RESEARCH

Factors associated with a high level of suicide risk among patients with late-life depression: a cross-sectional study from a tertiary psychiatric hospital in Guangzhou China

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Abstract

Background As global aging accelerates, depression among the elderly becomes more common. Research had revealed that patients with late-life depression (LLD) face a higher risk of suicide compared to their counterparts in other age groups, with the pathways to suicide being multifaceted. Thus, investigating the various factors linked to the elevated risk of suicide in patients with LLD is critical.

Objective To investigate the factors associated with a high level of suicide risk among patients with LLD.

Methods A total of 108 patients with LLD were recruited for this study. From October 2022 to November 2023, a cross-sectional study was conducted on patients with LLD from the Affiliated Brain Hospital of Guangzhou Medical University. Suicide risk was evaluated using the Chinese version of the Nurses' Global Assessment of Suicide Risk Scale (NGASR). Potential influencing factors were included and analyzed through multivariate linear regression to identify the factors associated with a high level of suicide risk among patients with LLD.

Results The mean NGASR score among patients with LLD was 7.30 ± 4.34 (range: $0 \sim 19$). Multiple linear regression analyses revealed that depression-anxiety of the Brief Psychiatric Rating Scale (BPRS) ($\beta = 0.31$, 95% CI = 0.13, 0.45, $p < 0.001$), activation of the BPRS ($\beta = -0.29$, 95% CI = -1.22, -0.35, $p < 0.001$), normal cognitive function of the Mini-Mental State Examination (MMSE) ($\beta = 0.21$, 95% CI = 0.50, 3.48, $p < 0.05$), involuntary admission ($\beta = 0.20$, 95% CI = 0.44, 3.43, $p < 0.05$), and objective support of the Social Support Rating Scale (SSRS) ($\beta = 0.21$, 95% CI = 0.08, 0.66, $p < 0.05$) were statistically associated with a high level of suicide risk in patients with LLD.

Conclusion This study found that LLD patients with severe depression-anxiety, low activation, normal cognitive function, involuntary admission, and strong objective support exhibited a high level of suicide risk. These patients should receive intensified monitoring and comprehensive measures should be implemented to prevent the occurrence of suicidal behaviors during hospitalization.

Keywords Cross-sectional study, Factors, Late-life depression, NGASR, Suicide risk

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Introduction

Given the rapid pace of global population aging, late-life depression (LLD) has emerged as a significant factor impacting the physical and mental well-being of older adults [1]. In 2020, the global population aged sixty years or above numbered one billion, projected to increase to 1.4 billion by 2030, and double to 2.1 billion by 2050 [2]. Furthermore, according to the Global Burden of Disease 2019 report, approximately 280 million people (3.8% of the total population) suffered from depression worldwide, with a prevalence rate of 5.7% among those aged sixty years or above [3]. Depression is predicted to become the leading cause of disease burden worldwide by 2030 [4]. Notably, the prevalence of LLD in China is high, ranging from 15.9 to 25.6% based on previous studies [5–7].

LLD, a prevalent mental disorder in older adults (≥60 years), is primarily characterized by depressed mood or loss of interest or pleasure [8]. Patients with LLD demonstrate more accompanying symptoms (e.g., anxiety/agitation, somatic complaints, psychotic symptoms, cognitive impairment, and sleep disturbances), setting it apart from depression in other age groups [8, 9]. Additionally, patients with LLD tend to have a poorer prognosis, a more chronic course, and a higher relapse rate [10]. Persistent or recurrent moderate to severe depressive episodes substantially worsen patient conditions, with the gravest cases escalating to suicide [4]. Significantly, the most serious and dangerous comorbid problem of LLD is suicide [11].

Every year, 703,000 deaths are attributed to suicide, with many more people attempting suicide, marking suicide as a serious public health problem globally [12]. Statistically, older adults are at high risk of suicide, with 27.2% of global suicide deaths occurring among people aged 60 or over, and 60%~90% of these are caused by depression [13, 14]. Based on a self-developed suicide risk assessment tool, a Chinese study found that 60% of LLD patients in hospitals were at risk of suicide [15]. Moreover, relative to younger patients, patients with LLD exhibit recurrent and entrenched suicidal thoughts, elaborate suicide plans, and elevated suicide mortality rates, likely as a result of the progressive accumulation of various risk factors over time [8, 16]. Suicide has devastating impacts across multiple dimensions, including medical, legal, psychological, and financial aspects, among others [16].

