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Suicide risk, psychopathology and cognitive impairments in schizophrenia with insomnia: a large-scale cross-sectional study

Chenghao Lu^{1,2}, Dan Qi^{1,2}, Yunxuan Ping³, Chuhao Zhang^{1,2}, Shuzhe Wang^{2,3}, Nannan Liu^{1,2}, Xinxu Wang^{1,2}, Shen Li^{1,2,3*} and Jie Li^{1,3*}

Abstract

Background The relationship between suicide risk, cognitive impairments, and psychiatric symptoms in schizophrenia patients with insomnia remains controversial. This study aims to investigate the prevalence of suicide risk, clinical characteristics, and cognitive impairments in a large sample of chronic schizophrenia patients with insomnia.

Methods We recruited 1,436 chronic schizophrenia patients. Sociodemographic data were collected from all participants. The Positive and Negative Syndrome Scale (PANSS), Insomnia Severity Index (ISI), and Beck Scale for Suicide Ideation (BSI) were used to assess patients' psychiatric symptoms, insomnia, and severity of suicidal ideation, respectively. The Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) was utilized to evaluate cognitive function in the patients.

Results Insomnia prevalence was 9.5%. Patients with insomnia had a significantly higher suicide risk compared to those without (38% vs. 19.8%). In the insomnia group, the severity of suicidal ideation was negatively correlated with language function scores ($r = -0.344, p = 0.004$). Moreover, language function and general psychopathology scores were significant predictors of the severity of suicidal ideation ($B = -0.59, p = 0.008$; $B = 0.97, p = 0.010$). Language function and general psychopathology scores were also associated with suicide risk ($B = -0.05, p = 0.019$; $B = 0.11, p = 0.012$). The combined AUCROC value for these two predictors reached 0.758.

Conclusion Chronic schizophrenia patients with insomnia have a higher risk of suicide. Additionally, language function and general psychopathology serve as risk factors and predictors of suicide risk in chronic schizophrenia patients with insomnia.

Keywords Schizophrenia, Insomnia, Suicide risk, Psychopathology, Cognitive impairments

*Correspondence:

Shen Li
lishen@tmu.edu.cn
Jie Li
jieli@tmhmc.com

¹Institute of Mental Health, Tianjin Anding Hospital, Mental Health Center of Tianjin Medical University, No. 13, Liulin Road, Hexi District, Tianjin 300222, China

²Brain Assessment & Intervention Laboratory, Tianjin Anding Hospital, Mental Health Center of Tianjin Medical University, Tianjin 300222, China

³Institute of Mental Health, Tianjin Anding Hospital, Mental Health Center of Tianjin University, No. 13, Liulin Road, Hexi District, 300222 Tianjin, China



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Introduction

Schizophrenia is a serious and common chronic mental disorder associated with higher mortality rate compared to the general population [1]. Suicide is notably common among patients with schizophrenia globally and is a leading cause of death among these patients [2]. In China, the lifetime prevalence rates of suicidal ideation and suicide attempts among patients with schizophrenia are reported to be 25.8% and 14.6%, respectively [3]. Research indicates that, in contrast to the pronounced suicidality observed in patients with acute schizophrenia, patients with chronic schizophrenia often exhibit more covert suicidal ideation and behaviors due to their prolonged psychological distress and cognitive impairments, resulting in a higher mortality rate [4].

Insomnia is a common comorbid symptom among patients with chronic schizophrenia, with a prevalence rate ranging from 13.5 to 44% [5–7]. Studies have shown that insomnia is commonly present in individuals with first-episode psychosis as well as in clinical high-risk, and is closely linked to greater symptom severity, cognitive deficits, and diminished quality of life [6, 8–10]. Furthermore, a recent meta-analysis of seven studies involving patients with schizophrenia indicated that insomnia significantly increases the risk of suicide and serves as a strong predictor of suicidal behavior [11]. Beyond patients with schizophrenia, a large-scale meta-analysis has also demonstrated that insomnia is a significant risk factor for suicidal ideation and suicide attempts among adolescents [12]. In adolescents with psychiatric disorders, insomnia is considered to play a central role in the underlying mechanisms contributing to suicide risk [13].

