital length of stay, and hospital fees were recorded from electronic medical records. CGA was conducted within 48 hours of admission

by a team consisting of geriatricians and a geriatric nurse. Written informed consent was obtained from all participants (or their legal proxies).

Assessment of depressive symptom
The study used 15-Geriatric Depression Scale (GDS) to assess depressive symptom among elderly people in the preceding week. Each of the 15 items was coded as 0 (no) or 1 (yes). The GDS-15 has been used in numerous studies on geriatric depression with a sensitivity of 79% and specificity of 77% in the general hospital.[20,21] In this study, participants with a total GDS-15 score of 6 or above were classified as depressed.[22]

Assessment of CGA
Comorbidities: the prevalence of 18 common medical conditions was determined using a checklist that followed the question: "Do you suffer, or were you ever told by a doctor that you suffer, from the following problems in the past one year?" Chronic diseases included cardiovascular disease and hypertension, diabetes mellitus, obstructive pulmonary disease, malignancy, Parkinson's disease, arthritis or osteoarthritis, chronic kidney disease, etc. Comorbidity, defined as more than three chronic diseases, was calculated for analysis.

Physical function: activities of daily living (ADLs) were measured using the modified Barthel Index, which consists of 10 items (grooming, bathing, eating, dressing, toilet use, fecal and urinary continence, ability to go up and down stairs, and walking in a hallway). This index ranges from 0 to 100, with a score of 100 indicating full independence, a score of 60–99 indicating partial dependence, and a score of <60 full dependence.[23]

Nutrition: nutrition was assessed with the Mini Nutritional Assessment Short Form (MNA-SF), with scores ranging from 0 to 14; scores of <8 indicated malnutrition, between 8 and 11 indicated risk of malnutrition, more than 11 indicated normal nutritional status.[24]

Family function: family functioning was assessed using the Family APGAR Index, which evaluates Adaptability, Partnership, Growth, Affection, and Resolve, and scores each component from zero to two. The Chinese version of Family APGAR index has been widely used in China, with satisfactory validity and reliability.[25] The total score range varies from 0 to 10. Higher scores indicate higher levels of satisfaction with family functioning. According to the cut-off scores, a score of 0–7 indicates moderate family dysfunction and 8–10 indicates supportive family functioning.[26]

Frailty: the 5-item FRAIL scale was used for screening for frailty. There are five components: fatigue, resistance, ambulation, illnesses, and loss of weight. Frailty scores range from 0 to 5 and represent frail (3–5), pre-frail (1–2), and robust (0) health status.[27]

Cognitive function: cognitive function was measured using the Chinese version of the MMSE. Cognitive impairment was considered possible if the MMSE score was <18 for illiterate, <21 for elderly with primary education, and <25 above junior middle school.[28]

Assessment of covariates

Demographic characteristics: questions about age, gender, and smoking and drinking habits were answered by the participants.

Physical examination: body mass index was calculated as weight in kilograms divided by height in meters squared at admission; systolic blood pressure and diastolic blood pressure were defined by the mean of two out of three measures using standard protocol in admission.

Laboratory tests: blood routine, C-reactive protein, fasting glucose, serum albumin, low-density lipoprotein, and data on kidney and hepatic function were collected via the electronic medical record.

Assessment of outcomes

Prolonged hospital length: defined as more than third quartile of hospital length of our participants.

Higher hospital expense: defined as more than third quartile of hospital expense of our participants.

Statistical analyses

All statistical analyses for the present study were carried out with the SPSS for Windows software package, version 22.0 (SPSS Inc., Chicago, IL, USA). The normal variables were reported as mean ± standard deviation (SD), while the nonnormal variables were described by median ± interquartile range. Categorical variables were reported as frequency and proportions. We first performed univariate analysis to investigate the association between all individual variables and depressive symptom at admission by Student's *t*-tests/analysis of variance when distributions were normal and Mann–Whitney *U*/ Kruskal–Wallis tests otherwise. Only those univariate variables that showed a significant relationship with the outcome were subsequently tested in the final logistic regression model (enter). Another multiple logistic regression was also performed to explore the association between depressive symptoms and prolonged hospital length and higher hospital

expense. First, we used the unadjusted model, then used two mutually adjusted models: 1) model 1: (age and gender); 2) model 2: model 1+ CGS (comorbidity + ADL + MMSE+ APGAR + frailty + MNA-SF). Two-sided *P*-values were considered to be statistically significant at ≤0.05.