The development of suicide risk is complex, involving biological, psychological, clinical and socioenvironmental factors [17]. Determining an individual's risk of suicide is challenging due to the involvement of multiple risk factors. Fernandez-Rodrigues et al. gathered integrated evidence on potential risk factors for suicidal behavior in LLD by studying sociodemographic, clinical (both psychiatric and organic) factors, and psychosocial risk factors. The study revealed that the suicide risk of patients with LLD is associated not only with the severity of depressive episodes and psychiatric comorbidities but also with the level of social support and feelings of loneliness [16]. Despite the strong link between depression and suicide risk established by previous studies, the severity of depression alone is not a dependable predictor of suicidal behavior [18]. Furthermore, the majority of existing studies emphasize psychiatric comorbidity primarily in the presence of comorbid anxiety or concurrent substance use disorders, with very few researches on other comorbid psychiatric symptoms [16]. A significant amount of evidence suggests that loneliness and social isolation elevate the risk of suicide, while the quality of perceived social support is associated with health outcomes [19]. As family structures and elderly care models in China undergo changes, the connection between social support and suicide risk in older adults with depression requires more in-depth investigation. Moreover, the relationship between depression and cognitive function in older adults adds another layer of complexity, with mixed findings on its impact on suicidal behavior in LLD patients [20–22]. To sum up, the literature on variables correlated with suicide risk in elderly individuals with depression demonstrates variability in findings. Despite the prevalence of suicide in LLD patients, limited attention has been given by the media, healthcare programs, and funding agencies to the issue of suicide in older adults [23]. Therefore, the exploration of factors related to suicide risk in patients with LLD holds both clinical significance and societal value.

This study aims to investigate the current status of suicide risk among patients with LLD and analyze its related factors, to explore valuable insights for the prevention and control of suicidal behavior and targeted interventions for hospitalized LLD patients.

Materials and methods

Study design and participants

This cross-sectional study was conducted from October 2022 to November 2023 by convenience sampling from the Affiliated Brain Hospital of Guangzhou Medical University. The inclusion criteria were as follows: (1) age≥60 years old; (2) within 24 to 72 h of hospital admission; (3) compliance with the diagnostic criteria for depression according to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-V); (4) possess the capacity to respond naturally and complete scale rating; (5) agreed to sign informed consent.

Based on the research findings of Gu [24], we used PASS 2020 software to calculate the sample size. The parameters were set as follows: "Interval Type" to "Two-Sided", "Population Size" to "Infinite", "Confidence Level"

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to 0.95, "Distance from Mean to Limits" to 1.02, and "Standard Deviation" to 4.08. The calculation indicated that a sample size of 62 would be required. To accommodate a 20% attrition rate and additional confounding factors, 75 participants were considered adequate.

Questionnaire

General information

A form was used to collect data on gender, age, marital status, education level, type of admission attitude, and type of admission arrangement. The scales used for evaluation included the Nurses' Global Assessment of Suicide Risk (NGASR), Mini-Mental State Examination (MMSE), Social Support Rating Scale (SSRS), and Brief Psychiatric Rating Scale (BPRS).

Nurses' Global Assessment of Suicide Risk (NGASR)

The Nurses' Global Assessment of Suicide Risk (NGASR) is a validated tool for suicide risk assessment that is assessed by trained nurses [25]. The scale contains fifteen items, each assessed as "yes" or "no". Affirmative answers are weighted, with five key indicators (hopelessness, depression/loss of interest or loss of pleasure, a plan to commit suicide, recent bereavement or relationship breakdown, prior suicide attempt) valued at three points and the remainder at one point. Negative responses received zero points. The total score is twenty-five, with $0 \sim 5$ as "low risk", $6 \sim 8$ as "moderate risk", $9 \sim 11$ as "high risk", and ≥12 as "very high risk". High and very high suicide risks were classified as suicidal tendencies [26].

Mini-mental state examination (MMSE)

The Mini-Mental State Examination (MMSE) is one of the most widely used cognitive screening tests in clinical settings [27]. Developed in 1975, the MMSE is a brief test to examine orientation, immediate and short-term memory, attention, calculation, language, and praxis. Its total score ranged from zero (worst) to thirty (best) points. The Chinese version of the MMSE, developed by Zhang et al., demonstrated good reliability and validity in older adults [28]. Scores of $27 \sim 30$ suggest normal cognitive and intellectual function, with $21 \sim 26$ indicating mild dementia, $10 \sim 20$ indicating moderate dementia, and less than 10 indicating severe dementia.

