

# Insomnia mediated the relationship between personality disorders symptoms and depression: A case-control study

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**Background and Objective.** Personality disorders (PDs) are associated with insomnia and depression, but little is known about the inter-relationships among these variables. Therefore, this study examined these inter-relationships and the mediating effect of insomnia on the association between PD symptoms and depression severity.

**Methods.** There were 138 study participants, including 69 individuals with depression and 69 healthy controls. The main variables were the Hamilton Depression Rating Scale (HAMD), Athens Sleep Insomnia Scale (AIS), and Personality Diagnostic Questionnaire (PDQ-4+). Multivariate linear regression analyzed the ability of PD symptoms and insomnia to predict depression severity. The mediating effect of insomnia on the association between PD symptoms and depression was also tested.

**Results.** PDQ-4+ and AIS scores were higher in the depression than the healthy control group ( $P < 0.001$ ). PDQ-4+ and AIS scores were correlated ( $r = 0.606$ ,  $p < 0.001$ ), and PDQ-4+ scores ( $r = 0.716$ ,  $p < 0.001$ ) and AIS scores ( $r = 0.620$ ,  $p < 0.001$ ) had significant positive correlations with HAMD scores. Regression revealed that PD symptoms and insomnia predicted depression severity, after adjusting for covariates, and that insomnia mediated the association of PD symptoms with depression severity.

**Conclusions.** PD symptoms and insomnia predict depression severity, and insomnia mediates the association between PD symptoms and depression severity. This is the first study to report these findings in a Chinese sample. Therefore, the impact of PD symptoms and insomnia should be considered when designing interventions for depressive patients.

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## Abstract

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**Results.** PDQ-4+ and AIS scores were higher in the depression than the healthy control group ( $P < 0.001$ ). PDQ-4+ and AIS scores were correlated ( $r = 0.606, p < 0.001$ ), and PDQ-4+ scores ( $r = 0.716, p < 0.001$ ) and AIS scores ( $r = 0.620, p < 0.001$ ) had significant positive correlations with HAMD scores. Regression revealed that PD symptoms and insomnia predicted depression severity, after adjusting for covariates, and that insomnia mediated the association of PD symptoms with depression severity.

**Conclusions.** PD symptoms and insomnia predict depression severity, and insomnia mediates the association between PD symptoms and depression severity. This is the first study to report these findings in a Chinese sample. Therefore, the impact of PD symptoms and insomnia should be considered when designing interventions for depressive patients.

**Key Words** Personality disorders symptoms, Insomnia, Depression, Mediation

## Introduction

Depression is a common and recurrent, but often neglected mental disorder. According to an epidemiological study by the World Health Organization (WHO), the number of depressed patients is about 350 million globally, and the prevalence of depression in China is 3.02% (Smith, 2014). However, the prevalence of depression in China varies among different study populations. For example, the point prevalence of major depression among Chinese children and adolescents is 1.3% (Xuet al., 2018), and 2.7% in older adults (Wanget al., 2018). Depression not only affects health outcomes, such as disability (Eurviriyankulet al., 2016) and suicide behaviors (Junget al., 2018), but also imposes a high economic burden (Hsieh & Qin, 2018), accounting for approximately 10.3% of the overall burden of diseases, worldwide (Smith, 2014). Therefore, it is necessary to explore and understand the risk factors for depression.

