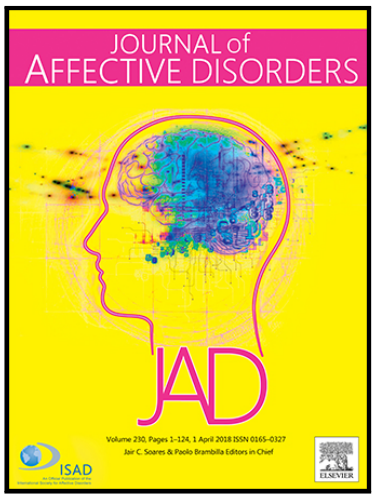

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Highlights:

- First study to examine relationship neuroticism and suicide among postpartum women
- Neuroticism trait predicted suicidal ideation among postpartum women
- Anxiety and depression mediated association between neuroticism and suicidal ideation

Relationship between trait neuroticism and suicidal ideation among postpartum women in China: Testing a mediation model

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Abstract

Background: Suicidal ideation is a common phenomenon among postpartum women around the world. However, evidence of the relationship between neuroticism and suicidal ideation among postpartum women is still lacking.

Methods: From March 2017 to December 2018, a total of 1027 postpartum women (assessed no later than one month post-birth) were recruited to complete questionnaires assessing neuroticism, depression, anxiety and suicidal ideation.

Results: Anxiety and depression fully mediated the association between neuroticism and suicidal ideation (Total indirect effects = 0.11, 95%CI: 0.07, 0.15). The indirect effect of the pathway of EPQ (Neuroticism)-Anxiety-Suicidal ideation was more significant than other pathways (Indirect effects=0.04, 95%CI: 0.02, 0.07).

Conclusion: Interventions for suicidal ideation in postpartum women need to target neuroticism and further research is necessary understand the mechanisms by which neuroticism affects suicidal ideation.

Keywords: neuroticism, anxiety, depression, suicidal ideation, mediation model

1. Introduction

Suicide is a major public health concern and one of the primary causes of death in the postpartum period (Oates, 2003; Shuchman, 2014). According to a recent survey in the US, suicide was found to be one of the leading causes of death for reproductive aged-women (Ballesteros et al., 2017). Postpartum women were found to have a relatively higher risk of suicide, which has a great negative effect on the baby's growth and development, as well as the emotional burden on their families (Gold et al., 2011).

Suicidal ideation is one of the major risk factors predicting suicide (Chen et al., 2018; Lindahl et al., 2005), and is a common phenomenon among postpartum women around the world. Recent studies in the UK and China found suicidal ideation to be reported in 9% and 11.74% of postpartum women (Howard et al., 2011; Shi et al., 2018). Both severe depression (Nierenberg et al., 2001; Simon et al., 2013), and anxiety (Sareen et al., 2005) have been associated with suicidal ideation among postpartum women (Simon et al., 2013). Additionally, while depression and anxiety are often comorbid, previous studies note that depression can explain at least some of the association between anxiety and suicidal ideation (Preacher and Hayes, 2009; Seligman and Ollendick, 1998).

Beside the impact of depressive and anxiety symptoms, the personality trait of neuroticism is also worthy of study. Neuroticism is regarded as a risk factor for depression and anxiety (Hakulinen et al., 2015; Kotov et al., 2010; Vink et al., 2008), with individuals who score higher in trait neuroticism being more likely to have a

more negative temperament and increased emotionality. Neuroticism scores can be decreased after receiving treatments for depression and anxiety (Hakulinen et al., 2015), including anti-depressant medication (Hakulinen et al., 2015). The association between neuroticism, anxiety, and depression, has meant that neuroticism has become an emerging target for interventions (Blanco et al., 2014). Thus, the potential association between neuroticism and suicidal ideation among the postpartum women is of particular interest, given the strong association between suicidal ideation and depressive symptoms.

No current research has focused on mechanisms underlying associations between neuroticism, anxiety, depression and suicidal ideation in postpartum women. We aim to investigate the association between trait neuroticism and suicidal ideation, as well as exploring whether anxiety and depression mediate this association among the postpartum women (Rappaport et al., 2017; Vittengl, 2017).