Social Support Rating Scale (SSRS)

The Social Support Rating Scale (SSRS), revised by domestic scholars Xiao et al., comprises ten items encompassing three dimensions: subjective support (4 items), objective support (3 items), and utilization of support (3 items) [29]. Higher scores on the scale indicate a greater level of social support. The SSRS has favourable reliability and validity, in addition to being applicable to diverse populations.

Brief psychiatric rating scale (BPRS)

The Brief Psychiatric Rating Scale (BPRS), developed by Overall & Gorham (1962), was used to evaluate the severity of psychiatric symptoms [30]. This instrument comprises two assessments for negative symptoms, specifically depression-anxiety (somatic concern, anxiety, guilty feelings, and depressive mood), and lack of vitality, as well as three assessments for positive symptoms, including thought disturbance, activation (tension, mannerism-posturing, and excitement), and hostile suspicion. The scale comprises eighteen items, with a total score ranging from 18 to 126. Higher scores on this assessment tool are indicative of more severe psychiatric symptoms.

Data collection

This study adopted a questionnaire-survey approach to gather data. In the inpatient department of a psychiatric hospital, four researchers distributed the survey questionnaire onsite. All assessments were conducted within seventy-two hours of admission, including the patients' general information, suicide risk, cognitive function, social support, and psychiatric symptoms. To ensure data consistency and accuracy, all researchers received training before the survey. In this study, 120 questionnaires were distributed, and 108 collected questionnaires were deemed valid, with a successful response rate of 90.0%.

Statistical analysis

SPSS 27.0 was used for statistical analysis. The data obtained from the measurement tools were normally or almost normally distributed. Continuous variables were presented as the mean±standard deviation (SD), and categorical variables were presented as frequency and percentage. The independent sample t-test was utilized to assess differences in two categories, while one-way analysis of variance (ANOVA) was employed for comparisons among three or more categories. All p values were two-tailed, with the significance level set at 0.05. In the univariate analysis, the variables with a p value <0.05 were included in univariate linear regression analysis. Within the univariate linear regression models, variables with a p value < 0.10 were then chosen as independent variables for the multiple linear regression analysis, with the NGASR score serving as the dependent variable. Multiple linear regression analysis was subsequently performed via the "enter" method to identify which of the selected independent variables were significant predictors of suicide risk in elderly patients with depression.

Results

Normality test results

The normality of the variables was assessed using skewness and kurtosis. According to the criteria proposed by Kline [31], if the absolute values of the skewness are

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Table 1 Normality test results

Item	Skewness	Kurtosis
Age (yrs)	0.51	-0.50
NGASR	0.22	-0.59
MMSE	-1.11	0.66
BPRS	0.83	1.25
Depression-Anxiety	0.28	-0.67
Lack of vitality	2.28	7.10
Thought disturbance	1.37	1.25
Activation	1.44	2.21
Hostile suspicion	2.32	5.29
SSRS	1.19	2.93
Objective support	-0.33	-0.24
Subjective support	1.07	1.89
Utilization of support	1.48	2.37

Table 2 Demographic and clinical characteristics

Item	Frequency/Mean	Proportion(%)/SD
Sex		
Male	27	25.0
Female	81	75.0
Age (yrs)		
60~64	33	30.6
65~69	32	29.6
70~74	22	20.4
≥75	21	19.4
Education		
Illiteracy	10	9.3
Primary School	34	31.5
Secondary school	35	32.4
High School	16	14.8
College and above	13	12.0
Marital Status		
Married	84	77.8
Divorce	3	2.8
Widowed	21	19.4
Type of admission attitude		
Voluntary admission	31	28.7
Involuntary admission[a]	77	71.3
Type of admission arrangement		
Caregiver-assisted	102	94.4
Non-caregiver-assisted	6	5.6
MMSE		
Abnormal (≤26)	77	71.3
Normal (27~30)	31	28.7
NGASR		
Low risk (0~5)	45	41.7
Moderate risk (6~8)	21	19.4
High risk (9~11)	24	22.2
Very high risk (≥12)	18	16.7
BPRS	32.82	8.52
SSRS	31.67	6.05

(a) Involuntary admission refers to the process by which individuals with mental disorders, due to the pathological nature of their psychiatric symptoms, lack the capacity for accurate self-assessment of their mental state and are unable to seek medical care independently, necessitating intervention by others [32]

within 3 and the absolute values of the kurtosis are within 8, the data can be considered to approximate a normal distribution. Based on the analysis results shown in Table 1, the absolute values of the skewness and kurtosis coefficients for all variables in the current study fall within the standard range. Therefore, it can be concluded that the data for all variables satisfy the assumption of approximate normality (Table 1).

