# RESEARCH

# Effects of psychosocial factors on postpartum depression: a half-longitudinal mediation analysis of cognitive reactivity

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# Abstract

**Background** The prevention and treatment of perinatal depression are currently the focus of perinatal health care, with cognitive reactivity confirmed to be an important predictor. However, how cognitive reactivity mediates the relationship between psychosocial factors (e.g. family function, perceived stress, mindfulness, and insomnia) and perinatal depression remains unclear. This study aims to investigate the mediating role of cognitive reactivity between psychosocial factors and perinatal depression.

**Methods** Based on a half-longitudinal design, this study investigated 368 perinatal women from China in the third trimester (T1) and three months postpartum (T2) using the Perceived Stress Scale, Cognitive and Affective Mindfulness Scale, Athens Insomnia Scale, Family Adaptation Partnership Growth Affection and Resolve Index, Leiden Index of Depression Sensitivity, and Edinburgh Postnatal Depression Scale. Data were analysed using structural equation modelling.

**Results** The overall fit of the hypothetical structural model is acceptable. The analysis confirmed a direct relationship between family function, perceived stress, mindfulness, and insomnia at T1, and cognitive reactivity at T2. Factors other than mindfulness at T1 had a direct effect on perinatal depression at T2. Furthermore, cognitive reactivity at T2 mediated the influences of family function, perceived stress, mindfulness, and insomnia at T1 on perinatal depression at T2.

**Conclusions** Cognitive reactivity levels in the third trimester were stable predictors and mediators of postpartum depression. Effective strategies to reduce cognitive reactivity in perinatal women should focus on enhancing family function, mindfulness, and sleep quality and in guiding women toward adopting positive coping styles to alleviate stress levels, ultimately reducing postpartum depression.

Keywords Perinatal depression, Cognitive reactivity, Mediation analysis, Longitudinal studies, Psychology

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# Introduction

Perinatal depression (PND) refers to an episode of depression experienced by some women during pregnancy and up to one year after delivery [1]. It is divided into prenatal and postpartum depression, often occurring in late pregnancy and up to three months after delivery [2]. In China, the incidence of PND ranges from 3.0 to 68.4%, with a rapid increase reported of 9% per year [3]. Therefore, it has become a focal point in perinatal healthcare. Women with PND struggle to adapt to changes after pregnancy, feel helpless or isolated, and may withdraw from social activities [4]. Severe depression may even lead to suicide or infanticide, placing a heavy burden on perinatal women, their families, and society at large [5].

According to Beck's cognitive vulnerability theory [6], dysfunctional attitudes play a crucial role in the development of depression following stressful life events. The activation of dysfunctional attitudes through sadness has been termed cognitive reactivity (CR) [7]. Previous studies have demonstrated that CR stability is a predictor of the onset and recurrence of depression. It has been reported that with every 10-point increase in the CR score, the risk of depression recurrence increases by 20% [8]. Similarly, CR has been shown to account for 45% of first-episode depression and 53% of recurrent depression among college students [9]. While studies in this area are limited, a positive predictive relationship has been observed between CR and depression levels at six weeks postpartum in perinatal women, marking the first investigation of CR in this population [10]. Therefore, exploring CR as a point of entry to understand the mechanism of PND holds promise for its prevention and treatment, which is crucial for enhancing maternal and infant health.

The available evidence suggests that CR and PND are influenced by multiple physiological, psychological, and social factors. Negative correlations have been reported between CR and sleep quality [11]. A longitudinal survey indicated that poor sleep quality during the third trimester exacerbates the risk of postnatal depression, with sleep quality having a dynamic effect on depressive symptoms in early pregnancy [12]. Positive psychological factors such as mindfulness have been identified as crucial protective factors against CR. Scholars have observed that higher levels of individual mindfulness are associated with lower CR levels and a reduced likelihood of depression or recurrence [8, 13]. Furthermore, stressors have been found to be positively correlated with CR [14], while high stress and adverse life events during pregnancy have been widely linked to the occurrence and progression of PND [15]. A Turkish study identified family dysfunction as a critical factor in the development of postpartum depressive symptoms [16]. According to multifactor system theory related to stress [17], the generation of stress responses includes three parts: stressors, mediating variables, and stress response, with cognitive factors at the core. Despite the established associations between the aforementioned psychosocial factors and CR and PND, the exact pathways through which CR mediates the impact of these factors on PND remain unclear. Further research is required to elucidate the underlying mechanisms. Therefore, this study used CR as a mediating variable to examine the roles of various psychosocial factors (stressors) and stress response in relation to PND.