The mechanisms underlying the association between insomnia and suicide risk in patients with schizophrenia are likely to involve a multifaceted interplay of physiological, psychological, and cognitive factors. On one hand, insomnia may exacerbate emotional dysregulation, thereby increasing the prevalence of anxiety and depression, which consequently elevates the likelihood of suicidal ideation and behaviors [14]. On the other hand, insomnia can also affect 5-hydroxytryptamine (5-HT) functioning, further exacerbating cognitive impairments and the deterioration of psychiatric symptoms [15]. Studies have shown that patients at high risk for suicide tend to exhibit more severe psychiatric symptoms [8, 16], and impairments in information processing and decision-making abilities may enhance impulsivity-related suicidal thoughts and behaviors [17].

The risk of suicide in patients with schizophrenia is associated with multiple factors, with cognitive functioning receiving increasing scholarly attention. Ranjbar et al. demonstrated that patients with heightened suicide risk exhibit poorer abilities in emotion regulation and control [18]. Similarly, Yin et al. and Li et al. reported that

first-episode schizophrenia patients with suicidal risk present with more severe cognitive impairments [19, 20]. However, some studies have indicated that patients with suicidal ideation or suicide attempts may actually display better cognitive functioning [21], and that cognitive impairments are linked to a lower risk of suicide [22]. In contrast, Dai et al. found no significant differences in cognitive functioning between patients with and without suicide risk [23]. These conflicting results may be attributable to variations in sample size and individual differences across studies.

To date, no studies have explored the association between suicide risk and cognitive impairments in chronic schizophrenia patients with insomnia. We hypothesize that language dysfunction and general psychopathology are significantly associated with suicide risk in chronic schizophrenia patients with insomnia. Therefore, this study aims to investigate: (1) the prevalence of suicide risk and its related risk factors in chronic schizophrenia patients with insomnia; and (2) the impact of cognitive impairments, particularly language dysfunction, as well as general psychopathology on suicide risk.

Methods

Study design and participants

From October 2021 to October 2024, we recruited a total of 1,436 patients with chronic schizophrenia from both the outpatient and inpatient departments of Tianjin Anding Hospital. The inclusion criteria were as follows: (1) meeting the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) criteria for schizophrenia; (2) duration of illness greater than two years; (3) aged between 18 and 70 years, of Han Chinese ethnicity; and (4) receiving a stable dose of antipsychotic medication for more than six months. Exclusion criteria included: (1) a history of substance dependence (except for tobacco); (2) pregnancy or breastfeeding; (3) severe physical illness or history of traumatic brain injury; (4) intellectual disability or dementia; and (5) meeting the DSM-5 criteria for other psychiatric disorders. This study was approved by the Ethics Committee of Tianjin Anding Hospital (Approval No. 2022-09), and written informed consent was obtained from all participants. The study procedures adhered to the ethical principles outlined in the Declaration of Helsinki.

Data collection

Sociodemographic and general clinical data

Sociodemographic and general clinical data were collected for all patients through a self-designed questionnaire and medical record review. The data included age, years of education, gender, marital status, age of onset, duration of illness, smoking status, clozapine use, and body mass index. The daily dosage of antipsychotic

medications was standardized to chlorpromazine equivalents (CPZ) using the defined daily dose methodology as recommended by the World Health Organization Collaborating Centre for Drug Statistics Methodology [24].

Suicide risk

Suicidal ideation refers to an individual having thoughts of suicide without actually attempting it, while suicide attempts refer to instances where an individual has tried to commit suicide but was unsuccessful. To assess patients' ideation and attempts, interviews were conducted with all participants. Each participant was asked, "Have you ever attempted suicide in your lifetime?" In addition, the research team reviewed medical records and communicated with family members to verify any history of suicidal ideation or attempts. Based on previous research, patients with either suicidal ideation or suicide attempts were classified into the suicide risk group [25]. To further assess the intensity of suicidal risk, the Beck Scale for Suicide Ideation (BSI) was used to quantify suicidal ideation [26]. In this study, the Cronbach's α coefficient for the BSI was 0.916, indicating high internal consistency.

Psychiatric symptoms

Psychiatric symptoms were assessed by two trained psychiatrists using the Positive and Negative Syndrome Scale (PANSS). The PANSS consists of 30 items divided into three subscales: the positive symptoms subscale (P1-P7), the negative symptoms subscale (N1-N7), and the general psychopathology subscale (G1-G16) [27]. The Cronbach's α coefficient for the PANSS in this study was 0.908, indicating high internal consistency. The inter-rater correlation coefficient between the two raters exceeded 0.8.

