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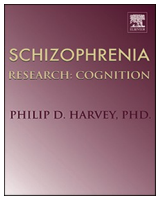

Correlation analysis between insomnia symptoms and language function in patients with schizophrenia

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ABSTRACT

Objective: To explore the correlation between insomnia and language ability in patients with schizophrenia.
Methods: 120 patients with schizophrenia admitted to our hospital from June 2020 to January 2022 were enrolled as the research objects. According to the total score of the Pittsburgh Sleep Index (PSQI), they were divided into the insomnia group (PSQI total score $>$ 10 points) and the non-insomnia group (PSQI total score $\leq$ 10 points). To compare the difference in verbal fluency scale between insomnia and non-insomnia groups and to understand the correlation between insomnia symptoms and language ability in patients with schizophrenia.
Results: There were no significant differences in age, gender, and years of education between the insomnia group and the non-insomnia group ($P > 0.05$). The total score of the verbal fluency test (VFT) in the insomnia group was significantly different from that in the non-insomnia group ($P < 0.01$). The total score of the insomnia group was lower than that of the non-insomnia group, and the factors (fluency animal, fluency fruit and vegetable, speech fluency, motor fluency) were lower than that of the non-insomnia group. Logistic regression analysis showed that the total verbal fluency score in schizophrenia patients was negatively correlated with insomnia symptoms ($P < 0.05$). Schizophrenia patients with insomnia symptoms had worse language ability than those without.
Conclusion: There is a significant difference in language ability between schizophrenia patients with insomnia and those without insomnia symptoms. This suggests that schizophrenia patients with insomnia have a greater probability of language ability disorder.

1. Introduction

Schizophrenia is a common severe mental illness. Insomnia symptoms are common in schizophrenia and occur throughout the disease. The community survey found that the prevalence of schizophrenia patients with at least one insomnia symptom was 28.9 % (Hou et al., 2017). A joint one-year survey in Beijing and Hong Kong found that the frequency of at least one insomnia symptom was 36.0 % (Xiang et al., 2009). Although insomnia is not included in the diagnostic criteria for schizophrenia, there is increasing evidence that insomnia is one of the most common health problems in the world (Ohayon, 2002) and is closely related to schizophrenia (Benson, 2006; Meyer et al., 2020; Robertson et al., 2019; Pocivavsek and Rowland, 2018).

A large body of literature has documented that people with schizophrenia have dysfunction in language learning. Language ability is a remarkable human skill, and understanding and using language is the cornerstone of developing multiple abilities, including social skills in life and general cognitive functioning. Language ability will directly affect the development or change of cognitive function (Canfield et al., 2017). Cognitive function is a mental process involving perception, reasoning, memory, and other intellectual abilities, while cognitive impairment is a failure of cognitive or intellectual ability (Shahrokh et al., 2011). Schizophrenia has lower cognitive function than people with other affective disorders. The same results have also been found in patients with first-episode mental illness (Gebreegziabhere et al., 2022).

In clinical work, it has been found that insomnia symptoms have a particular impact on cognitive function, and patients with insomnia symptoms often show delayed reactions and memory loss during the day. Some studies have found that insomnia plays a vital role in exacerbating the core symptoms of schizophrenia, such as cognitive impairment (Bromundt et al., 2011; Laskemoen et al., 2020a), auditory hallucinations and delusions (Mulligan et al., 2016; Blanchard et al., 2020), social withdrawal, and depression (Roenneberg and Merrow, 2016). Clinical trials have shown that treating insomnia can minimize

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the impact of psychotic symptoms and improve quality of life (Bozikas et al., 2005; Freeman et al., 2015). Therefore, it is necessary to explore the effect of insomnia symptoms on language ability in patients with schizophrenia.

The verbal fluency task (VFT) mainly evaluates language and executive control related to essential neurocognitive functions such as working memory, motivation, and attention (Fisk and Sharp, 2004). However, studies have found no statistical difference in the number of words generated during VFT in patients with chronic insomnia compared with healthy controls (Sun et al., 2017). However, patients with schizophrenia have deficits in VFT (Kronholm et al., 2009), and deterioration in semantic fluency is more common and severe than in phonological fluency (Bortolato et al., 2015; Bokat and Goldberg, 2003). The number of correct responses of recent-onset psychosis, chronic schizophrenia, and first-degree relatives was significantly lower than that of healthy controls. This study aimed to explore the effect of insomnia symptoms on the language ability of schizophrenia patients and the correlation between the two using VFT and to provide a reference for the treatment strategy to improve psychotic symptoms.