Mediation analyses aim to reveal how exposure leads to its hypothesised impact on outcomes [18]. Typically, all measurements should be separated in different wave studies. However, it has been argued that half-longitudinal mediation can be explored in two-wave studies [19]. Previous studies have successfully demonstrated the applicability of this statistical approach to illustrate the role of mediators [20]. Therefore, our study employed a half-longitudinal design to investigate the mediating effects of CR (baseline or follow-up) on the relationships between perceived stress, insomnia, mindfulness, family function (baseline), and PND (follow-up). The hypothetical model of this half-longitudinal study is depicted in Fig. 1. We propose the following hypotheses:

(1) hypothesis 1 (2) Perceived stress, insomnia, mindfulness, family function (baseline), and CR (either baseline or follow-up) have varying predictive effects on perinatal women's experience of PND (follow-up).

(3) hypothesis 2 (4) Perceived stress, insomnia, mindfulness, and family function (baseline) have distinct predictive effects on CR (both baseline and follow-up) in perinatal women.

(5) hypothesis 3 (6) The relationship between perceived stress, insomnia, mindfulness, and family function (base-line) in perinatal women is associated with PND (follow-up) through the mediating effect of CR (either baseline or follow-up).

# Methods

# Study design

This two-wave prospective study was conducted in Fujian Province, China, between December 2021 and January 2023. This study was approved by the Institutional Review Board of the Second Affiliated Hospital of Fujian Medical University (No. 2022085), and all participants provided signed informed consent. Participants completed the baseline questionnaire in the third trimester (T1) and were followed up at three months postpartum (T2) through face-to-face interviews to assess levels of perceived stress, family function, insomnia, mindfulness, CR, and PND. This study adhered to Strengthening



Fig. 1 Hypothetical half-longitudinal mediation model

the Reporting of Observational Studies in Epidemiology (STROBE) statement of von Elm et al. [21].

#### Participants

We enrolled 1426 pregnant patients from the obstetrical clinics and inpatient departments of three tertiary hospitals (level 3) in Fuzhou and Quanzhou City, Fujian Province, China. Inclusion criteria were: (1) age  $\geq$  20 years, (2) singleton pregnancy with gestational age  $\geq$  28 weeks confirmed by type-B ultrasonic test, (3) assessed as high-risk for PND with a score  $\geq$  58 on the 26-item Chinese version of the Leiden Index of Depression Sensitivity (LEIDS-RR-CV) and a score  $\leq$  12 on the 10-item Edinburgh Postnatal Depression Scale (EPDS), and (4) willingness to participate in a follow-up period of up to three months postpartum. Women with preexisting mental disorders or cognitive impairments were excluded from the study.

According to Pan et al. [22], determining the sample size for mediation analysis of longitudinal data requires 80% power, which depends on the intraclass correlation coefficient (ICC). The effect sizes were denoted as SL for small (0.14), M for medium (0.39), L for large (0.59), and H for halfway (0.26). In this study, we selected an ICC of 0.2. With the effect size SL indicating  $\beta a = 0.14$  and  $\beta b = 0.59$ , we opted for the most powerful bootstrapping method. The minimum sample size required was 278 patients. Factoring in a 15% attrition rate, we established that the required sample size should be at least 320.

# Measurements

### Exposure measures

**Perceived stress scale (PSS-10)** The PSS-10 is a valid and reliable instrument for measuring overall levels of perceived stress [23]. Participants were asked to indicate how frequently they experienced certain feelings over the past month using a four-point Likert scale, ranging from "never" to "always", with scores assigned from 0 to 4. The total PSS-10 score ranged from 0 to 40, with a higher score indicating a greater level of perceived stress [23]. Previous studies have reported that the PSS-10 demonstrates satisfactory internal consistency, test–retest reliability, and validity in pregnant and postpartum women [24, 25]. In this study, the Cronbach's  $\alpha$  in women at T1 was 0.822.