Results

The study included 411 hospitalized patients with a mean (SD) age of 75.9 (8.1) years between 60 and 97 years, predominantly males (64.5%). The most frequent reasons for admission (Table 1) to the hospital were respiratory illnesses (36.3%), metabolic disorders (18.7%), cardiovascular conditions (17.8%), gastrointestinal conditions (8.0%), and infectious diseases (5.1%). The median length of hospital stay was 9 days (interquartile range: 3–72). Only one patient died during the hospitalization.

Depressive symptoms were present in 32.8% of the study participants. Univariate analysis revealed that significant associations were seen between depressive symptoms and older age, female gender, lower body mass index, more chronic diseases, impaired family function, cognitive impairment, malnutrition, increased frailty, and need for support while performing ADL (Table 2). The depressed group also showed longer hospitalization.

The meaningful findings of the univariate analysis were also evaluated with logistic regression analysis (Table 3). According to the logistic regression analysis, depressive symptoms were significantly presented in the elderly with poor cognitive function (odds ratio [OR] =1.97, 95% CI: 1.09–3.55) compared to the ones with normal cognition. Depressive symptoms were also found in elderly patients with dysfunctional family support (OR =2.01, 95% CI: 1.10–3.66). Frail subjects were more likely to have depressive symptoms than the ones who were not (OR =5.07, 95% CI: 1.95–13.20).

Another logistic regression was conducted to identify whether depressive symptom were associated with the

Table 1 Admission of elderly patients (N=411)

Disease	Number (%)
Cardiovascular	73 (17.8)
Cancer	9 (2.2)
Gastrointestinal	33 (8.0)
Genitourinary	9 (2.2)
Infectious	21 (5.1)
Metabolic-endocrine	77 (18.7)
Musculoskeletal	7 (1.7)
Neurological	11 (2.7)
Respiratory	149 (36.3)
Other	22 (5.4)

Table 2 Characteristics of participants according to GDS scores ≥6 (N=411)

	Nondepressed (N=276, 67.2%)	Depressed (N=135, 32.8%)	P-value
Demographic			
Age[a]	75.0 (70.0, 81.8)	78.0 (72.0, 84.0)	0.004*
Gender (F)[b]			0.004*
Female	85 (30.8%)	61 (45.2%)	
Male	191 (69.2%)	74 (54.8%)	
Smoking[b]			0.552
Current	34 (12.3%)	13 (9.8%)	
Past	78 (28.3%)	44 (32.6%)	
Never	164 (59.6%)	78 (57.8%)	
Drinking[b]			0.122
Current	46 (16.7%)	13 (9.6%)	
Past	69 (25.0%)	28 (20.7%)	
Never	169 (58.3%)	94 (69.7%)	
PE/laboratory[a]			
Body mass index (kg/m²)	22.0 (19.0, 24.9)	20.5 (18.7, 24.3)	0.033*
Systolic pressure (mmHg)	132 (120, 144)	132 (117, 146)	0.762
Distolic pressure (mmHg)	76 (68, 84)	75 (70, 84)	0.513
White blood cell (×10⁹/L)	6.25 (4.8, 8.7)	6.38 (4.8, 9.1)	0.488
Hemoglobin (g/L)	125 (109, 136)	121 (104, 131)	0.063
CRP (mg/L)	6.00 (3.0, 21.7)	7.90 (2.7, 54.4)	0.357
Albumin (g/L)	41.9 (39.2, 44.5)	41.3 (37.9, 43.7)	0.119
ALT (μ/L)	19.0 (13.0, 31.0)	17.0 (11.7, 26.9)	0.061
Creatinine (μmol/L)	70.5 (56.6, 93.1)	77.4 (57.5, 98.7)	0.068
Uric acid (μmol/L)	320.5 (259, 389)	333 (253, 402)	0.543
LDL (mmol/L)	2.44 (1.8, 3.1)	2.39 (1.9, 2.9)	0.939
CGA			
Comorbidity[a]	2 (1, 4)	4 (2, 6)	0.000*
APGAR[b]			0.000*
Good	234 (84.6%)	89 (66.0%)	
Dysfunctional	42 (15.4%)	46 (34.0%)	
Impaired cognition[b]			0.000*
No	218 (79.0%)	66 (48.9%)	
Yes	58 (21.0%)	69 (51.1%)	
MNA-SF[b]			0.016*
Normal	30 (10.9%)	4 (2.9%)	
Malnutrition risk	158 (57.2%)	78 (57.8%)	
Malnutrition	88 (31.9%)	53 (39.3%)	
ADL[b]			0.000*
Normal	129 (46.8%)	34 (25.2%)	
Mild impaired	127 (46.0%)	70 (51.9%)	
Severe impaired	20 (7.2%)	31 (22.9%)	
Frailty[b]			0.000*
Robust	66 (23.9%)	7 (5.2%)	
Pre-frail	94 (34.1%)	22 (16.3%)	
Frail	116 (42.0%)	106 (78.5%)	
Outcomes			
Hospital length[a]	9.0 (7.0, 11.8)	10.0 (7.5, 13.0)	0.018*
Hospital fee[a]	11,146 (8,719, 14,005)	11,463 (8,555, 15,616)	0.113