Insomnia

The Insomnia Severity Index (ISI) was employed to evaluate insomnia severity among patients. The ISI is a 7-item self-report scale rated on a 4-point Likert scale, with higher scores indicating greater insomnia severity, and is clinically categorized as: 0–7 (no insomnia), 8–14 (subthreshold), 15–21 (moderate), and 22–28 (severe insomnia) [28]. Based on previous studies, a cutoff score of 7 was used to categorize patients into an insomnia group ($ISI > 7$) and a non-insomnia group ($ISI \leq 7$) [7, 29, 30]. Although this threshold may appear relatively low compared to general populations, it has been shown to be sensitive and appropriate in identifying clinically meaningful insomnia symptoms in patients with schizophrenia, who may experience significant cognitive and emotional impact even from mild sleep disturbances [31, 32]. Finally, a total of 137 patients were included

in the insomnia group. Subsequently, the insomnia group was further subdivided based on the presence or absence of suicidal ideation or suicide attempts. A total of 52 patients were classified into the suicide risk group, while 85 patients were classified into the non-suicide risk group.

Cognitive function

The Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) was utilized to assess cognitive function in patients. The RBANS evaluates five cognitive domains: immediate memory, attention, language, visuospatial/constructional, and delayed memory [33]. Previous reliability and validity studies have demonstrated that the Chinese version of the RBANS possesses strong clinical validity and test-retest reliability [34]. The Cronbach's α coefficient for the RBANS was 0.896, indicating high internal consistency. All assessments were conducted in a quiet room within the hospital by three trained psychiatrists using a standardized, face-to-face procedure to ensure consistency. Additionally, inter-rater reliability was evaluated by having three psychiatrists independently assess a subset of 30 participants, and the intraclass correlation coefficients for all scales used in this study exceeded 0.8, indicating excellent agreement.

Data analysis

First, the Kolmogorov-Smirnov test was used to assess the normality of variable distributions. For continuous variables with normal distributions, independent samples t-tests were applied; for non-normally distributed continuous variables, the Mann-Whitney U test was used; and categorical variables were analyzed with the chi-square test. Spearman correlation analysis was conducted to calculate the correlation coefficient between the severity of suicidal ideation and cognitive function. Additionally, variables with significant differences in the univariate analysis and core variables of this study (PANSS and RBANS scores) were subjected to multiple stepwise regression analysis to identify predictors of the severity of suicidal ideation (as a continuous variable) among chronic schizophrenia patients with and without insomnia. Furthermore, the area under the receiver operating characteristic curve (AUCROC) was calculated to assess the ability of relevant variables to distinguish suicide risk, with an AUCROC between 0.7 and 0.8 generally considered acceptable. All statistical analyses were performed using SPSS software version 26.0, with categorical variables presented as frequencies and percentages and continuous variables as means \pm standard deviations. A two-tailed significance level of $p < 0.05$ was set for α .

Results

Prevalence, demographics, clinical characteristics, and cognitive function of chronic schizophrenia patients with insomnia

Among the 1,436 patients with chronic schizophrenia, the prevalence of insomnia was 9.5% ($n=137$). There were no significant differences in sociodemographic variables, including age, gender, age at first onset, duration of illness, clozapine use, and CPZ dosage, between patients in the insomnia and non-insomnia groups (see Table 1).

In addition, patients in the insomnia group had significantly higher scores on the BSI, as well as higher total PANSS scores, positive symptom scores, and general psychopathology scores (all $p_s < 0.001$). While the RBANS total scores and scores across the five cognitive domains were lower in the insomnia group than in the

non-insomnia group, these differences were not statistically significant (see Table 1).

Correlation between severity of suicidal ideation and cognitive function in chronic schizophrenia patients with insomnia

Correlation analysis indicated a significant negative relationship between the severity of suicidal ideation and language function in the insomnia group ($r = -0.344$, $p = 0.004$). In contrast, this association was not observed in the non-insomnia group ($r = -0.008$, $p = 0.845$). No significant correlations were found for other cognitive function scores in either group (see Table 2).