Demographic and clinical characteristics
Most participants were female (75.0%, $n=81$). The mean age was 68.65 ± 6.52 years old, with 30.6% ($n=33$) of the participants aged between 60 and 64 years old. Among the participants, 32.4% ($n=35$) had received secondary education, whereas 31.5% ($n=34$) had primary education; only a small proportion of participants were illiterate. In terms of marital status, the majority of participants were married, accounting for 77.8% ($n=84$). Furthermore, 71.3% ($n=77$) of the participants were involuntary admission. Additionally, 94.4% ($n=102$) of the participants were assisted in hospitalization by caregivers. Most participants had abnormal cognitive function (71.3%, $n=77$). All participants were at risk of suicide, with 22.2% ($n=24$) assessed as high risk and 16.7% ($n=18$) assessed as very high risk (Table 2).

NGASR scores in LLD participants with different characteristics
The type of admission attitude and cognitive function were significantly associated with the suicide risk among LLD patients ($p<0.05$). Moreover, the depression-anxiety and activation dimensions of the BPRS, as well as the objective and subjective support dimensions of the SSRS demonstrated statistical significance ($p<0.05$) (Table 3).

Univariate linear regression analysis of suicide risk influencing factors in LLD participants
According to the univariate linear regression analysis of the relevant variables, the results revealed a statistically significant correlation with the type of admission attitude, cognitive function, depression-anxiety and activation dimensions of the BPRS, as well as the objective support dimension of the SSRS ($p<0.05$) (Table 4).

Multiple linear regression analysis of suicide risk influencing factors in LLD participants
A multiple linear regression analysis model was constructed. The NGASR scores were considered as the dependent variable and the statistically significant variables of the univariate linear analysis as independent variables. The results showed that the depression-anxiety of BPRS ($\beta=0.31$, 95% CI$=0.13$, 0.45, $p<0.001$), activation of BPRS ($\beta=-0.29$, 95% CI$=-1.22$, -0.35, $p<0.001$), normal cognitive function of MMSE ($\beta=0.21$, 95% CI$=0.50$, 3.48,

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Table 3 NGASR scores in LLD participants with different characteristics

Item	Mean	SD	t/F	p
Sex			0.87	0.387
Male	7.93	3.74		
Female	7.09	4.53		
Age (yrs)			2.05	0.112
60~64	7.70	3.99		
65~69	6.91	4.04		
70~74	5.77	3.90		
≥75	8.86	5.34		
Education			1.31	0.285
Illiteracy	9.40	4.65		
Primary School	6.50	3.92		
Secondary school	7.11	5.11		
High School	7.13	4.00		
College and above	8.46	2.93		
Marital Status			1.22	0.301
Married	6.98	4.25		
Divorce	7.00	1.73		
Widowed	8.62	4.83		
Type of admission attitude			-2.36	**0.020**
Voluntary admission	5.78	4.22		
Involuntary admission	7.91	4.27		
Type of admission arrangement			1.68	0.096
Caregiver-assisted	7.13	4.22		
Non-caregiver-assisted	10.17	5.81		
MMSE			7.97	**0.006**
Abnormal (≤26)	6.57	4.41		
Normal (27~30)	9.10	3.63		
BPRS				
Depression-Anxiety	12.92	4.55	2.15	**0.009**
Lack of vitality	6.16	3.21	0.71	0.735
Thought disturbance	5.70	2.37	1.95	0.054
Activation	3.91	1.60	2.61	**0.010**
Hostile suspicion	4.14	2.56	0.97	0.482
SSRS				
Objective support	9.09	2.51	2.66	**0.005**
Subjective support	17.81	3.73	1.92	**0.024**
Utilization of support	4.77	2.04	1.50	0.159

Table 4 Univariate linear regression analysis of suicide risk influencing factors in LLD participants

Item	β	p
Type of admission attitude		
Voluntary admission	-0.22	**0.020**
Involuntary admission	0.22	**0.020**
MMSE		
Abnormal (≤26)	-0.26	**0.006**
Normal (27~30)	0.26	**0.006**
BPRS		
Depression-Anxiety	0.40	**0.000**
Activation	-0.31	**0.001**
SSRS		
Objective support	0.37	**0.000**
Subjective support	0.18	0.674

16.7% were considered to be at very high risk. This is significantly higher than the 10.9% high-risk and 13.5% very high-risk reported in a previous study of non-LLD patients by Fan [33]. These findings suggest that LLD patients may be at an elevated risk of suicide compared to their younger counterparts. Given the higher proportion of LLD patients assessed as being at high and very high suicide risk, increased clinical vigilance and targeted interventions tailored to the specific needs of this vulnerable population are warranted to help mitigate their elevated risk of suicide.