**Cognitive and affective mindfulness scale** – **revised** (**CAMS-R**) The CAMS-R comprises 12 items organised into four dimensions: attention, present focus, awareness, and acceptance. Responses were rated on a four-point Likert scale, ranging from 'never' to 'always', with scores assigned from 1 to 4. The total score ranged from 12 to 48, with a higher total score indicating a higher level of mindfulness in the individual [26]. In this study, the Cronbach's  $\alpha$  in women at T1 was 0.905.

Athens INSOMNIA scale (AIS) The AIS is an eight-item self-report scale that assesses insomnia in two domains: nocturnal sleep disturbance and daytime dysfunction, which includes daytime sleepiness. Each item is rated from 0 to 3, with higher scores indicating more severe insomnia conditions [27]. In this study, the Cronbach's  $\alpha$  in women at T1 was 0.813.

Family adaptation partnership growth affection and resolve index (APGAR) The Family APGAR, developed by Smilkstein [28], is a well-established tool known for its reliability and validity. This scale assessed family members' perceptions of family functioning by measuring their

satisfaction with family relationships. It encompasses five parameters: adaptation, partnership, growth, affection, and resolve. Participants can choose from three response options: 'almost always', 'sometimes', or 'hardly ever', which correspond to scores of 2, 1, and 0 respectively. The total score is obtained by summing the points for each item, with higher scores indicating better family functioning. In this study, the Cronbach's  $\alpha$  in women at T1was 0.892.

# Mediator measures

Chinese version of the Leiden index of depression sensitivity (LEIDS-RR-CV) To assess CR, we used the 26-item self-report LEIDS-RR-CV, which encompasses five subscales: hopelessness/suicidality, acceptance/cop-ing, aggression, control/perfectionism, and avoidant cop-ing. Responses are rated on a five-point Likert scale ranging from 1 to 5 ("not at all" to "very strongly"), with higher scores indicating greater CR [29]. The LEIDS-RR-CV has demonstrated reliability and validity for quantifying CR among perinatal Chinese women and for screening for high-risk depression during this period [10]. This study found acceptable reliability for the overall scale score (Cronbach's  $\alpha$  = 0.875–0.895).

#### **Outcome measures**

Edinburgh postnatal depression scale (EPDS) We employed the 10-item self-report EPDS, which is widely recognised as a primary screening tool for common depressive symptoms in both pre- and postpartum women [30]. Responses were rated on a four-point Likert scale ranging from 0 to 3, with higher total scores indicating a higher presence of depressive symptoms (range: 0–30). The EPDS has been validated in numerous countries and has demonstrated robust psychometric properties in both pre- and postpartum contexts [31, 32]. A recommended cutoff score of 13 or higher is used when assessing the potential for PND [33]. In this study, the Cronbach's  $\alpha$  in women at T2 was 0.857.

#### Sociodemographic and clinical characteristics

We obtained the participants' sociodemographic and clinical data from the medical record databases of the participating hospitals. This included information on maternal age, gestational week, whether the participant was the only daughter, marital status, education level, residential location, occupation, monthly household income (in RMB,  $\}$ ), number of pregnancies, number of children, and prenatal psychological screening.

### Data analysis

Data analysis was conducted using SPSS 26.0 and R 4.2.3 software. All statistical tests were two-sided, with p < .05

used to indicate statistical significance. The parameter likelihood method [34] was used for the imputation and parameter estimation of missing values. The demographic variables, perceived stress, family function, mindfulness, CR, and PND are described as mean, standard deviation (SD), range, number (N), and percentage (%), as appropriate. Pearson's correlation analysis was used to investigate the relationships among these variables. The half-longitudinal mediation model was analysed using the R package "lavaan". In the hypothetical model, CR at baseline or follow-up served as the mediation variable; baseline perceived stress, mindfulness, insomnia, and family function served as exposure variables; and PND was the outcome. The fit indices used in this study included the chi-square statistic (chi-squared), Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and Root Mean Square Error of Approximation (RMSEA).

# Results

#### Participant characteristics

In this study, a total of 1,426 questionnaires were distributed, and 1,409 valid responses were collected. Based on the measurement results, we identified 368 women at high risk of PND who met the inclusion criteria for this study. Of these, 329 women were followed up at three months postpartum, resulting in a 10.6% attrition rate (see Fig. 2).There were no significant differences in sociodemographic and clinical characteristics between our sample of 329 women and the 39 women who were excluded. The sociodemographic and clinical characteristics of the study participants are presented in Table 1.