Furthermore, multiple stepwise regression analysis, using the severity of suicidal ideation as the dependent variable, demonstrated that language function ($B = -0.59$, $p = 0.008$, 95%CI = -1.01 , -0.16) and general

Table 1 Demographic, clinical characteristics, and cognitive function of the study sample

	Non-insomnia ($n = 1299$)	Insomnia ($n = 137$)	t/Z/ χ^2	p-value	Non-Suicide risk ($n = 85$)	Suicide risk ($n = 52$)	t/Z/ χ^2	p-value
Age, years	47.91 \pm 13.09	48.06 \pm 13.18	-0.13	0.893	50.31 \pm 12.38	41.53 \pm 10.69	3.36	0.001
Gender, %			0.46	0.498			0.19	0.663
Male	769 (53.5%)	77 (5.4%)			49 (35.8%)	28 (20.4%)		
Female	530 (36.9%)	60 (4.2%)			36 (26.3%)	24 (17.5%)		
Education, years	9.83 \pm 3.28	9.43 \pm 3.51	1.33	0.185	8.14 \pm 3.36	8.41 \pm 2.99	-0.38	0.709
Marriage, %			0.27	0.602			0.22	0.640
Unmarried	713 (49.7%)	72 (5.0%)			46 (33.5%)	26 (19.0%)		
Married	586 (40.8%)	65 (4.4%)			39 (28.5%)	26 (19.0%)		
Smoking, %			0.18	0.670			0.29	0.592
Non-smoker	791 (55.1%)	79 (5.5%)			52 (38.0%)	29 (21.1%)		
Smoker	510 (35.5%)	56 (3.9%)			33 (24.1%)	23 (16.8%)		
Age of onset, years	26.02 \pm 8.54	26.55 \pm 8.65	-0.69	0.488	27.24 \pm 9.08	24.35 \pm 7.09	1.56	0.123
Duration of illness, years	21.90 \pm 12.64	21.49 \pm 12.49	0.37	0.714	23.06 \pm 10.48	17.18 \pm 12.06	2.36	0.020
CPZ, mg/day	299.36 \pm 205.66	294.23 \pm 212.13	0.23	0.817	320.50 \pm 221.92	251.63 \pm 190.46	1.57	0.121
Clozapine, yes/no	372/927	45/92	1.07	0.302	23/62	22/30	3.40	0.065
BMI, Kg/m ²	24.80 \pm 4.49	24.57 \pm 3.72	0.67	0.506	24.554 \pm 3.44	24.61 \pm 4.23	-0.62	0.920
ISI scores	1.87 \pm 1.86	11.37 \pm 3.40	-27.62	< 0.001	11.47 \pm 3.37	11.76 \pm 3.70	-0.38	0.707
Suicide risk	257 (19.8%)	52 (38%)	24.23	< 0.001	-	-	-	-
BSI scores	18.30 \pm 17.31	29.55 \pm 25.06	-3.98	< 0.001	11.91 \pm 7.93	51.49 \pm 21.45	-18.05	< 0.001
PANSS								
P scores	15.82 \pm 5.57	18.15 \pm 5.92	-4.62	< 0.001	17.53 \pm 5.70	18.36 \pm 5.16	-0.67	0.502
N scores	21.21 \pm 7.51	21.99 \pm 6.91	-1.16	0.245	23.21 \pm 5.97	23.38 \pm 6.25	0.13	0.899
G scores	37.14 \pm 9.02	41.25 \pm 9.30	-5.06	< 0.001	43.63 \pm 8.03	46.52 \pm 8.10	-1.61	0.111
Total PANSS scores	74.28 \pm 17.50	81.40 \pm 17.36	-4.53	< 0.001	84.37 \pm 15.13	88.28 \pm 15.49	-1.15	0.255
RBANS								
Immediate Memory	58.86 \pm 22.94	57.18 \pm 15.13	0.76	0.448	54.38 \pm 12.71	55.24 \pm 15.07	-0.25	0.801
Visuospatial/Constructional	78.83 \pm 18.22	77.13 \pm 17.62	0.94	0.349	80.94 \pm 17.95	73.70 \pm 18.93	1.61	0.113
Language	81.07 \pm 14.73	78.90 \pm 14.76	1.48	0.139	80.82 \pm 13.00	72.70 \pm 13.43	2.52	0.014
Attention	82.02 \pm 16.07	79.81 \pm 17.44	1.37	0.172	74.21 \pm 15.51	73.73 \pm 16.65	0.12	0.903
Delayed Memory	65.51 \pm 19.69	63.42 \pm 19.58	1.07	0.286	63.18 \pm 18.33	57.30 \pm 18.31	1.31	0.194
Total RBANS scores	67.06 \pm 14.18	64.94 \pm 13.49	1.51	0.131	63.41 \pm 11.78	60.42 \pm 13.65	0.96	0.341