In the context of the current study's findings, the data revealed an association between diminished levels of activation and heightened suicide risk among patients with LLD. This observation is particularly noteworthy when considered in the context of prior research on the melancholic subtype of major depressive disorder [34]. LLD patients with low levels of activation might experience persistent feelings of sadness, loss of interest and pleasure, as well as symptoms of low energy or fatigue, which are included in the diagnostic criteria for melancholic depression [35]. Furthermore, prior research had indicated that depressed patients with melancholic features exhibit greater illness severity, poorer treatment outcomes, and a higher prevalence of suicidal ideation and suicide risk [36]. Importantly, multiple large-scale clinical surveys showed that the melancholic depression subtype accounts for a very high percentage of depression cases, especially among female patients [37]. Specifically, the melancholic subtype was shown to comprise 53.4% of all depression cases, with an even more alarming prevalence of 81.3% among female patients [37]. Given the predominantly female sample of this study (75%), the high prevalence of melancholic features among this population may help explain the observed association between diminished activation and heightened suicide risk.

Our cross-sectional results suggested that normal cognitive functioning was associated with a higher risk

$p<0.05$), involuntary admission ($\beta=0.20$, 95% CI=0.44, 3.43, $p<0.05$), and objective support dimension of SSRS ($\beta=0.21$, 95%$CI=0.08$, 0.66, $p<0.05$) were the main influencing factors for suicide risk (Table 5).

Discussion

Our study found that suicide risk in patients with LLD was associated with worsening of depression-anxiety severity, decreased levels of activation, normal cognitive function, involuntary admission, and increased levels of objective support. LLD patients had a total suicide risk score of 7.30±4.34, indicating a moderate level of suicide risk. Furthermore, our study revealed that 22.2% of LLD patients were assessed as high suicide risk, and

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Table 5 Multiple linear regression analysis of suicide risk influencing factors in LLD participants

Item	Non-standardized		β	t	*p*	95% CI
	β	Standard Error				
(Constant)	1.26	1.78		0.71	0.478	-2.26, 4.79
BPRS(= Depression-Anxiety)	0.29	0.81	0.31	3.63	**0.000**	0.13, 0.45
BPRS (= Activation)	-0.78	0.22	-0.29	-3.60	**0.000**	-1.22, -0.35
MMSE (= Normal)	1.99	0.75	0.21	2.65	**0.009**	0.50, 3.48
Type of admission attitude (=Involuntary admission)	1.94	0.75	0.20	2.57	**0.012**	0.44, 3.43
SSRS(=Objective support)	0.37	0.15	0.21	2.54	**0.013**	0.08, 0.66

$R^2 = 0.39$, Adjusted $R^2 = 0.36$, F = 13.19, $p < 0.001$

of suicide, aligning with the conclusion of Wastler et al. [21] that greater cognition is associated with an increased risk for suicide. Similarly, the study by Arslanoglou et al. [20] also indicated that patients with LLD at risk of suicide exhibit fewer cognitive deficits compared to their non-suicidal counterparts. Additionally, a separate study proposed that cognition serves as a correlated or proxy risk factor for suicide rather than a causal risk factor. Insight had been suggested as a potential mechanism to explain the link between cognition and suicide, with better cognition leading to improved insight and increased suicide risk [38]. However, the relationship between specific cognitive domains and suicide risk remains complex. Coexisting cognitive impairment is common in individuals with LLD and can involve multiple cognitive domains, including working memory, verbal learning and executive function [9, 21, 39, 40]. Research showed differing effects of these cognitive domains on suicide risk. For example, one study reported that the odds of experiencing suicidal ideation decreased for every one-unit increase in working memory (*OR*=0.922, *SE*=0.040; *CI*: 0.854–0.997) [39]. However, another study identified verbal learning as the only cognitive domain linked to increased suicide risk, with better verbal learning correlating with higher risk of suicide [21]. Furthermore, evidence suggested that elderly individuals with depression who attempted suicide displayed poorer executive function compared to those who did not attempt suicide [40]. Conversely, Zoghbi et al. [22] proposed that psychiatric patients with higher executive functioning are more likely to carry out their suicide plan, as better executive functioning may allow for more effective planning and goal-directed behavior. These studies had reported inconsistent findings regarding the relationship between specific cognitive domains and suicide risk. One possible explanation for these mixed results is that different cognitive domains may have varying associations with suicide risk. Our findings should be integrated with caution, further research is needed to understand the relation between specific cognitive domains and risk of suicide among LLD patients.