Personality disorders (PDs) are defined as patterns of inner experience and behavior that obviously deviate from the expectations of an individual's culture, have an onset in early life, and may lead to distress and impairment in individuals in the future (Esbec & Echeburua, 2011). A survey of 13 countries showed that the estimated prevalence of having any personality disorder was 6.1%, and the prevalence in China was 4.1% (Huanget al., 2009). Several recent studies have found that PDs are associated with long-term mental illness and social consequences (Samuels, 2011). Research has also found that PDs are comorbid with major depressive disorder (MDD), with 42.36% patients with MDD meeting at least one criterion for a diagnosis of a PD (Zhenget al., 2019). A longitudinal cohort study indicated that the presence of PDs predicted the occurrence of later depression, and the severity of PDs increased the risk of MDD (Moranet al., 2016). Even after controlling for Axis I comorbidities, the avoidant, borderline, paranoid, schizoid, and schizotypal personality disorders (especially borderline personality disorder) all increased the risk of depression (Skodolet al., 2011). The cluster B PDs have been found to predict the severity and duration of depression, whereas the cluster C PDs predict its chronicity (Iacovielloet al., 2007). PDs also have been shown to be associated with the effects of treatment for depression. For example, compared to patients with major depression, patients with both borderline personality disorder and major depression have poor self-regulation ability, which affects their treatment (Kimet al., 2018). Moreover, a PD comorbidity makes the treatment of major depression more complex, and it is associated with higher rates of recurrent depression and hospital readmission, compared to patients who only have major depression (Wiegand & Godemann, 2017). PDs are also associated with significantly greater severity of self-harm, overall psychopathology, and impairment(Ayodejiet al., 2015). However, the mechanism underlying the relationship between PDs and depression is unclear.

Sleep difficulty is a crucial public health problem that involves daytime impairments and poor nighttime sleep. Insomnia is associated with brain function, cognitive and emotional effects, and physical health (Jiet al., 2019), and sleep loss can disrupt regions of the brain involved in affective regulation (Kahn-Greeneet al., 2007). Recent studies have shown that insomnia not only reduces quality of life, but is linked to the development of diseases (Otakaet al., 2019). Most mental disorders are associated with sleep continuity problems, and depth of sleep and rapid-eye movement sleep may play an important role in psychiatric comorbidity processes (Baglioniet al., 2016). Insomnia is closely related to depression (Baglioniet al., 2011). For

example, a cohort study of elderly Asian persons found depression is associated with a number of sleep-related issues (Yuet al., 2016). This relationship was confirmed by a recent longitudinal study that showed poor sleep quality was significantly associated with greater symptoms of depression and anxiety, although the study involved two different populations (Okunet al., 2018). In addition, PDs are associated with insomnia (Akramet al., 2018; Hafizi, 2013). Features of cluster A and C PDs are linked to poorer sleep quality-related daytime functioning, fatigue, and estimated nightly wake-time (Ruiteret al., 2012). A cross-sectional study also reported that PDs, especially borderline personality disorder, were associated with insomnia symptoms (Oltmanns, Weinstein & Oltmanns, 2014). Moreover, the symptoms of borderline personality disorder interact with chronic sleep problems to predict elevated social/emotional, cognitive, and self-care deficits (Selby, 2013).

However, the relationship between insomnia, PD symptoms, and the severity of depression have not been studied in China. Thus, this cross-sectional study aimed to compare differences in PD symptoms and insomnia between individuals with depression and healthy controls, and to explore the relationships among PD symptoms, insomnia, and depression. We hypothesized that PD symptoms would be associated with insomnia and depression and that insomnia mediated the association between PD symptoms and depression.

## Materials & Methods

### Participants

The present study used a case-control design. Depressed patients between 18 and 60 years of age were consecutively recruited from the Inpatient Department of Mental Health of the Second Affiliated Hospital of Guangxi Medical University in Guangxi, China. A total of 69 depressed inpatients (mean age = 33.1 years, SD = 13.70) were recruited. The diagnosis of depression was made by trained psychologists using the Structured Clinical Interview based on the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (SCID for Axis II DSM-V). We excluded patients with organic brain disorders, other psychiatric disorders (e.g., bipolar disorder), mental retardation, any major physical illnesses, or a family history of genetic disorders. Patients with response omission rate on the questionnaire of more than 5% and those who recently had transfusion therapy were also excluded.

We also recruited 69 healthy controls (mean age = 35.2 years, SD = 12.2) from the same hospital through posters placed in the Medical Examination Center. The inclusion criteria for the control group were having a Hamilton Depression Rating Scale (HAMD-24) score and a Hamilton Anxiety Rating Scale (HAMA-24) score lower than the positive threshold. The control group was selected according to a 1:1 age matching ratio ( $\pm 3$  years). People with a current or past mental illness, any major physical illness, genetic disease, or a family history of mental illness were excluded.