Bold values indicate $p < 0.05$

CPZ chlorpromazine equivalent, BMI body mass index, ISI Insomnia Severity Index, PANSS Positive and Negative Syndrome Scale, P positive symptom, N negative symptom, G General psychopathology symptom, RBANS Repeatable Battery for the Assessment of Neuropsychological Status

Table 2 Correlation between the severity of suicidal ideation and cognitive function in chronic schizophrenia patients with insomnia and non-insomnia

	Non-insomnia (n = 1299) <i>r</i> (<i>p</i> -value)	Insomnia (n = 137) <i>r</i> (<i>p</i> -value)
Immediate Memory	0.075 (0.081)	0.012 (0.920)
Visuospatial/Constructional	0.026 (0.552)	−0.224 (0.068)
Language	−0.008 (0.845)	−0.344 (0.004)
Attention	0.053 (0.219)	−0.084 (0.500)
Delayed Memory	0.052 (0.232)	−0.166 (0.179)
Total RBANS scores	0.055 (0.199)	−0.153 (0.217)

Bold values indicate $p < 0.05$

RBANS Repeatable Battery for the Assessment of Neuropsychological Status

psychopathology scores ($B = 0.97$, $p = 0.010$, $95\%CI = 0.24, 1.70$) were significant predictors of suicidal ideation exclusively within the insomnia group (see Table 3). As show in Fig. 1A–C, in the non-insomnia group, positive symptom scores ($B = 0.84$, $p < 0.001$, $95\%CI = 0.54, 1.14$) and age ($B = -0.17$, $p = 0.012$, $95\%CI = -0.29, -0.04$) were predictive of suicidal ideation.

Prevalence, demographics, clinical characteristics, and cognitive function in chronic schizophrenia patients with insomnia and suicide risk

The prevalence of suicide risk was significantly higher in the insomnia group compared to the non-insomnia group (38% vs. 19.8%, $p < 0.001$). Compared to patients without suicide risk, those with suicide risk were younger ($p = 0.001$), had a shorter duration of illness ($p = 0.02$), and scored lower in language function ($p = 0.014$). No significant differences were found in other general characteristics (e.g., clozapine use), clinical symptoms, or cognitive function (see Table 1).

Factors for suicide risk in chronic schizophrenia patients with insomnia

Binary logistic regression analysis identified factors associated with suicide risk in chronic schizophrenia patients with insomnia, including general psychopathology scores ($B = 0.11$, $p = 0.012$, $OR = 1.120$, $95\%CI = 1.025–1.223$) and language function scores ($B = -0.05$, $p = 0.019$, $OR = 0.950$, $95\%CI = 0.910–0.992$). Age and duration of

illness were not significantly associated with suicide risk (see Table 4).

In addition, as show in Fig. 1D, the AUCROC values for general psychopathology and language function were 0.592 ($p = 0.005$, $95\% CI = 0.470–0.715$) and 0.307 ($p = 0.007$, $95\% CI = 0.179–0.435$), respectively. When general psychopathology and language function were combined, the AUCROC value increased to 0.758 ($p < 0.001$, $95\% CI = 0.640–0.875$).

Discussion

To our knowledge, this study preliminarily investigates the prevalence of suicide risk and associated cognitive function characteristics in chronic schizophrenia patients with insomnia. The main findings are as follows: (1) among 1,436 patients with chronic schizophrenia, 9.5% had comorbid insomnia; (2) the prevalence of suicide risk was significantly higher in patients with insomnia (38%) compared to those without insomnia (19.8%); (3) language function and general psychopathology were significant predictors of suicidal ideation severity in chronic schizophrenia patients with insomnia; (4) language function and general psychopathology were correlated with suicide risk in these patients, and their combination enhanced the predictive accuracy for suicide risk.

In this study, the prevalence of insomnia in chronic schizophrenia patients with insomnia was 9.5%. Peng et al. reported a similar prevalence, finding that 10% of chronic schizophrenia patients in China experience insomnia [30]. Miller et al. found a prevalence of 18% in a sample of 328 Chinese patients with chronic schizophrenia [7]. However, another study reported a much higher prevalence of 44% among Caucasian patients with chronic schizophrenia [35]. Differences in the prevalence of insomnia among patients with schizophrenia may be attributable to variations in sample size, ethnicity, and local socioeconomic and cultural factors.