Notes: [a]Wilcoxon rank test; [b]χ^2 test; *$P<0.05$.
Abbreviations: ADL, activities of daily living; ALT, aminotransferases; APGAR, Family APGAR Index; CGA, comprehensive geriatric assessment; CRP, C-reactive protein; GDS, Geriatric Depressive Scale; LDL, low-density lipoprotein; MNA-SF, Mini Nutritional Assessment Short Form; PE, physical examination.

outcome (prolonged hospitalization and high hospital expense). In the unadjusted analysis, depressive symptoms were associated with longer hospitalization (OR =1.64, 95% CI: 1.05–2.57) and higher hospital expense (OR =1.83, 95% CI: 1.11–3.01). The results were similar in model 1 with confounding factors of age and gender. When adding the variables of CGA in model 2, depressive symptoms were only independently associated with

Table 3 Factors associated with geriatric depressive symptom according to multiple logistic regression

Factor	OR	95% CI	Wald	P-value
Age	0.99	0.96–1.03	0.051	0.822
Gender				
Female	1			
Male	0.69	0.39–1.21	1.644	0.200
Body mass index	0.99	0.91–1.07	0.078	0.781
Comorbidity	1.05	0.94–1.17	0.750	0.387
MNA-SF				
Normal	1			
Malnutrition risk	0.47	0.12–1.81	1.882	0.170
Malnutrition	1.07	0.56–2.02	1.207	0.272
APGAR				
Good	1			
Dysfunctional	2.01	1.10–3.66	5.191	0.023*
Impaired cognition				
No	1			
Yes	1.97	1.09–3.55	5.107	0.024*
ADL				
Normal	1			
Mild impaired	1.11	0.59–2.05	0.107	0.743
Severe impaired	2.04	0.84–4.99	2.457	0.117
Frailty				
Robust	1			
Pre-frail	1.95	0.71–5.32	1.682	0.195
Frail	5.07	1.95–13.20	11.040	0.001*

Note: *$P<0.05$.
Abbreviations: ADL, activities of daily living; APGAR, Family APGAR Index; MNA-SF, Mini Nutritional Assessment Short Form; OR, odd ratio.

longer hospitalizations (OR =1.73, 95% CI: 1.02–2.93) (Table 4).

Discussion

While the majority of research was done to understand the differences in demographic characteristics (gender, age, marital status, education, income) and depression in community-settings elderly,[29–31] our study evaluated depressive symptoms among elderly inpatients in a Chinese public university hospital and found independent associations for depressive symptoms and some CGA domains such as poor family function, cognitive impairment, and frailty. We also found that depressive symptoms were associated with longer hospitalization in elderly inpatients.

This study revealed that 32.8% of hospitalized older adults experience depressive symptoms. This finding is similar to previous cross-sectional study showing depression rates of 38.6% among elderly inpatients in China,[32] but higher than the 18.1% rate described in another Chinese study involving hospitalized elderly people conducted in 13 general hospitals.[14] This could be due to the use of different measurements for depression and the differences in study populations (eg, types and severity of the original diseases that caused the hospitalization).

In contrast with community-based studies,[29–31] we found no significant differences in the prevalence of depression among different genders, or ages of elderly inpatients, which are congruent with those of several studies conducted in China[14,33] and Brazil.[9] This could be explained based on the fact that the stress of getting sick and being hospitalized can be considered an adverse condition for hospitalized elderly independent of gender and age, which increased the risk of depression.[34] Therefore, health status, routinely evaluated by CGA, might be a more important factor associated with depression among elderly people.