#### **Correlations of variables**

As shown in Table 2, Pearson analysis showed that the total PND scores at T2 were significantly positively correlated with CR (T1 and T2), perceived stress (T1), and insomnia (T1), and negatively correlated with family function (T1). However, the relationship between mind-fulness (T1) and CR (T1) or PND (T2) was not significant (p > .05).

# **Mediation analysis**

The mediating effect of CR at T1 on the relationship between exposure variables (family function, perceived stress, mindfulness, and insomnia) at T1 and PND at T2 was statistically insignificant (p >.05), even after controlling for demographic and clinical variables. Table 3 lists the effect coefficients of the model mediated by CR at T1.

In contrast, CR at T2 significantly mediated the relationship between the exposure variables (family function, perceived stress, mindfulness, and insomnia) at T1 and PND at T2 (p <.05), after controlling for demographic and clinical variables (Fig. 3). The direct effects of



Fig. 2 Sample screening and loss to follow-up

family function, perceived stress, and insomnia on PND were significant (coefficients  $\beta$  = -0.45, 0.285, and 0.246, respectively), while a direct effect was not found for mindfulness (coefficient  $\beta$  = 0.031, 95% CI: -0.030–0.093). All mediation models exhibited acceptable fit indices, as follows:  $\chi$ 2(df), 14.27(8)–29.308(8); AIC, 4210.743–4299.358; BIC, 4260.092–4348.707; and RMSEA, 0.049–0.090. Table 4 lists the effect coefficients of the model mediated by CR at T2.

# Discussion

To the best of our knowledge, this is the first longitudinal study to explore the mediating role of CR on psychosocial factors and PND. Our results not only indicated that CR was a stable predictor of PND but also elucidated the mechanisms through which different stressors influence PND levels. Specifically, we found that women in the third trimester with high levels of mindfulness and strong family functioning, coupled with low levels of perceived stress and insomnia, tended to exhibit reduced CR and depression in the postpartum period. These findings deepen understanding of the potential factors associated with reductions in PND and can aid in the development of more tailored interventions for women at a high risk of PND.

The first hypothesis proposed in this study was partially supported and clarified. Our findings align with previous studies demonstrating positive direct relationships between perceived stress and insomnia at T1 and PND at T2, while family function at T1 negatively predicted PND at T2 [16, 35]. Physiologically, higher perceived stress can lead to dysfunction of the hypothalamic-pituitary-adrenocortical axis and abnormal cortisol secretion, resulting in a depressive mood [36]. Sleep quality is crucial for mental health; however, physiological changes and psychological stressors during the third trimester can disrupt sleep patterns and contribute to the development of PND [37]. Additionally, family care is a vital component of the social support system for perinatal women, and this may be particularly affected by Chinese family culture, which traditionally views the family as an inseparable unit. Without adequate support and understanding from family members, women may experience increased feelings of loneliness, helplessness, and hopelessness, leading to increased depression [38].

Furthermore, we found that maternal CR levels positively predicted contemporaneous depression levels, which is consistent with the findings of previous studies [8, 9] and which provides further evidence that CR is a stable predictor of depression occurrence or recurrence. According to the diathesis-stress model [39], psychological disorders result from interactions between individual diathesis factors and environmental stressors. Higher CR indicates a stronger association between negative emotions and negative cognition [40]. Thus, perinatal women with high CR levels may experience not only negative emotions but also intense dysfunctional self-cognition, self-evaluation, and self-blame attributions when facing