All the participants were given detailed information about the content and aims of the study, and the individuals then gave their written informed consent to participate in the study. The study was approved by the ethics committee of Guangxi Medical University (Approval number: 20160302-13).

### Measures

**Insomnia.** The Athens Insomnia Scale (AIS), which is a psychometric instrument based on the Tenth Revision of the International Classification Diseases (ICD-10), was used to assess insomnia symptoms during the past month (Chung, Kan & Yeung, 2011). This is an 8-item self-report scale in which participants rate their insomnia on a scale from 0 to 3; the total score ranges from 0 to 24, with higher scores indicating poorer insomnia symptoms (Soldatos, Dikeos & Paparrigopoulos, 2000). A score of 6 or higher suggests participants have insomnia (Soldatos, Dikeos & Paparrigopoulos, 2003). The AIS is a reliable and valid tool, which has been widely used to test insomnia in different languages. The Cronbach's alpha of the AIS was 0.81 in a previous Chinese study (Chung, Kan & Yeung, 2011).

**Personality disorders symptoms.** The Personality Diagnostic Questionnaire (PDQ-4+) (Hyler et al., 1992) was used to evaluate symptoms of PDs according to the SCID for Axis II DSM-V criteria. This questionnaire screens 12 types of PDs, including the three clusters of PDs (A, B, and C), depressive PDs, and negativist PDs. The PDQ-4+ is a self-report questionnaire that consists of 107 true-false items, with higher total scores indicating a greater likelihood of having PD symptoms. This tool is a valid and reliable measure of PDs and has been used to screen for PDs in China (Yanget al., 2000).

**Depressive symptoms.** The Hamilton Depression Rating Scale (HAMD) (Hamilton, 1960) was used by trained evaluators to assess the severity of the participants' depressive symptoms during the past two weeks. The HAMD contains 24 questions, with each question having five responses

options, which are rated from 0 to 5; higher scores indicate greater severity of depressive symptoms. This scale is known to have satisfactory reliability and validity to assess depression (Huanget al., 2012).

## Statistical analysis

SPSS version 23.0 was used to enter and analyze the data. The chi-square test and Fisher's exact test were used to compare differences in the frequency of categorical variables (e.g., gender, ethnicity, and marital status) between the depressed and control groups. Student's *t*-test was used to analyze differences in insomnia (AIS scores), severity of depression (HAMD scores) and symptoms of personality disorders (PDQ-4+ scores) between the two groups, and Spearman's rank correlation was used to measure the associations among the AIS, HAMD, and PDQ-4+ scores. Multivariate linear regression was used to analyze the degree to which insomnia (AIS) and PD symptoms (PDQ-4+) predicted the severity of depression (HAMD), controlling for age, gender, ethnicity, education, income, and marital status. Finally, we conducted mediation analysis using AMOS 23.0, with HAMD as the dependent variable, and AIS as the mediating variable between PDQ-4+ and HAMD; the analysis met the four criteria of Baron and Kenny's method (Baron & Kenny, 1986). Bootstrapping was used to test if AIS mediated the association between PDQ-4+ and HAMD. A  $p < 0.05$  was considered to be statistically significant in all the analyses.

## Results

### Sociodemographic characteristics

Table 1 shows the main sociodemographic characteristics of the depression and control groups. The depressed patients and healthy controls did not differ with respect to age, gender, ethnic, marital status, education, or income ( $p > 0.05$ ).

HAMD scores were significantly higher in the depression group than in the healthy control group ( $\chi^2 = -40.377, p < 0.001$ ). Significant group differences were found for insomnia and PD symptoms: Compared to the healthy controls, the patients had more severe PD symptoms ( $\chi^2 = -13.833, p < 0.001$ ) and sleep problems ( $\chi^2 = -11.368, p < 0.001$ ) (see Table 1).

