PREVALENCE AND POTENTIAL ASSOCIATED FACTORS OF DEPRESSION AMONG CHINESE OLDER INPATIENTS

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Abstract: *Introduction:* Little is known about the current representative depression situation among Chinese older inpatients. The aim of this study is to examine prevalence of depression and associated risk factors among Chinese older inpatients by a large-scale cross-sectional national survey. *Methods:* This study is based on baseline survey data from a large-scale cohort study in a representative sample of Chinese older inpatients. The procedure of this study involves physical examination and face-to-face questionnaire interviews. Depression was assessed based on the Geriatric Depression Scale 15. Mixed-effect Poisson regression model was used to examine the relationship between depression and covariates by controlling the cluster effect of hospital wards. *Results:* Of all 9727 respondents, the mean age of all respondents was 72.4±5.7 years, from 65 to 97. The average GDS score was 2 (1, 4). The prevalence rate of depression was 16.7% (95%CI: 15.8-17.4%) among older inpatients. The prevalence rates were 14.6% for males and 19.5% for females respectively. After controlling the cluster effect of hospital wards, age, gender, ADL score, educational level, BMI, frail, marriage, falls, alcohol drinking, cognitive function, living conditions, vision, hearing, sleep and defecation function were associated with depression. Emaciation (OR=1.176, 95%CI: 1.107-1.249), frail (OR=1.562, 95%CI: 1.489-1.639), divorced or widowed (OR=1.083 95%CI: 1.017-1.153), living in the bungalow (OR=1.075, 95%CI: 1.023-1.130), falls (OR=1.078, 95%CI: 1.030-1.128), cognitive function (OR=1.142, 95%CI: 1.091-1.195), vision dysfunction (OR=1.125, 95%CI: 1.076-1.177), hearing dysfunction (OR=1.061, 95%CI: 1.011-1.113), sleep dysfunction (OR=1.237, 95%CI: 1.194-1.282), defecation dysfunction (OR=1.160, 95%CI: 1.103-1.221) could increase prevalence risk of depression. *Conclusions:* There was a high prevalence of depression among Chinese older inpatients. Demographic characteristics, physical and mental conditions indicators have strong effect on prevalence and strength of depression. Therefore, it is essential to assess depression and perform comprehensive measures to improve physical and mental conditions in order to manage depressive symptoms in older inpatients.

Key words: Depression, prevalence, elderly, inpatient, associated factors.

Introduction

With the decline of infant mortality rate and the prolonging of life expectancy, many countries have stepped into aging societies gradually. In 2000, Chinese older adults over 60 years old approached 127 million (10.2% in total China population) and older adults over 65 year old approached 0.88 million (7.0%), and then China entered the aging society too (1). In 2018, Chinese older adults over 60 years old approached 241 million (17.2% in total China population) and was expected to approach 480 million in 2050.

Depression is one of the most prevalent mental disorders and a common cause of disability and reduced life-satisfaction in old adults (2). Depressed elders often suffer from markedly diminished function and quality of life as well as mood symptoms (3). Increased mortality from illness and suicide is also an important concomitant effect of depression in late life. Depression in older adults may be more persistent than depression earlier in life, often running a chronic, remitting course (4). The significance of late life depression is heightened by the fact that there are an increasing number of elders worldwide (5).

Many studies have explored the prevalence of depression in older adults. The prevalence of major depression ranges from 0.9% to 9.4% in private households, from 14% to 42% in institutional living, and from 1% to 16% among elderly living in private households or in institutions; and clinically relevant depressive symptom cases in similar settings vary between 7.2% and 49% (6).

Studies report that prevalence of depression among patients in medical institutions was significantly higher than general population (7-9). In particular, among older inpatients, depression prevalence estimates range from 25.1% to 57.5% (10-14) and are associated with a variety of negative effects, including functional impairment, lower quality of life, increased medical problems, poor adherence to medical treatment (14), and suicide attempts and death by suicide (15). Furthermore, depression among inpatients can negatively impact treatment outcomes. Overall, depression results in a significant problem among older inpatients and can have substantial negative effects on rehabilitation for a variety of illnesses and conditions. Along with the worldwide increase in the number of older people (16), a better understanding of depression in older inpatients is highly valuable from clinical and public health

perspectives.