# Table 1 The sociodemographic and clinical characteristics of participants

	The third trimester women ( $n = 368$ )	The three-month postpartum women ( $n = 329$ )
	П (%)	n (%)
Age (years)	10 (5 1 ()	10 (5 70)
18-24	19 (5.16)	140 (42 55)
25-29	156 (42.39)	140 (42.55)
30-34	175 (47.56)	156 (47.42)
≥35	18 (4.89)	14 (4.25)
Gestational weeks		
≤31+6	17 (4.62)	14 (4.26)
32-36+6	127 (34.51)	111 (33.74)
≥37	224 (60.87)	204 (62.00)
Only daughter		
No	313 (85.05)	280 (85.11)
Yes	55 (14.95)	49 (14.89)
Marital status		
Unmarried	7 (1.90)	7 (2.13)
Married	354 (96.20)	317 (96.35)
Remarried	7 (1.90)	5 (1.52)
Educational level		
Middle school degree or below	39 (10.60)	34 (10.33)
High school / technical school degree	58 (15.76)	53 (16.11)
Bachelor / college degree	249 (67.66)	222 (67.48)
Master degree or above	22 (5.98)	20 (6.08)
Residential location		
Urban	288 (78.26)	258 (78.42)
Rural	80 (21.74)	71 (21.58)
Occupation		( )
Civil servant	6 (1.63)	5 (1.52)
Enterprise managers	26 (7.07)	25 (7.60)
Clerk	98 (26.63)	90 (27.36)
Teachers/technicians	85 (23.10)	77 (23.40)
Medical staff	18 (4 89)	15 (4 56)
Service industry/workers	22 (5 98)	18 (5 47)
Other	113 (30 71)	99 (30 09)
Monthly household income (BMB ¥)	115 (30.77)	55 (50.05)
	4 (1 09)	3 (0.01)
1001 3000		20 (6.08)
3001-5000	130 (37 77)	125 (37 99)
5001 8000	131 (35.60)	121 (36 78)
> 9001	60 (19 75)	60 (19 24)
20001	09 (18.73)	00 (18.24)
	174 (47 20)	150 (40.02)
Unice	174 (47.28)	158 (48.02)
Twice	136 (36.96)	121 (36.78)
Inree times or more	58 (15.76)	50 (15.20)
Number of children	24.5 (52.42)	
1	215 (58.42)	196 (59.57)
2	139 (37.77)	121 (36.79)
≥3	14 (3.81)	12 (3.64)
Prenatal psychological screening		
No	343 (93.21)	306 (93.01)
Yes	25 (6.79)	23 (6.99)

Variable	$Mean \pm SD$	CR T1	CR T2	PND T2	Family function T1	Perceived stress T1	Mindfulness T1	Insomnia T1
CRT1	$64.8 \pm 6.71$	1						
CRT2	$69.1 \pm 14.03$	0.36 <sup>a</sup>	1					
PND T2	$10.48 \pm 5.35$	0.34 <sup>a</sup>	0.79 <sup>a</sup>	1				
Family function T1	$7.32 \pm 2.38$	-0.14 <sup>a</sup>	-0.40 <sup>a</sup>	-0.49 <sup>a</sup>	1			
Perceived stress T1	$16.38 \pm 3.54$	0.33 <sup>a</sup>	0.46 <sup>a</sup>	0.54 <sup>a</sup>	-0.54 <sup>a</sup>	1		
Mindfulness T1	$28.58 \pm 5.69$	-0.01	-0.12 <sup>b</sup>	-0.08	0.08	-0.26 <sup>a</sup>	1	
Insomnia T1	$6.69 \pm 3.30$	0.04	0.28 <sup>a</sup>	0.37 <sup>a</sup>	-0.37 <sup>a</sup>	0.32 <sup>a</sup>	0.17 <sup>a</sup>	1

Table 2 Bivariate correlation among variables

Abbreviations: CR, cognitive reactivity; PND, perinatal depression

<sup>a</sup>p <.01

<sup>b</sup>p <.05

Table 3 Results of path relationship test for the model mediated by CR at T1

	Independent variable	Dependent variable	Total effect (β)	SE	95% CI
Model 1	CR T1	PPD T2	0.019	0.024	-0.031~0.061
	Family function T1	CR T1	-0.053	0.157	-0.456~0.158
		PPD T2	-0.162 <sup>a</sup>	0.068	-0.497~-0.232
Model 2	CR T1	PPD T2	0.033	0.025	-0.023~0.076
	Perceived stress T1	CR T1	0.292 <sup>a</sup>	0.105	0.348~0.759
		PPD T2	0.181ª	0.051	0.174~0.373
Model 3	CRT1	PPD T2	0.066	0.028	-0.003~0.108
	Mindfulness T1	CR T1	-0.017	0.065	-0.148~0.107
		PPD T2	0.003	0.031	-0.059~0.064
Model 4	CR T1	PPD T2	0.078 <sup>b</sup>	0.028	0.008~0.116
	Insomnia T1	CR T1	-0.001	0.112	-0.223~0.217
		PPD T2	0.173 <sup>a</sup>	0.055	0.173~0.387

Abbreviations: CR, cognitive reactivity; PPD, postpartum depression; SE, standard error; CI, confidence interval

<sup>a</sup>p <.001

<sup>b</sup>p <.05

stressful events, leading to depression [41]. In contrast to previous studies [42], we found no direct relationship between mindfulness and PND. One possible explanation for this inconsistency is that CR acts as an overarching mediating factor, attenuating the direct influence of mindfulness on PND.