The study found that patients with insomnia exhibited a significantly higher prevalence of suicide risk compared to those without insomnia (38% vs. 19.8%), a finding that aligns with current literature on the association between insomnia and suicide risk [36]. Multiple cross-sectional studies have shown that chronic or first-episode schizophrenia patients with insomnia, as well as clinical

Table 3 Multiple Stepwise regression model for the severity of suicidal ideation in chronic schizophrenia patients with insomnia and non-insomnia

	variables	B	95%CI	t	p-value	R ²	Adjusted R ²	VIF
Insomnia	Language	−0.59	(−1.01, −0.16)	−2.76	0.008	0.21	0.18	1.01
	G scores	0.97	(0.24, 1.70)	2.65	0.010			1.01
Non-insomnia	P scores	0.84	(0.54–1.14)	5.50	< 0.001	0.07	0.07	1.01
	Age	−0.17	(−0.29–0.04)	−2.54	0.012			1.01

Bold values indicate $p < 0.05$

P positive symptom, G General psychopathology symptom

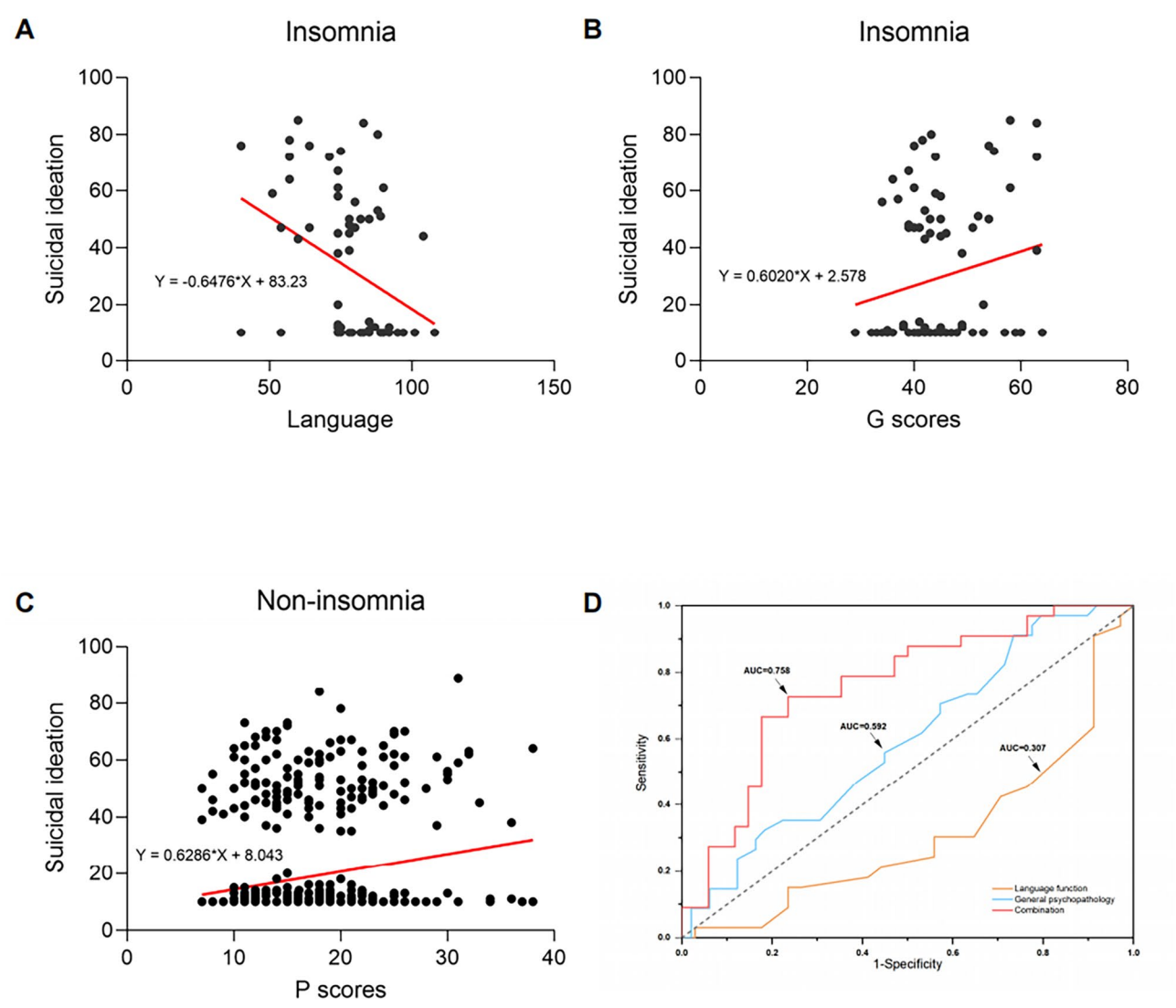


Fig. 1 (A)Scatter plot with linear regression between language function and suicidal ideation in the insomnia group; (B) Scatter plot with linear regression between general psychopathology scores and suicidal ideation in the insomnia group; (C)Scatter plot with linear regression between positive symptom scores and suicidal ideation in the non-insomnia group; (D) The ability of associated factors to distinguish between suicide risk and non-suicide risk in chronic schizophrenia patients with comorbid insomnia

Table 4 Binary logistic regression model of cognitive function as indicator of suicide risk in insomnia group

	B	Wald	p-value	OR	95% CI
Age	−0.06	1.52	0.218	0.947	0.868–1.033
Duration of illness	−0.03	0.28	0.600	0.976	0.890–1.070
G scores	0.11	6.32	0.012	1.120	1.025–1.223
Language	−0.05	5.48	0.019	0.950	0.910–0.992

Bold values indicate $p < 0.05$

G General psychopathology symptom

high-risk groups for psychosis, tend to face a higher risk of suicide [8, 30, 37, 38]. Furthermore, longitudinal research has validated this association, demonstrating that patients with insomnia at baseline had a fourfold increase in suicide attempt rates during follow-up and an elevenfold increase in suicide risk after one year [39].

On the other hand, studies have also found that patients whose insomnia improved experienced a significantly reduced suicide risk after three months [40]. The relationship between insomnia and suicide risk in patients with schizophrenia is likely related to the emotional instability and cognitive impairments caused by insomnia [41]. Therefore, it is essential to focus on the suicide risk in patients with schizophrenia who experience insomnia, while actively addressing and improving their insomnia to reduce the risk of suicide.