### Association between symptoms of personality disorders, sleep problems, and depression

Table 2 shows that total PDQ-4+ scores were significantly correlated with HAMD scores ( $r = 0.716, p < 0.001$ ) and AIS scores ( $r = 0.606, p < 0.001$ ). AIS scores also had a significant positive correlation with HAMD scores ( $r = 0.620, p < 0.001$ ).

### Regression analysis for predicting depression

The multivariate regression that was conducted to test the ability of insomnia (AIS) and PD symptoms (PDQ-4+) to predict depression severity (HAMD) found both variables significantly predicted the severity of depression. Table 3 shows the AIS scores ( $\beta = 0.618, p < 0.001$ ) and PDQ-4+ scores ( $\beta = 0.319, p < 0.001$ ) had significant positive associations with HAMD scores, after adjusting for the covariates.

### Mediating effect of insomnia on the association between PD symptoms and depression

We conducted a mediation analysis based on the results of correlation analyses and multivariate regression analysis. Figure 1 shows the path coefficients calculated by AMOS. We found insomnia significantly mediated the relationship between PD symptoms and depression based on 1000 bootstrap samples (see Table 4). The indirect effect [ $B(SE) = 0.202(0.04)$ ] of PD symptoms on depression through insomnia, the direct effect of PD symptoms on depression ( $c' = 0.567$ ), and the total effect of PD symptoms on depression ( $c = 0.768$ ) were all statistically significant.

## Discussion

The main aim of this study was to explore the associations among PD symptoms, insomnia, and the severity of depression. Personality traits may develop into PDs under certain circumstances and conditions and may cause clinical problems. For instance, research has shown that PDs are frequently associated with internalized and externalized symptoms, social relationship problems, impulsive behavior, and comorbidities (Sperandeo et al., 2019). The patients in our study had higher PDQ-4+ scores than the healthy controls, which shows that PD symptoms are common among depressed in-patients. This result is in line with a study by Kounoue et al. that found patients in Togo who were treated for MDD had higher PDQ-4+ scores and more PD symptoms than controls did (Kounoue et al., 2013). Furthermore, several other studies have detected generally high rates of PDs in patients with depression. For example, Sanderson et al. (Sanderson et al., 1992), which used the Axis I SCID-P and the Axis II SCID-II to assess the PD symptoms of patients with major depression, found 50% of these patients had at least one PD



symptom. A Thai study similarly found that 77% of depressed patients suffered from at least one PD and 60% had two or more PDs (Wongpakaran et al., 2015).

PD symptoms in our study were significantly and independently associated with an increased risk of depression, which is consistent with the findings of prior studies. For example, longitudinal cohort studies have reported that the presence of PDs predicts the occurrence of later depression (Moran et al., 2016) and relapses of depression (Alnaes & Torgersen, 1997). Another study also showed that PDs, such as the avoidant, borderline, histrionic, and schizotypal types, can enhance the persistence of major depression (Skodole et al., 2011). The dysfunctional beliefs, cognitive reactivity, and rumination of patients with major depression are associated with personality pathologies (van Rijsbergen et al., 2015). Our data also highlight: (1) that patients with depression were more likely to have insomnia than healthy controls were; and (2) that the severity of insomnia was associated with depression, in both the clinical sample and the healthy controls. Our findings are consistent with many studies that have found insomnia is associated with depression and that it appears to be a risk factor for depression (Fernandez-Mendoza et al., 2015; Okun et al., 2018). A study by Fernandez-Mendoza et al., which used psychometric and polysomnographic data to measure the sleep quality of a sample of the general population, found that persistence and worsening poor sleep, or insomnia, were significant predictors of the incidence of depression (Fernandez-Mendoza et al., 2015). A population case-control also indicated that having any sleep disorder was a risk factor for depression (Byrne et al., 2019). Therefore, our findings provide further evidence confirming that PD symptoms and insomnia are risk factors for depression.