Most of previous estimates on depression in Chinese patients were conducted from patients across different ages which could not reflects the depression of older inpatients, and based on only one province or a small sample size which could not represent Chinese older inpatient population (19-20). However, little is known about the the current representative prevalence of older inpatients' depression status in China, and up to date no information on the associated factors of depression has been reported among Chinese older inpatients based on large-scale representative narional sample. Specifically, the aim of this study is to examine prevalence of depression and associated risk factors among Chinese older inpatients by a large-scale cross-sectional national survey.

Methods

Sample and participants

This study is based on baseline survey data from a large-scale cohort study in a representative sample of Chinese older inpatients. The baseline survey was conducted in 2018 in order to examine the older inpatients' physiological and psychological conditions. It has been approved by the review board of Peking Union Medical College Hospital, Chinese Academy of Medical Sciences.

A sample size of 7299 can produce a two-sided 95% confidence interval with a tolerance error equal to 0.005 when the predicted prevalence rate is 5%. Considering the potential non-response and loss to follow, 10, 000 subjects will be recruited in this study.

Two-stage cluster sampling method was used to recruit eligible subjects. China consists of six administration regions according to different geographic and economic conditions, one province or municipality city was randomly selected in each administration region. In brief, this survey was carried out in six provinces or municipality city of China, including Sichuan province, Heilongjiang province, Hubei province, Beijing Municipality City, Qinghai province and Shandong province. And then one tertiary hospital was sampled in each province or municipality city. All eligible older inpatients who lived in the internal wards and surgical wards of these selected hospitals in the study period were considered as the study subjects. All included subjects were 65 years old or older and gave their informed consent to participant in the study. The procedure of this study involves physical examination and face-to-face questionnaire interviews.

Depression assessment

The depression assessment scale was designed based on the Geriatric Depression Scale 15 (GDS15) (23). For it, subjects were asked if there was ever a time when they felt sad, blue, or depressed for two weeks or more in a row during the past twelve months. Fifteen questions were asked about whether they were satisfied for their life, had lost interest in things, felt tired or low energy, had more trouble concentrating than usual, thought a lot about death and feeling of worthless, etc. Each response was assessed with one or zero score. The total GDS score was the sum of responses of these fifteen depression questions (range 0-15). If the total GDS score is above 5, the subject was considered as depressed. The larger GDS score means the severer depression conditions.

Definition of covariates

Potential associated factors of depression conditions in the models included age, sex, ethnicity, marital status, education, living conditions, tobacco smoking, alcohol drinking, body mass index (BMI), falls, long-time bedridden, vision, hearing, sleep, urinary function, defecation function, frail, basic activity of daily living (ADL) and cognitive function.

Marital status was dichotomized as married, divorced or widowed. Education was categorized as illiterate, primary school, middle school, university or graduate. Living conditions was categorized as building with elevators, building without elevators and bungalow. Vision and hearing was assessed whether or not influencing normal life. sleep, urinary function, defecation function was dichotomized as normal function or dysfunction.

BMI was defined as weight (kg) divided by squared height (m^2). Weight was measured to the nearest 0.1 kg and height was measured to the nearest 1 mm. According to Chinese guidelines for prevention and control of adult overweight and obesity (24) and the Chinese criteria by Working Group on Obesity in China (WGOC) (25), obesity is defined as BMI equal to or greater than 28 kg/m^2; overweight is defined as BMI less than 28 kg/m^2 and equal to or greater than 24 kg/m^2, emaciation is defined as BMI less than 18.5 kg/m^2, normal weight is defined as BMI less than 24 kg/m^2 and equal to or greater than 18.5 kg/m^2.

Frailty was assessed with the FRAIL scale (26). The FRAIL scale includes five components: fatigue, resistance, ambulation, illness, and loss of weight. The total FRAIL score was the sum of responses of these five components (range 0-5). If the total score equal to or exceed 3, the subject was considered as being the frail status. The larger total score means the severer frail conditions.

ADL was assessed with the Barthel index and instrumental activity of daily living (27). The ADL index includes ten questions. The total ADL score was the sum of responses of these ten components (range 0-30). The smaller ADL score means the severer ADL function limitation.