Social support, consisting of subjective support, objective support, and support utilization, is frequently viewed as a protective factor against suicide [41]. Interestingly, our study found that LLD patients with high suicide risk reported higher levels of objective support. This finding indicates that the effectiveness of objective support may not be uniformly beneficial and could vary depending on individual circumstances and perceptions. Specifically, the majority of participants in our study received assistance from family members such as spouses or children during hospitalization. Despite the availability of this support, many elderly individuals reported feelings of being a burden and expressed concerns about the cost of hospitalization, which can lead them to consider suicide as a way to alleviate their families' difficulties [42]. This aligns with the interpersonal theory of suicide, which identifies perceived burden as a precursor to suicidal ideation [43]. Furthermore, Wang et al. found that depression, hopelessness, and perceived burden interact and exacerbate each other, increasing the likelihood of suicide [44]. Accordingly, healthcare professionals should improve patients' comprehension of objective support from a cognitive standpoint, alleviate their stress, and effectively utilize objective support to foster psychological recuperation and prevent suicidal tendencies.

Our study found that depression-anxiety severity and involuntary hospitalization were significantly associated with suicide risk among patients with LLD. These factors have been emphasized in other studies as important indicators for identifying suicide risk [23, 45–48]. In terms of anxiety-depression, Guo et al. [45] noted that psychiatric patients frequently experience feelings of anxiety and distress about their current and future circumstances, often accompanied by emotions such as sadness, frustration, and helplessness. These negative emotions can hinder their willingness to seek mental health services. Thus, such emotional decline may lead to extreme outcomes such as self-injury [45]. Michaud et al. [46] reported that the severity of suicidal ideation and behavior was independently associated with involuntary hospitalization. Levola et al. found that depression and involuntary psychiatric hospitalization were significantly linked to an increased risk of suicide by 132% and 40%, respectively [47, 48]. Consequently, healthcare professionals should actively and meticulously pay attention to LLD patients displaying anxiety, depression symptoms, and resistance

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to hospitalization, as these individuals have an increased risk of suicide.

The limitations of the study include the questionnaire that didn't take into consideration all potential risk factors for suicide, such as history of suicide attempts, sleep disturbances, and economic stress. In addition, our data were collected solely from a single public psychiatric hospital. Consequently, the generalizability of our findings to LLD in broader community settings may be restricted. Finally, this study utilized the MMSE to assess cognitive function in patients. Although the MMSE is one of the most widely used tools in clinical and research settings for evaluating cognitive impairments, it possesses inherent limitations in its assessment capabilities [49]. Future studies should consider the MMSE as an initial screening tool rather than a definitive measure for comprehensive cognitive evaluation.

Conclusion

In conclusion, suicide risk in LLD patients was influenced by a range of social and psychological factors. Our study highlighted that the high suicide risk among LLD patients is associated with the severity of depression-anxiety, level of activation, normal cognitive function, involuntary admission, and objective support. To intervene suicidal risk of LLD patients, healthcare providers should establish a comprehensive suicide risk assessment process. In addition, for LLD patients at risk of suicide, a multidisciplinary team should be formed to collaborate in developing personalized intervention plans and dynamically monitor their suicide risk.

Abbreviations
LLD   Late-life depression
NGASR   Nurses' Global Assessment of Suicide Risk
MMSE   Mini-Mental State Examination
SSRS   Social Support Rating Scale
BPRS   Brief Psychiatric Rating Scale
SD   Standard Deviation

Declarations

Ethics approval and consent to participate
This study obtained ethical approval from the IRB of the Affiliated Brain Hospital of Guangzhou Medical University (approval number: 2024-003). The entire study was carried out in accordance with the Declaration of Helsinki. The participants' data were used solely for this research study and kept confidential. Informed consent was obtained from all participants before enrollment in the study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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