In our study, significantly more depressive symptoms were found among those with higher frailty scale. Makizako et al[35] also revealed older people with frailty were prone to have incidence of depression 15-months later. Previous studies indicate that factors similar to components of physical frailty, such as mobility, balance problems, weakness, poor endurance, etc, may lead to disability and functional dependence, thus increasing the risk for developing depressive symptoms in elderly adults.[36,37] The possible biological mechanisms accounting for frailty, such as cerebrovascular disease, oxidative stress, chronic inflammation, hypothalamic–pituitary–adrenal axis dysregulation, and mitochondrial dysfunction, are also identified in individuals with late-life depression.[38,39] A meta-analysis conducted by Soysal et al[40] has proven the reciprocal interaction between depression and frailty in older adults. Therefore, it might be essential to evaluate and manage frailty in order to improve depressive symptoms.

Table 4 The association of depressive symptom with prolonged hospital length and hospital expense according to logistical regression

	OR (95% CI)		
	Unadjusted model	Model 1	Model 2
Depressive symptom with hospital length	1.64 (1.05–2.57)*	1.71 (1.08–2.76)*	1.73 (1.02–2.93)*
Depressive symptom with hospital expense	1.83 (1.11–3.01)*	1.86 (1.12–3.09)*	1.18 (0.67–2.11)

Notes: *$P<0.05$. Model 1 mutually adjusted for age and sex. Model 2 mutually adjusted for model 1+ CGA (comorbidity + ADL + MMSE+ APGAR + frailty + MNA-SF).
Abbreviations: ADL, activities of daily living; APGAR, family APGAR assessment; CGA, comprehensive geriatric assessment; MNA-SF, Mini Nutritional Assessment Short Form; OR, odd ratio.

A significant association was also seen between depressive symptoms and impaired cognition in our study. A meta-analysis conducted by Ismail showed that depression is common in people with mild cognitive impairment (MCI), with an overall pooled prevalence of 32%.[41] Depression may come from the impairment in attention and working memory, changes in sleep patterns, and social isolation accompanied by cognitive impairment.[42] Moreover, the brain structure changes in MCI share some common features of late-life depression.[43,44] Numerous studies have demonstrated the relationship between inpatient elderly depression and objective family support such as living alone, or being widowed or divorced.[8,9,30] In our study, we found poor subjective family support assessed by Family APGAR Index was independently associated with depression. With the increasing age, elderly patients' social roles and self-concept has been changed, and the emotional support of functional family has become more important for them.[45] When elderly patients are sick and hospitalized, a dysfunctional family dynamic may contribute to the occurrence of depression. Our findings are aligned with previous research suggesting that depression has strong negative relationship with family function in elderly.[46,47]

In our present study, longer hospitalization was observed in depressive elderly than their nondepressed counterparts, which is consistent with the previous studies.[9,48] This might be explained in that the depressed group was more frail, had more comorbidity conditions, had worse nutritional status, and was disabled. However after controlling for these confounding factors, depressive symptoms still influenced the hospitalization process. The mechanisms linking depression to longer hospitalization are not clear, but are likely to include multiple pathways such as slow resolution of inflammatory responses, impaired behavioral adaptation, and greater susceptibility to infection.[49] Further work is needed to investigate these biological and behavioral pathways in elderly patients.

One limitation of our study is the adoption of the GDS scale, rather than structured interviews for diagnosing depression, to measure depressive symptom, which is considered more appropriate for identification and less sensitive to somatic symptoms that might cause overestimation of depression. Another methodological limitation is inherent in the cross-sectional study design, which generates information concerning prevalence and associated factors, but not concerning etiological factors or the direction of causality. Finally, the study was performed at a single tertiary care hospital, and thus the result might be prudently generalized to other settings and needs to be verified in larger population and across multiple hospital centers.

Conclusion

Depressive symptom was prevalent among the hospitalized elderly, especially among patients with frailty, poor cognition, and less family support. Our results should encourage geriatricians to adopt a brief instrument such as GDS-15 and CGA to early screen depressive symptoms. Future studies are needed to identify the appropriate measures to intervene elderly inpatient with depressive symptom and their impact on patients' function and health outcomes.

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Disclosure

The authors report no conflicts of interest in this work.

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