Cognitive function was assessed based on the mini-mental state examination Scale (28). According to the scale, cognitive function was dichotomized as normal cognitive function and cognitive dysfunction.

Quality control

All researchers were trained based on the training manual. Before the survey, they were trained about the application of the depression assessment, frail assessment and other health

assessment scales. Trained medical professionals carried out the survey and interview. All the case report forms were double-checked to guarantee the authenticity and accuracy of raw data. Database was constructed with electronic data collection system and was corrected to guarantee the accuracy and integration of the data.

Statistical analyses

Continuous variables were described with mean and standard deviation (SD). Categorical variables were described with number and percentage. The GDS score were described with median (lower quartile, upper quartile). Considering that the elderly hospitalizing in the same ward and same hospital were more likely to be assessed as similar depression scores, mixed-effect Poisson regression model was used to examine the relationship between depression and covariates in order to control the cluster effect of hospital wards. Odds ratio (OR) and its 95% confidence interval (CI) were used to assess the relationship strength. All statistical analysis was conducted in SAS9.4 software (SAS institute Inc., Cary, NC, USA). Two sided $P<0.05$ was considered statistically significant.

Results

Demographics

Out of 9997 included subjects, 9727 subjects accomplished the demographic and depression questionnaire survey and the completion rate was 97.3%. The mean age of all respondents was 72.4±5.7 years, from 65 to 97. 57.7% of respondents were male ones. 94.0% of respondents were Han nationalities. 11.3% of respondents were divorced or widowed. 3.2% of respondents were transferred from other medical institutions. 95.4% of respondents paid for the medical expenses with health insurance or enjoyed free medical care. 16.3% of respondents were illiterate. Emaciated, over-weighted and obese respondents were 7.0%, 34.2% and 10.2% respectively among all the respondents. 11.0% and 22.9% of respondents were current tobacco smoker and former smoker. 11.6% and 12.1% of respondents were current alcohol drinker and former drinker. 14.2% of respondents suffered from falls in the past year. 2.7% of respondents were bedridden for at least four weeks.

Distribution of depression

Table 1 presents the observed distribution of the GDS scores. The average GDS score was 2 (1, 4). Of all 9727 respondents, 17.7% (1771 ones) reported no any depression symptoms. The larger GDS score means the lower proportion of respondents. The GDS score of 6336 respondents (71.8%) ranged from one to five. The GDS score of 1620 respondents was above than five and the prevalence rate of depression was 16.7% (95%CI: 15.8-17.4%) among older inpatients.

Table 1
Observed distribution of gross depression score (GDS)

GDS	number	percentage
0	1771	18.2
1	1923	19.8
2	1596	16.4
3	1250	12.8
4	916	9.4
5	651	6.7
6	461	4.7
7	317	3.3
8	244	2.5
9	177	1.8
10	139	1.4
11	87	0.9
12	89	0.9
13	48	0.5
14	42	0.4
15	16	0.2

Table 2 was tabulated about the prevalence conditions of depression across different covariates. The mean age for depressed subjects was 72.4±5.8 years old, which was not statistically different from the mean age for non-depressed subjects (72.4±5.7 years old). There was not significant difference about depression prevalence between Han nationality and others. The ADL scores for depressed subjects was 25.8±5.4, which was significantly lower than the ADL scores for non-depressed subjects (28.2±4.0), P<0.001. The prevalence rates of depression was 14.6% for males and 19.5% for females respectively. Subjects who are emaciated (P<0.001), female (P<0.001), frail (P<0.001), illiterate (P<0.001), divorced or widowed (P<0.001), fell down once in the past year (P<0.001), long-time bedridden (P<0.001), living in the bungalow (P<0.001), cognitive dysfunctional (P<0.001), vision dysfunctional (P<0.001), hearing dysfunctional (P<0.001), sleep dysfunctional (P<0.001), urinary dysfunctional (P<0.001) or defecation dysfunctional (P<0.001) has higher prevalence of depression. Subjects who are current smoker (P<0.001) or current drinker (P<0.001) has lower prevalence of depression.