Moreover, the present study showed that insomnia mediated the relationship between PD symptom and the severity of depression, which contributes to our understanding of the pathways from PD symptoms to depression. To the best of our knowledge, this is the first study to examine whether insomnia mediates the relationship between PD symptoms and depression in a Chinese sample. These findings may be partly explained by a biologically plausible mechanism – the dopamine (DA) system. Several studies have shown that DA system dysfunction is associated with the symptoms and treatment of depression (Dailly et al., 2004). For example, anhedonia, which is a common symptom of depression that is associated with the dysfunction of dopamine, is thought to result from reduced D<sub>2</sub>/D<sub>3</sub> receptor binding in the nucleus accumbens (Papp, Klimek & Willner, 1994). Some studies have also shown that DA dysfunction is related to

emotional dysregulation, impulsivity, and cognitive-perceptual impairments in people with borderline personality disorder (Friedel, 2004). In addition, insomnia has been demonstrated to be associated with dopamine dysfunction (Finan & Smith, 2013). Insomnia causes abnormalities in amygdala-frontal functional connectivity, which predict the development of internalized psychopathologies (Klumpp, Hosseini & Phan, 2018) and have a negative effect on mood and cognitive function, and increase the risk of mortality (Roth, 2007). Poor sleep is known to be a risk factor for the development and maintenance of mood disorders (Gillin, 1998). Taken together, our research indicates that PD symptoms and insomnia are likely to aggravate psychopathological symptoms and lead to depression. Currently, however, it is unclear what mechanisms underlie the mediating role of insomnia on the relationship between PDs and depression. Future research is needed to further elucidate the mechanism.

The comorbidity of PD symptoms and sleep problems are not only associated with depression severity, but with other unhealthy outcomes, including suicidal behaviors (Ayodeji et al., 2015; Liu et al., 2019; Otaka et al., 2019; Zenget al., 2015). Therefore, when working with depressed patients, clinicians should be aware of the likely comorbidity of PDs and sleep problems. Furthermore, the possible mediating effect of insomnia on the relationship between PD symptoms and depression could help us understand the pathways from PD symptoms to psychopathology. According to our results and the evidence reviewed above, reducing PD symptoms and improving sleep quality may retard the development of depression.

The cross-sectional design of our study is a limitation because it makes it impossible to determine causality. First, although the research evidence supporting our model was discussed in the Introduction, the mediating effect of insomnia on the association between PD symptoms and depression is a hypothesis that needs to be more thoroughly explored in prospective and longitudinal research. Our study was affected by both selection bias and the confounding bias of a case-control study; a prospective cohort study would have allowed us to clarify the relationships among PD symptoms, insomnia, and depression. Second, the assessment of PD symptoms in entire sample was conducting by screening participants with the PDQ-4+, rather than a clinical diagnosis made by psychologists using a structured interview. Third, due to the small sample size, we did not test the relationship of each PD symptom with depression or the relationship of each PD symptom with insomnia. Doing so will require a study with large sample size. Finally, using a self-report scale to assess insomnia may involve a certain degree of recall

bias. Despite these limitations, our study establishes links among PD symptoms, insomnia, and depression.

## Conclusions

These findings further demonstrate that PD symptoms and insomnia are risk factors for depression. To the best of our knowledge, this is the first study to examine the mediating role of insomnia on the relationship between PD symptoms and depression in China. In clinical practice, we should focus on evaluating PD symptoms and sleep problems in patients with depression so that we can provide optional interventions and treatments for them in a timely way. Prospective studies are needed in the future to verify the mediating role of insomnia on the association between PD symptoms and depression.

## Additional information and declarations

### Founding

This work was funded by the National Nature Science Foundation of China (No.81660569) and the Nature Science Foundation of Guangxi Province (No.2017GXNSFAA198212).

### Grant Disclosures

The following grant information was disclosed by the authors:

The National Nature Science Foundation of China: 81660569.

The Nature Science Foundation of Guangxi Province: 2017GXNSFAA198212.

### Competing Interests

The authors declare there are no competing interests.

### Human Ethics

The following information was supplied relating to ethical approval (i.e., approving body and any reference numbers):

The ethics committee of Guangxi Medical University approved this study (Approval number: 20160302-13)

### Author Contributions

Fenglan Chen performed the experiments, analyzed the data, prepared the figures and/or tables and drafted the work.