2. Data and methods

2.1. General information

One hundred twenty patients with schizophrenia admitted to our hospital from June 2020 to January 2022 were included in the study. PSQI is a standardized, self-administered questionnaire developed by Daniel J. Buysse that evaluates retrospective sleep quality and disturbances within the past month (Chiu et al., 2018). The PSQI contains 19 self-report questions and 5 questions rated by the bed partner or roommate. This study utilised only the self-rated questions which combine to form seven component scores (Chiu et al., 2018). The seven component scores include subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. Each component has a range of 0–3 points. In all cases a score of 0 indicates the best outcome, while a score of 3 indicates the worst outcome. A global PSQI score is calculated from adding together all seven component scores to give an overall indication of sleep quality. The PSQI global score ranges from 0 to 21 points, with 0 indicating no difficulty and 21 severe difficulties. A global score of $\geq$5 indicates poor sleep quality (Chiu et al., 2018). This cut-off has been shown to have high specificity and sensitivity for distinguishing insomnia patients and controls (Chiu et al., 2018; Buysse et al., 1989). A score of 0–5 indicates good sleep quality; A score of 6–10 indicates critical sleep quality; A score of 11–15 indicates poor sleep quality; A score of 16–21 indicates poor sleep quality (Chiu et al., 2018). According to the total score of the Pittsburgh Sleep Index (PSQI), they were divided into the insomnia group (PSQI total score $>$ 10 points) and the non-insomnia group (PSQI total score $\leq$ 10 points).

Inclusion criteria: ① Patients who met DSM-V diagnostic criteria for schizophrenia; ② Aged 18–60 years old; ③ Education years $\geq$12 years; ④ Patients with normal reading ability. Exclusion criteria: ①comorbid chronic diseases with significant effects on cognition and sleep; ②Complicated with epilepsy; ③ There are primary diseases that cause sleep disorders, such as periodic leg movement, restless leg syndrome, and narcolepsy. The subjects and their guardians were informed of the study and signed an informed consent agreement. This study was reviewed and approved by the Ethics Committee of our hospital.

2.2. Research methods

① The demographic characteristics and whether to take sleep drugs were compared between insomnia and non-insomnia groups. Demographic characteristics included age, gender, and years of education. Sleep drugs include: benzodiazepines (lorazepam, clonazepam, diazepam, Estazolam, etc.), antidepressants (trazodone, mirtazapine tablets, etc.), antipsychotics (olanzapine, quetiapine, etc.).② The language ability of the insomnia group and non-insomnia groups language abilities were compared. A verbal fluency test (VFT) was used to assess language ability. VFT was first proposed by Thurstone et al. in 1962 and applied to mainly evaluate the subjects' language ability, semantic memory, and executive function. The scale includes four-factor scores: fluid animal, Smooth fruits and vegetables, Fluency of speech, and Fluency of movement. The VFT scoring method is to score 1 point for saying a word related to the item within the specified time. VFT is also used to evaluate information processing speed (Nuechterlein et al., 2008; Nuechterlein et al., 2004). ③ To analyze the correlation between insomnia symptoms and language ability in patients with schizophrenia.

2.3. Statistical methods

SPSS20.0 was used for data analysis. Shapiro-Wilk test was used to test the normality of measurement data. Mean $\pm$ standard deviation ($x \pm s$) was used to describe the measurement data conforming to the normal distribution. The median and quartile [M (P25, P75)] describe measurements that do not conform to a normal distribution. *t*-test or Mann-Whitney *U* test was used for comparison between groups. The measurement data of age, VFT total score, and each factor score of the insomnia group and the non-insomnia group did not conform to normal distribution by the Shapiro-Wilk test, so the Mann-Whitney *U* test was used for comparison and analysis. The chi-square test was used for the count data of gender and whether to take sleep drugs between the two groups. Logistic regression was used to analyze the correlation between VFT score and insomnia symptoms in patients with schizophrenia. The test level was two-sided, and $P < 0.05$ was considered statistically significant.

3. Results

3.1. Analysis of demographic characteristics between the insomnia group and non-insomnia group

There were no significant differences in gender, age, years of education, or whether to take sleep drugs between the insomnia and non-insomnia groups ($P > 0.05$) (Table 1).