Associated factors of depression

Table 3 gives the results of the univariate Poisson regression and multivariate mixed-effect Poisson regression models of associated factors for depression. After controlling the cluster effect of hospital wards, females were more likely to get depression (OR=1.059, 95%CI: 1.013-1.107) than males. Subjects had less odds of getting depression

Table 2
Prevalence Conditions of Depression across demographics (n (%))

Characteristics	Depression	Non-Depression	P
Age	72.4±5.8	72.4±5.7	0.982
ADL score	25.8±5.4	28.2±4.0	<0.001
BMI			<0.001
Obesity	129(13.2%)	846(86.8%)	
Overweight	418(12.7%)	2878(87.3%)	
Emaciation	193(28.6%)	481(71.4%)	
Normal	836(17.9%)	3823(82.1%)	
Gender			<0.001
Male	818 (14.6%)	4795 (85.4%)	
Female	802(19.5%)	3312(80.5%)	
Ethnicity			0.080
Han	1508 (16.5%)	7638 (83.5%)	
Others	112 (19.3%)	469 (80.7%)	
Frail			<0.001
Yes	700(40.8%)	1014(59.2%)	
No	920(11.5%)	7093(88.5%)	
Educational level			<0.001
University	174 (12.1%)	1259 (87.9%)	
Middle school	587(14.9%)	3343 (85.1%)	
Primary school	485 (17.5%)	2292 (82.5%)	
Illiterate	374(23.6%)	1211(76.4%)	
Marrige			<0.001
Divorced or widowed	228 (20.9%)	865 (79.1%)	
Married	1391 (16.1%)	7232 (83.9%)	
Smoking			<0.001
Current smoker	131(12.2%)	942(87.8%)	
Former smoker	356(16.0%)	1871(84.0%)	
Non-smoker	1133(17.6%)	5294(82.4%)	
Drinking			<0.001
Current drinker	110(9.8%)	1014(90.2%)	
Former drinker	208(17.7%)	968(82.3%)	
Non-drinker	1302(17.5%)	6125(82.5%)	
Falls			<0.001
Yes	312(22.6%)	1071(77.4%)	
No	1308(15.7%)	7036(84.3%)	
Long-time bedridden			<0.001
Yes	120(46.5%)	138(53.5%)	
No	1500(15.8%)	7969(84.2%)	
Cognitive function			<0.001
Normal	1063(14.4%)	6335(85.6%)	
Dysfunction	464(24.2%)	1450(75.8%)	
Living conditions			<0.001
Building with elevators	550(15.7%)	2953(84.3%)	
Building without elevators	714(15.6%)	3879(84.5%)	
Bungalow	356(21.8%)	1275(78.2%)	
Vision			<0.001
Normal	1176(15.3%)	6499(84.7%)	
Dysfunction	444(21.6%)	1608(78.4%)	
Hearing			<0.001
Normal	1257(15.9%)	6676(84.2%)	
Dysfunction	363(20.2%)	1431(79.8%)	
sleep			<0.001
Normal	624(11.3%)	4883(88.7%)	
Dysfunction	996(23.6%0	3224(76.4%)	
Urinary function			<0.001
Normal	1303(15.6%)	7075(84.5%)	
Dysfunction	317(23.5%)	1032(76.5%)	
Defecation function			<0.001
Normal	1274(15.0%)	7249(85.1%)	
Dysfunction	346(28.7%)	858(71.3%)	

with aging (OR=0.993, 95%CI: 0.990-0.997) or larger ADL scores (OR=0.979, 95%CI: 0.974-0.984), but the relationship strength was weak. Ethnicity and smoking conditions were not statistically associated with depression after controlling other covriates. Both educational level and BMI levels were closely associated with depression. Higher educational level (OR=0.877, 95%CI: 0.816-0.843) could reduce the prevalence risk compared to illiterate subjects. Compared to normal-weight subjects, emaciated subjects were more risky for depression (OR=1.176, 95%CI: 1.107-1.249), but overweight (OR=0.915, 95%CI: 0.882-0.948) and obese subjects (OR=0.920, 95%CI: 0.872-0.970) were associated with a lower prevalence rate of depression. Similar with univariate analysis results, current drinkers had lower prevalence hazard (OR=0.901, 95%CI: 0.849-0.956) in the multivariate model and frail subjects had higher prevalence hazard (OR=1.562, 95%CI: 1.489-1.639). Divorced or widowed (OR=1.083 95%CI: 1.017-1.153), living in the bungalow (OR=1.075, 95%CI: 1.023-1.130), falls (OR=1.078, 95%CI: 1.030-1.128), cognitive function (OR=1.142, 95%CI: 1.091-1.195), vision dysfunction (OR=1.125, 95%CI: 1.076-1.177), hearing dysfunction (OR=1.061, 95%CI: 1.011-1.113), sleep dysfunction (OR=1.237, 95%CI: 1.194-1.282), defecation dysfunction (OR=1.160, 95%CI: 1.103-1.221) could increase prevalence risk of depression. Contrary to univariate analysis results, association of long-time bedridden, or urinary function and depression was not significant in the multivariate model.