The study also found that general psychopathology is associated with the suicide risk in chronic schizophrenia patients with insomnia, rather than positive symptoms. Most studies have indicated that schizophrenia patients with suicidal ideation or behaviors exhibit more severe

positive symptoms and general psychopathology [7, 42–44]. Furthermore, research has shown that insomnia is positively correlated with both positive symptoms and general psychopathology; the severity of insomnia is associated with more pronounced psychopathological manifestations [45, 46]. Miller et al. found that terminal insomnia in schizophrenia patients is correlated with the severity of positive symptoms, whereas initial sleep is not [43]. A recent study indicated that both insomnia and positive symptoms are independently related to suicidal ideation, with insomnia serving as a moderating factor between positive symptoms and suicidal ideation [30]. However, our study found that in patients with insomnia, general psychopathology was independently associated with suicide risk, while positive symptoms are independently associated with suicide risk in patients without insomnia. These findings still require validation in larger sample sizes and longitudinal studies.

Based on our knowledge, this is the first study that preliminarily indicates a relationship between language function impairment and the risk of suicide in chronic schizophrenia patients with insomnia. Previous studies have not directly established a link between language function and suicide risk in schizophrenia patients. However, some research has pointed out that language function impairment is associated with other high-risk factors for suicide, such as poorer emotional regulation and expression abilities [41, 47], higher levels of anxiety and depression [25], less social communication and support [48], and poorer impulse control [49]. Insomnia not only leads to cognitive function decline but also exacerbates damage to brain regions associated with language, thereby increasing the risk of suicide [50]. Furthermore, neuroimaging studies have indicated abnormalities in the prefrontal cortex of schizophrenia patients [51]. The prefrontal cortex is closely related to language and executive function [52], and insomnia can inhibit the function of this area [53]. Zhou et al. found that chronic insomnia leads to decreased activity in the prefrontal cortex, thereby hindering patients' ability to effectively express emotions and self-regulate, which may indirectly increase suicidal ideation and behavior [54]. In terms of biological mechanisms, insomnia is closely associated with reduced 5-HT, and a deficiency in 5-HT can impair emotional regulation abilities, affect patients' language expression and consequently increase their risk of suicide [55, 56]. In summary, attention should be paid to language function impairment in chronic schizophrenia patients with insomnia to reduce the risk of suicide.