3.2. Comparison and analysis of VFT scores between the insomnia group and non-insomnia group

There were 60 cases in the insomnia group and 60 in the non-insomnia group. The measurement data of age, VFT total score, and each factor score of the insomnia and non-insomnia groups did not conform to normal distribution by the Shapiro-Wilk test. There was a significant difference in the total score of the verbal fluency test (VFT) between the insomnia group and the non-insomnia group ($P < 0.01$). The total score of the insomnia group was lower than that of the non-insomnia group, and the comparison of all factors was lower than that of the non-insomnia group (Table 2).

Table 1
analysis of demographic characteristics and whether to take sleep medication between insomnia group and non-insomnia group.

Indicators	Insomnia group (n = 60)	Non-insomnia group (n = 60)	Z/χ2	P
Gender(male/female)	37/23	38/22	−0.188	0.851
Age(years)	43.5(42, 47)	45.5(34, 50)	−0.529	0.597
Years of education	12.5(12, 15)	12(12, 15)	−0.372	0.710
Whether to take sleep drugs	2(1, 2)	1.5(1, 2)	−1.844	0.065

Table 2
Analysis of language ability between the insomnia group and the non-insomnia group.

Groups	VFT total score M(*P*25, *P*75)	Fluid animal M(*P*25, *P*75)	Smooth fruits and vegetables M(*P*25, *P*75)	Fluency of speech M(*P*25, *P*75)	Fluency of movement M(*P*25, *P*75)
Insomnia group	26(24, 28)	14(13, 15)	12(11, 14)	3.5(2, 4)	7(7, 8)
non-insomnia group	37(21, 45)	18.5(6, 25)	17(14, 22)	4.5(3, 8)	11.5(8, 22)
Z	−3.194	−2.647	−6.871	−2.661	−7.479
P	0.001	0.008	0.000	0.008	0.000

3.3. Correlation analysis between VFT score and insomnia symptoms

Logistic regression analysis showed that the total score of verbal fluency was negatively correlated with insomnia symptoms ($\beta = -0.071$, $OR = 0.931$, $P < 0.001$), and the 95 % confidence interval of OR value was (0.896, 0.968). Schizophrenia patients with insomnia have a higher probability of language impairment than those without insomnia (Table 3).

4. Discussion

As many studies have found that insomnia is one of the most common health problems globally (Ohayon, 2002), patients with schizophrenia have a higher incidence of insomnia. Hence, their health faces a more significant threat. Exploring the factors related to insomnia symptoms of schizophrenia is helpful to explore methods and strategies to improve the health of patients with schizophrenia.

In our study, it was found that the total score of VFT in schizophrenia patients was negatively correlated with the symptoms of insomnia. The lower the score of VFT in schizophrenia patients with insomnia, the greater the probability of language impairment. However, previous studies have found no statistical difference in the number of words generated during VFT between patients with chronic insomnia and healthy controls (Sun et al., 2017). However, in a study of the association between short sleep duration and cognitive function in >5000 adults, sleep duration was associated with verbal fluency and list memory (Fisk and Sharp, 2004), consistent with our findings. The study of Bortolato et al. found that patients with schizophrenia are defective in the VFT process (Kronholm et al., 2009), and the deterioration of semantic fluency is more common and severe than the deterioration of phonological fluency (Bortolato et al., 2015; Bokat and Goldberg, 2003). Verbal Fluency task (VFT) is used to evaluate language ability, and currently, VFT is also used to evaluate information processing speed (Nuechterlein et al., 2008; Nuechterlein et al., 2004). Information processing speed is included in one of the objective cognitive functions, and Laskemoen's study found that insomnia and sleepiness significantly impacted information processing speed in patients with schizophrenia. Similar findings have not been found in healthy people (Laskemoen et al., 2020b). Therefore, it is speculated that the language ability of patients with schizophrenia is closely related to cognitive function, which is also consistent with the research results of Fisk and Sharp (2004).

The low cognitive function of schizophrenia is significantly different from that of other mental diseases, and the same results have been found in first-episode schizophrenia patients (Hou et al., 2017). A large body of literature has documented that people with schizophrenia have dysfunction in language learning—severe deficiencies in reasoning, planning, abstract thinking, and problem-solving (Mihaljević-Peleš et al., 2019). Cognitive impairment seriously affects the quality of life of patients with schizophrenia. Cognitive impairment (PWS) in patients with schizophrenia can be considered as part of the core symptoms of schizophrenia because

①Almost all (98 %) PWS show a cognitive decline compared with pre-onset (Keefe et al., 2005);

②PWS shows a broader range of cognitive impairment domains, each with different severity (Heinrichs and Zakzanis, 1998);

③Cognitive impairment can also occur in PWS without antipsychotic drugs (Fatouros-Bergman et al., 2014).