In summary, after controlling the cluster effect of hospital wards, age, gender, ADL score, educational level, BMI, frail, marriage, falls, alcohol drinking, cognitive function, living conditions, vision, hearing, sleep and defecation function were associated with depression.

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Table 3
Associated Factors with Depression from Regression Model

Characteristics	Univariate		Multivariate	
	OR	95%CI	OR	95%CI
Age	1.004	1.002-1.006	0.993	0.990-0.997
ADL score	0.957	0.955-0.959	0.979	0.974-0.984
BMI				
Obesity	0.892	0.855-0.930	0.920	0.872-0.970
Overweight	0.855	0.832-0.879	0.915	0.882-0.948
Emaciation	1.388	1.332-1.447	1.176	1.107-1.249
Normal	1.0 (Ref.)		1.0 (Ref.)	
Gender				
Male	1.0 (Ref.)		1.0 (Ref.)	
Female	1.190	1.162-1.219	1.059	1.013-1.107
Ethnicity				
Han	1.0 (Ref.)		1.0 (Ref.)	
Others	1.165	1.109-1.223	0.996	0.928-1.069
Frail				
Yes	2.093	2.039-2.149	1.562	1.489-1.639
No	1.0 (Ref.)		1.0 (Ref.)	
Educational level				
University	0.719	0.688-0.751	0.877	0.816-0.843
Middle school	0.852	0.822-0.882	0.960	0.910-1.014
Primary school	0.808	0.781-0.835	0.984	0.928-1.043
Illiterate	1.0 (Ref.)		1.0 (Ref.)	
Marriage				
Divorced or widowed	1.184	1.142-1.227	1.083	1.017-1.153
Married	1.0 (Ref.)		1.0 (Ref.)	
Smoking				
Current smoker	0.855	0.821-0.891	0.960	0.907-1.015
Former smoker	0.945	0.918-0.973	1.004	0.955-1.055
Non-smoker	1.0 (Ref.)		1.0 (Ref.)	
Drinking				
Current drinker	0.744	0.714-0.776	0.901	0.849-0.956
Former drinker	0.985	0.950-1.022	1.026	0.968-1.086
Non-drinker	1.0 (Ref.)		1.0 (Ref.)	
Falls				
Yes	1.222	1.184-1.262	1.078	1.030-1.128
No	1.0 (Ref.)		1.0 (Ref.)	
Long-time bedridden				
Yes	1.942	1.835-2.056	1.083	0.987-1.188
No	1.0 (Ref.)		1.0 (Ref.)	
Cognitive function				
Normal	1.0 (Ref.)		1.0 (Ref.)	
Dysfunction	1.411	1.373-1.449	1.142	1.091-1.195
Living conditions				
Building with elevators	1.0 (Ref.)		1.0 (Ref.)	
Building without elevators	1.004	0.977-1.032	1.011	0.977-1.047
Bungalow	1.219	1.178-1.261	1.075	1.023-1.130
Vision				
Normal	1.0 (Ref.)		1.0 (Ref.)	
Dysfunction	1.245	1.210-1.281	1.125	1.076-1.177
Hearing				
Normal	1.0 (Ref.)		1.0 (Ref.)	
Dysfunction	1.191	1.156-1.228	1.061	1.011-1.113
sleep				
Normal	1.0 (Ref.)		1.0 (Ref.)	
Dysfunction	1.502	1.466-1.539	1.237	1.194-1.282
Urinary function				
Normal	1.0 (Ref.)		1.0 (Ref.)	
Dysfunction	1.207	1.168-1.247	1.035	0.980-1.094
Defecation function				
Normal	1.0 (Ref.)		1.0 (Ref.)	
Dysfunction	1.488	1.441-1.536	1.160	1.103-1.221