In this study, although some results reached statistical significance, we emphasize that statistical significance does not equate to clinical significance. Statistical significance indicates that the observed effect is unlikely to have occurred by chance, while clinical significance focuses

on whether the effect has a meaningful impact on the patient's actual clinical condition. Therefore, when interpreting the results of this study, we should not rely solely on *p*-values to assess the importance of the effect. While the relationship between suicide risk and insomnia was statistically significant, further investigation is needed to explore its practical significance in clinical interventions. The current study provides preliminary evidence for understanding the potential link between insomnia and suicide risk in patients with chronic schizophrenia, but the clinical significance of these findings still requires further validation in a broader clinical context. Future research should focus on translating these statistically significant findings into actionable treatment strategies and evaluating their long-term clinical effects in different patient populations.

The study has several limitations. Firstly, as a cross-sectional study, the assessments of suicidal risk, insomnia, and psychiatric symptoms reflect only the current status, preventing the establishment of causal relationships between suicide risk and associated factors in chronic schizophrenia patients with insomnia. Secondly, although there were no statistically significant differences in clozapine use between groups, its potential effects cannot be ignored [57]. Moreover, other medication side effects and comorbid depression were not systematically assessed, which may influence suicide risk, cognitive function, and sleep quality. Thirdly, the study classified patients with either suicidal ideation or a history of suicide attempts into a single "suicide risk" group. Although this approach is commonly used in related research, it may group together individuals with distinct clinical characteristics, thereby increasing within-group heterogeneity. Fourthly, the assessment of suicide risk relied primarily on self-reports from patients and their families, which may differ from actual circumstances. Additionally, although cognitive function was evaluated using the standardized RBANS, it may not fully capture all cognitive domains. Finally, insomnia was assessed through self-reported questionnaires without objective sleep measurements, potentially introducing subjective bias. Future research should employ longitudinal, multicenter study designs that incorporate objective sleep monitoring and comprehensive cognitive assessments, utilize more precise suicide risk assessment tools, and control for psychotropic medication use as well as relevant comorbid conditions, in order to improve the validity of findings and clarify causal relationships.

Conclusion

In conclusion, this preliminary study reveals that approximately 9.5% of chronic schizophrenia patients experience comorbid insomnia, and those with insomnia exhibit a significantly higher prevalence of suicide risk

compared to those without. Additionally, language function and general psychopathology were associated with suicidal ideation exclusively in patients with insomnia. The combination of language function and general psychopathology can serve as predictors for suicide risk in patients with insomnia. However, this study provides only a preliminary exploratory result, offering some insights into the potential association between insomnia and suicide risk in patients with chronic schizophrenia. Future research should further explore the mechanisms linking insomnia, psychiatric symptoms, cognitive function, and suicide risk to inform more effective interventions aimed at reducing suicide risk in patients.

Acknowledgements

We thank all the participants in the study.

Clinical trial number

Not applicable.

Authors' contributions

Chenghao Lu: Investigation, Writing – Original draft, Visualization, Formal analysis. Dan Qi: Investigation, Data curation. Yunxuan Ping: Data curation. Chuhao Zhang: Data curation. Shuzhe Wang: Data curation. Nannan Liu: Data curation. Xinxu Wang: Data curation. Shen Li and Jie Li: Writing – Review & editing, Supervision, Funding acquisition, Conceptualization.

Funding

This work was sponsored by National Natural Science Foundation of China (82371512), Tianjin Health Research Project (TJWJ2024MS037). All funding had no role in study design, data analysis, paper submission and publication.

Data availability

The datasets used and analysed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

All procedures involving human participants were conducted in accordance with the ethical standards of the institutional research committee and the principles of the Declaration of Helsinki. The study protocol was approved by the Ethics Committee of Tianjin Anding Hospital (Approval No. 2022-09). Written informed consent was obtained from all participants prior to their inclusion in the study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 4 July 2025 / Accepted: 6 August 2025

Published online: 02 October 2025

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