Much of the variation in language ability among individuals is due to genetic factors. A large number of phenotypic and genetic associations have been identified in a study of two-year-old twins (Dale et al., 2000). This result holds for people of all ages, the typical population, and individuals with speech disorders (Stromswold, 2001). For example, research reports suggest that innate genetic factors have a significant impact on language ability, but later, we still find that there are some strategies to improve language ability. Butt AK et al. concluded that enhanced and alternative communication significantly improved speech and language therapy (Butt et al., 2022). Pagnoni I et al. summarized and found that in patients with progressive aphasia, four types of treatment are used: (a) word retrieval therapy (Cadorio et al., 2017), (b) phonetic and orthographic processing (Henry et al., 2018), (c) Semantic processing (Meyer et al., 2015); (d) After the multimodal approach (Carthery-Goulart et al., 2013; Croot, 2018) treatment, the naming ability of patients has been improved (Pagnoni et al., 2021). At present, there is no relevant research report on whether the improvement of language ability in patients with schizophrenia can improve the symptoms of insomnia.

Based on the treatment effect of each treatment strategy in some diseases with language disorders, we will next try to use the above treatment strategies in schizophrenia patients to understand further whether the improvement of insomnia symptoms can affect the cognitive function of schizophrenia patients.

There are potential limitations to this study. First of all, this study has no objective measurement of sleep time. Second, although there was no significant difference in the use of sleep-improving drugs between the insomnia and non-insomnia groups in this study, different sleep-improving drugs had different effects on cognitive function. Studies have found that benzodiazepines can impair psychomotor speed, learning, acquisition of new knowledge, visuospatial perception, and immediate memory, and drug tolerance is manifested by sedation and the resulting adverse cognitive effects (Dubovsky and Marshall, 2022). One study showed that lorazepam may improve cognition, demonstrating that lorazepam increased functional magnetic resonance imaging network resilience in elderly subjects with low cognitive scores while improving these scores (Lalwani et al., 2021). The duration of medication may also have differential effects on cognitive function. In a multicenter prospective trial, the short-term addition of benzodiazepines did not impair cognitive function in patients with major depression (Duan et al., 2019). However, several studies have revealed persistent impairment in multiple cognitive domains after chronic benzodiazepine use. However, the effects of chronic benzodiazepine use on daily functions are usually not apparent (Stewart, 2005), and higher cognitive functions are often not affected (Wittenborn, 1979). The use of

Table 3
Logistics regression analysis of insomnia symptoms and language function.

	β	SE	Wald	P	OR	95 % confidence interval
VFT total score	−0.071	0.020	13.329	0.000	0.931	(0.896, 0.968)

sleep-improving drugs was not categorized in our study. Therefore, it cannot be determined whether the use of sleep-improving drugs influences the effect of insomnia on the VFT process of schizophrenia patients. Since the sample size will be too small if the drugs are classified for analysis in this study, the sample size will be expanded for analysis. Third, the main clinical manifestations of schizophrenia patients have a particular impact on cognitive function. Andreason et al. once believed that cognitive impairment is related to negative symptoms (Verbraak et al., 1993). However, Zhou Yunfei and Zhao Jinping (Yunfei and Jingping, 2001) found that patients with schizophrenia type II (mainly negative clinical symptoms) and schizophrenia type I (mainly positive clinical symptoms) had cognitive impairment. The memory, attention, and executive functions of patients with schizophrenia type II were worse than those of patients with schizophrenia type I. However, this study did not include the subjects' positive and negative symptoms in the analysis. The study did not conduct consistent results analysis on the symptoms in the sample, which may cause bias in the results. Finally, our study only excluded patients with abnormal blood lipid, blood glucose, and blood pressure, so it was impossible to avoid the influence of other emotional states (such as anxiety and depression symptoms that did not reach the diagnosis of anxiety and depression disorders) on the research results.

CRediT authorship contribution statement

Wu Linlin: Conceptualization, Resources, Writing – original draft, Writing – review & editing, Funding acquisition. **Ji Ruofei:** Formal analysis. **Chen Hudan:** Investigation, Resources. **Tang Ruxuan:** Investigation, Resources. **Yao Jing:** Resources, Writing – review & editing, Project administration.

Declaration of competing interest

There is no conflict of interest in this article.

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