OR: odds ratio; CI: confidence interval

DEPRESSION AMONG CHINESE OLDER INPATIENTS

Discussion

To the best of our knowledge, this is the first time to report the prevalence of depression and its associated factors among Chinese older inpatients with nationally representative sample covering six administration regions. Application of mixed-effect Poisson regression models can not only control the cluster effect of hospital wards, but also examine the effect of potential associated factors on both the prevalence and the strength of depression. Potential associated factors included indicators for demographic characteristics, physical conditions and mental conditions.

According to our survey data, Chinese older inpatients had a prevalence of depression (16.7%), which was higher than the previous reports (17-18, 29). Since our survey sample came from six high-rated hospital, subjects in our study suffered from more severe diseases and then more susceptible to depression, which maybe lead to a high estimation of prevalence of depression. The prevalence of depression across all Chinese older inpatients maybe lower. However, another study reported a higher prevalence of depression (32.8%) in China (19). This study was conducted among a sample from only one geriatric hospital with a small sample size, which limited the representativeness and publicity of the study reports.

Many demographic characteristics, physical conditions and mental conditions were found as associated with depression in this study. In contrast with previous studies (30-32), we found no significant differences in the prevalence of depression among different ethnicity, smoking conditions, long-time bedridden and urinary function, or a weak difference between different genders and ages of elderly inpatients, which were congruent with those of several studies (33-34).

Compared to subjects who lived in the building with elevators, subjects who lived in bungalow were more susceptible to depression. In China, living conditions were closely relative to economical conditions. There was great possibility that elderly living bungalow were poverty-stricken that might have strong effect on occurrence of depression symptoms.

Compared to illiterate subjects, well-educated ones had a low risk of depression, which was similar to a Brazilian study (35). Two reasons could be considered. First, educated subjects were more likely to enjoy better economical conditions. In addition, educated subjects were knowledgeable, which could help them understand the development of diseases and control depressed moods better.

Similar to a previous studies (36), widowed or divorced subjects had a higher risk of depression. With aging, elderly' social roles and self concept have been changed, and the emotional support of companions has become more important for them. Loneliness and lack of companion had a terrible effect on their mental conditions. An association between alcohol drinking and low risk of depression was found, which might be because alcohol drinking was a way for subjects to relieve stress and depressed moods. The definite reason need to be explored further in future.

Emaciation and frailty were found out a significant association with depression. Previous studies indicated that undernourishment and impaired physical function might lead to disability and functional dependence, thus increase the risk for developing depressive moods in elderly adults (37-39). Therefore, it might be essential to evaluate and manage frailty while improving depressive conditions.

In our present study, impaired vision function, hearing function, cognitive function, sleep function, defecation function, ADL function were significant associated with depression. These dysfunction of physical or mental conditions had terrible effect on quality of life of older inpatients and refrained them from taking part in social interactions, which made them more likely to suffer from depressive symptoms.

Now let's discuss about the limitations of this paper. First, due to the nature of cross sectional study design, we could not make causation between depression and influencing factors, but only explore the relationship between depression and potential associated factors. Second, depression could of course be defined in different ways, using different assessment scales. The different definitions of depression limit the comparison of prevalence figures from different studies. And older adults living in the same ward of the same hospital were more likely to be assessed as similar depression scores. In order to control the cluster effect of hospital wards, mixed-effect Poisson regression models was used to examine the relationship between prevalence and covariates. Finally, recall bias might exist in the current study due to self-report smoking and drinking conditions.

Despite these limitations, we can conclude that there was a high prevalence of depression among Chinese older inpatients. Demographic characteristics, physical and mental conditions indicators have strong effect on prevalence and strength of depression. Therefore, it is essential to assess depression and perform comprehensive measures to improve physical and mental conditions in order to manage depressive symptoms in older inpatients.

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