2. Methods

2.1 Participants

Participants who had recently given birth were recruited from Suzhou, China, from March 2017 to December 2018 in the local community service centers. Participants were eligible if they: (1) were aged 16-year-old or over, (2) gave birth to a baby within the past month, (3) provided written informed consent. A total of 1034 participants were recruited in this study, and 1027 postpartum women met this inclusion criteria, provided full data and were included for analyses. Ethical approval

was obtained from Ethics Committee of Suzhou Guangji Hospital, China.

2.2 Materials

Socio-demographic characteristics

Socio-demographic characteristics were collected including ethnicity, age, education level, yearly income, and marital status.

Neuroticism

Trait neuroticism was measured using the 24-item neuroticism subscale of Eysenck Personality Questionnaire (EPQ). The sum score was calculated by adding up all the positive answers, with higher scores indicating greater neuroticism. The previous Cronbach alpha of the Chinese version neuroticism subscale was 0.89 (Gong, 1984).

Anxiety symptoms

Anxiety symptoms were assessed using the Generalized Anxiety Disorder-7 scale (GAD-7), which comprises of 7 items. Each item is scored from 0 (no) to 3 (almost every day). Higher scores indicate more severe anxiety symptoms. The scale of GAD-7 have been frequently applied in China (previous Cronbach alpha was 0.89) (Chen et al., 2019; Tong et al., 2016).

Depression symptoms

Depressive symptoms were evaluated using the Edinburgh Postnatal Depression Scale (EPDS) (Cox et al., 1987). This consists of 10 items, each scored from 0-3, giving a total score ranging from 0-30. Higher scores indicate higher levels of depressive symptoms. Previous research has shown the scale to have good reliability

in China, with a Cronbach's alpha of 0.79 (Wang et al., 2009).

Suicidal ideation

Suicidal ideation was measured by one item from the nine-item patient Health Questionnaire (PHQ-9), which asked how often participants thought that they would be better off dead or of hurting oneself in some way. Following previous classification, participants who answered "never" were scored as no suicidal ideation, and any other answers were classified as suicidal ideation being present (Altura et al., 2016).

2.3 Statistical analyses

All data were analyzed using SPSS version 20.0. Descriptive statistics were computed for sociodemographic characteristics and all other study variables. Next, logistic regression analysis was used to explore the relationship between neuroticism, anxiety, depression and suicidal ideation. Finally, a mediation model was conducted using the SPSS PROCESS macro in order to test whether anxiety and depression mediated the association between neuroticism and suicidal ideation (Preacher and Hayes, 2009). All analyses controlled for covariates such as age, marital status, education level and yearly income, and the significance level was set at $P < 0.05$ (two tails).

3. Results

A total of 1027 postpartum women were entered into the analysis. For full participant details see Table 1. The overwhelming majority were from Han ethnicity (98.8%), the average age was 29.9 (SD = 4.3) years, around two-thirds (67.6%) had above bachelors degree level of education, and 47.6% of the participants were having

children for the first time. Additionally, 4.0% were above the cut off for an anxiety disorder (scores above 10) (Lowe et al., 2008), 14.1% showed depressive symptoms (scores greater than 12) (Shi et al., 2018) and 5.3% of participants had suicidal ideation. The correlation analysis among all key variables showed that suicidal ideation was significantly associated with trait neuroticism (r = 0.126, $p < 0.01$), anxiety (r = 0.263, $p < 0.01$) and depression (r = 0.241, $p < 0.01$).

Logistic regression for simple mediation analysis

In Table 2, the results indicated that trait neuroticism had indirect effect on suicidal ideation. After controlling for anxiety, the odds of trait neuroticism predicting suicidal ideation decreased from 1.22 (95% CI:1.15-1.28) to 1.12 (95%CI:1.05-1.19), indicating that anxiety was a mediator in the association between trait neuroticism and suicidal ideation. Likewise, depression had mediation effect between trait neuroticism and suicidal ideation, reducing the odds ratio from 1.22 (95%CI:1.15-1.28) to 1.09 (95% CI:1.02-1.17).