Xiujin Lin conceived and designed the experiments, performed the experiments, and revised it critically for important content.

Yuli Pan performed the experiments, prepared the figures and/or tables.

Xuan Zeng conceived and designed the experiments, prepared the figures and/or tables.

Shengjie Zhang performed the experiments, prepared the figures and/or tables.

Hong Hu analyzed the data, prepared the figures and/or tables.

Miaoyu Yu performed the experiments, and revised it critically for important content.

Junduan Wu conceived and designed the experiments, revised it critically for important content.

# **Data Availability**

The following information was supplied regarding data availability:

The raw data are available as a Supplemental File 1.

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**Table 1**(on next page)

Table 1. Sociodemographic characteristics and main study variables of all participants (N=138): patients with depression vs. controls.

1 Table 1. Sociodemographic characteristics and main study variables of all participants (N=138):  
2 patients with depression vs. controls.

	Depression		Controls			
Variable	N=69		N=69			
	n	%	n	%	$\chi^2/t$	$p$
Age (M±SD)	33.06±13.68		35.23±12.18		0.986	0.326
Gender						
Man	29	42.0	35	50.7	1.049	0.306
Female	40	58.0	34	49.3		
Ethnic						
Han	39	56.5	33	47.8	1.045	0.307
Zhuang	30	43.5	36	52.2		
Marital status*						
Single	34	49.3	26	37.7	-	0.418
Married	32	46.4	40	58.0		
Divorced or widowed	3	4.3	3	4.3		
Income per person (yuan/month)						
0-999	18	26.1	28	40.6	3.724	0.293
1000-1999	14	20.3	10	14.5		
2000-2999	12	17.4	8	11.6		
≥3000	25	36.2	23	33.3		
Education status						
<6 years	5	7.2	10	14.5	2.560	0.278
6-9 years	33	47.8	26	37.7		
≥9 years	31	44.9	33	47.8		
AIS scores (M±SD)	14.14±5.50		4.67±4.21		-11.368	<0.001

<b>HAMD scores (M±SD)</b>	27.32±4.79	3.48±1.08	-40.377	<0.001
<b>PDQ-4+ scores (M±SD)</b>	51.09±18.29	18.25±7.37	-13.833	<0.001

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# **Table 2**(on next page)

Table 2. Correlations between the main study variables (N=138).

1 Table 2. Correlations between the main study variables (N=138).

	PDQ4+	AIS	SDS
PDQ-4+ scores	1		
AIS scores	0.606**	1	
HAMD scores	0.716**	0.620**	1

2 \*\*  $p < 0.001$

3

# **Table 3**(on next page)

Table 3. Multivariate regression results for the predictors of depression severity.



1 Table 3. Multivariate regression results for the predictors of depression severity.

Independent variables	Dependent variables	Unadjusted $\beta$	Adjusted $\beta^{\#}$	SD	t	p
AIS scores	Depression	0.612	0.618	0.118	5.254	<0.001
PDQ-4+ scores	Depression	0.327	0.319	0.038	8.336	<0.001

2 # Adjusted for age, gender, education, income, ethnicity, and marital status.

3

4

**Table 4**(on next page)

Table 4. Standardized total, direct, indirect effects of the hypothesized model.

1 Table 4. Standardized total, direct, indirect effects of the hypothesized model.

	Point Estimate	Product of Coefficients		Bootstrapping			
				Bias-Corrected		Percentile	
				95%CI		95% CI	
				Lower	Upper	Lower	Upper
		SE	Z				
Total effect	0.768	0.032	24	0.702	0.824	0.705	0.826
Direct effect	0.567	0.058	9.78	0.450	0.672	0.453	0.679
Indirect effect	0.202	0.041	4.93	0.132	0.296	0.128	0.288

2

# Figure 1

Figure 1. Sleep quality mediates the relationship between PD symptoms and depression.

Figure 1. Sleep quality mediates the relationship between PD symptoms and depression.