Mediation analysis

Mediation analysis was shown in Figure 1. Anxiety and depression both fully mediated the relationship between trait neuroticism and suicidal ideation. In the mediation model, the direct effect of EPQ (Neuroticism) on suicidal ideation was non-significant (B = 0.07, 95%CI: 0.00, 0.14). The total indirect effect of EPQ (Neuroticism) on suicidal ideation was 0.11 (95%CI: 0.07, 0.15). The specific effects were as follows: the indirect effect of the pathway EPQ (Neuroticism)-Anxiety-Suicidal ideation was 0.04 (95%CI: 0.02, 0.07), the indirect

effect of the pathway EPQ(Neuroticism)-Depression-Suicidal ideation was 0.03 (95%CI: 0.01, 0.06), and the indirect effect of the pathway EPQ (Neuroticism)-Anxiety-Depression-Suicidal ideation was 0.03 (95%CI: 0.01, 0.05).

4. Discussion

This is the first study to investigate the relationship between trait neuroticism and suicidal ideation among postpartum women. Compared with postpartum women who were classified as having low neuroticism, in the current study, those with high neuroticism were prone to increased anxiety and depression which in turn, indirectly increased the risk of suicidal ideation. Additionally, anxiety and depression were found to be associated with suicidal ideation in the postpartum period. This is consistent with previous studies showing that higher levels of anxiety and depression can increase the risk of suicidal ideation among postpartum women (Davidson et al., 2011; Gold et al., 2011). Therefore, more attention should be paid to detecting the symptoms of anxiety and depression in the postpartum period to reduce the risk of suicidal ideation.

In current study, we found a lower percentage of 5.3% of postpartum women reported having suicidal ideation compared to similar studies. A recent study in Chongqing city, China reported that suicidal ideation incidence was 11.74% among postpartum women (Shi et al., 2018), while a previous review showed suicidal ideation ranging from 5% to 14% among postpartum women (Lindahl et al., 2005). The disparities among the rates could due to the different setting, measurements, sampling, and the diversity characteristics of the participants.

After controlling for age, marital status, education level and yearly income, we found that trait neuroticism did not predict suicidal ideation directly in the postpartum period. Previous studies found that neuroticism was a risk factor of suicidal ideation in community populations, however these did not control for the effects of anxiety and depression (Huang et al., 2019). In the current study, level of neuroticism was positively significantly associated with symptoms of depression and anxiety, and indirectly associated with suicidal ideation. Thus, it is necessary to pay more attention to the mechanism of trait neuroticism affect suicidal ideation among postpartum women in future research.

Furthermore, the fully mediating role of depression and anxiety in the association between the neuroticism and suicidal ideation, highlights the feasibility of targeting neuroticism for interventions designed to reduce suicidal ideation. Consistent with other research, the relationship between the neuroticism and suicidal ideation needs to account for anxiety and depression (Vittengl, 2017). This is supported by evidence from the current study, in which the indirect effect of the pathway EPQ (Neuroticism)-Anxiety-Suicidal ideation is more significant than other pathways. Therefore, in order to develop an effective targeted intervention, it is important to find related risks and understand the complex association among such risk factors including neuroticism.

There are some limitations in the present research. First, the participants were recruited in a single city in China, which may affect the representativeness of the sample. Second, the previous history of mental illness was not recorded in survey and

thus may be a source of bias in analysis. Third, since this study used a cross-sectional design, the causal relationships among variables cannot be fully established. However, the study has shown promising targets for future, longitudinal designs, which could provide evidence of causality.

5. Conclusion

In conclusion, trait neuroticism was associated with anxiety and depressive symptoms among postpartum women. Anxiety and depression fully mediate associations between neuroticism and suicidal ideation. In order to reduce suicidal ideation among the postpartum women, we need to pay more attention to women with high trait neuroticism. Future interventions should also take levels of neuroticism into consideration as a potential target for reducing suicidal ideation.

Conflicts of interest

All authors are no conflict of interest exists in carrying out this study and preparing the manuscript.

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Table1. Socio-demographic, Anxiety, Depression and Suicidal ideation characteristics

Characteristic	Number	Percent(%)
Ethnic		
Han	1015	98.8
others	12	1.2
Women Age		
≤20	9	0.9
21-25	141	13.7
26-30	467	45.5
31-35	300	29.2
36-40	105	10.2
≥41	5	0.5
Mean SD	29.9	4.3
Education level		
High school or lower	249	24.2
Bachelor degree	693	67.5
Master degree or higher	83	8.1
yearly income before pregnancy (RMB)		
＜50000	330	32.1
50000~15000	619	60.3
＞150000	78	7.6
Marital status		
Married	997	97.1
others	30	2.9
Giving a birth for the first time		
yes	489	47.6
no	538	52.4
Score of anxiety		
0-9	983	96.0
10-14	34	3.3
≥15	7	0.7
Score of depression		
0-11	882	85.9
≥12	145	14.1
Suicidal ideation		
Yes	52	5.3
No	973	94.7

Table2. Logistic regression results for key variables

[a] Variables	B	SE	p	OR	95%CI
[b] EPQ(Neuroticism)-Suicidal ideation	0.20	0.03	<0.001	1.22	1.15-1.28
[c] Anxiety -Suicidal ideation	0.30	0.03	<0.001	1.35	1.25-1.44
[d] Depression -Suicidal ideation	0.25	0.03	<0.001	1.28	1.21-1.36
[e]Anxiety-Suicidal ideation (controlling Depression)	0.17	0.05	<0.001	1.18	1.08-1.29
EPQ(Neuroticism)-Suicidal ideation (controlling Anxiety)	0.11	0.03	0.001	1.12	1.05-1.19
EPQ(Neuroticism)-Suicidal ideation (controlling Depression)	0.09	0.03	0.010	1.09	1.02-1.17
[f]EPQ(Neuroticism)-Suicidal ideation (controlling Anxiety and Depression)	0.07	0.04	0.063	1.07	1.00-1.15

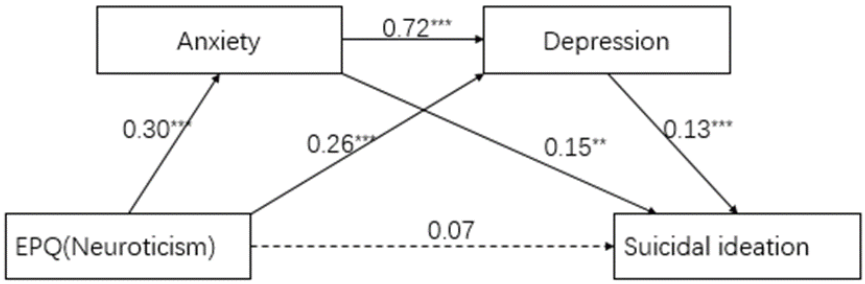
[a] Controlling for age, marital status, education level and yearly income
[b] Total effect of EPQ (Neuroticism) on Suicidal ideation
[c] Total effect of Anxiety on Suicidal ideation
[d] Total effect of Depression on Suicidal ideation
[e] Direct effect of Anxiety on Suicidal ideation
[f] Direct effect of EPQ (Neuroticism) on Suicidal ideation

Table 3. key variables and Spearman correlation coefficients

	Mean	SD	1	2	3	4
1. EPQ(Neuroticism)	8.65	5.45	1.000			
2. Anxiety	2.52	3.21	0.510**	1.000		
3. Depression	5.91	4.88	0.541**	0.628**	1.000	
4. Suicidal ideation	0.05	0.22	0.216**	0.263**	0.241**	1.000

**p < 0.01

Figure1. The final statistical mediation model in this research



*** p＜0.001 **p＜0.01 *p＜0.05

Table 4. Regression results for the conditional indirect effect (mediation model)

Path		Final Model*				
Variable 1	Variable 2	B	SE	T/Z	P	95%CI
EPQ(Neuroticism)	Anxiety	0.30	0.02	18.77	<0.001	0.27-0.33
EPQ(Neuroticism)	Depression	0.26	0.02	10.82	<0.001	0.21-0.31
Anxiety	Depression	0.72	0.04	17.75	<0.001	0.64-0.80

EPQ(Neuroticism)	Suicidal ideation	0.07	0.04	1.90	0.058	0.00-0.14
Anxiety	Suicidal ideation	0.15	0.05	3.24	0.001	0.06-0.24
Depression	Suicidal ideation	0.13	0.04	3.36	<0.001	0.06-0.21

controlling for age, marital status, education level and yearly income
*show the entire model (outcome=Anxiety/Depression/Suicidal ideation) is significant