Regarding the second hypothesis, in line with previous studies [9, 11, 13, 14], we observed that perceived stress and insomnia at T1 positively predicted CR at T2, while levels of mindfulness and family function at T1 were negatively associated with CR at T2. Individuals experiencing poorer sleep quality have been found to be more prone to reacting to negative moods through reactivating thoughts related to hopelessness or other negative states, leading to an elevation in CR [43]. Hormonal influences during the perinatal period may predispose women to negative thinking patterns in response to stress, resulting in self-perception bias and negative emotions such as worthlessness and sadness [44]. Some studies suggest that robust social support creates an environment conducive to interpreting stressful events positively and finding meaning in them [45]. This may explain why strong family functioning reduces maternal CR levels. Furthermore, according to mindfulness-to-meaning theory [46], mindfulness enables individuals to be aware of and analytically assess their negative emotions, allowing them to adjust their thought patterns and embrace an attitude of openness and acceptance rather than resistance or avoidance.

Consistent with previous studies [9], our findings indicated the significant mediating role of CR at T2, further validating multifactor system theory in relation to stress and providing strong theoretical support for the prevention and treatment of PND. Specifically, CR at T2 partially mediated the relationship between family function, perceived stress, and insomnia at T1 and PND at T2, and fully mediated the relationship between mindfulness at T1 and PND at T2. Strong family function and mindfulness can enhance the ability of perinatal women to cope with negative emotions, bolster their cognitive resilience, and consequently reduce the occurrence of depression [47, 48]. Moreover, good sleep quality enhances cognitive function and regulates emotional and stress levels in perinatal women, enabling them to better manage various tasks and role transitions after childbirth [49, 50]. An unexpected finding of this study was the absence of a significant mediating effect of CR at T1 between each stressor and PND. Therefore, the third hypothesis was



Fig. 3 The mediation of cognitive reactivity in the third trimester. \*p < .05, \*\*p < .01

only partially supported, which supports previous understanding that CR is activated when sadness reaches a certain threshold [8], and that this process requires a period of accumulation. However, owing to the lack of comparisons from relevant longitudinal studies, future research is needed to measure the dynamic mediating effect of CR with a greater number of time points.

# Limitations

Although this study yields important findings, it is imperative to interpret these results within the context of their limitations. First, the follow-up period in this study was short, and future research could benefit from including additional measurement points, such as early pregnancy, mid-pregnancy, and 1 year postpartum, to provide a more comprehensive understanding and basis for the development of PND intervention programs.

	Independent variable	Dependent variable	Total effect (β)	SE	95% CI
Model 1	CRT2	PPD T2	0.261ª	0.013	0.236~0.287
	Family function T1	CRT2	-2.167 <sup>a</sup>	0.268	-2.692~-1.643
		PPD T2	-0.450 <sup>a</sup>	0.079	-0.605~-0.295
Model 2	CR T2	PPD T2	0.260 <sup>a</sup>	0.013	0.233~0.286
	Perceived stress T1	CRT2	1.554 <sup>a</sup>	0.177	1.207~1.901
		PPD T2	0.285 <sup>a</sup>	0.057	0.174~0.396
Model 3	CR T2	PPD T2	0.289 <sup>a</sup>	0.012	0.264~0.313
	Mindfulness T1	CRT2	-0.265 <sup>b</sup>	0.121	-0.502~-0.028
		PPD T2	0.031	0.031	-0.030~0.093
Model 4	CRT2	PPD T2	0.275 <sup>a</sup>	0.013	0.250~0.299
	Insomnia T1	CRT2	1.019 <sup>a</sup>	0.201	0.625~1.413
		PPD T2	0.246 <sup>a</sup>	0.055	0.138~0.354

Table 4 Results of path relationship test for the model mediated by CR at T2

Abbreviations: CR, cognitive reactivity; PPD, postpartum depression; SE, standard error; CI, confidence interval

<sup>b</sup>p <.05

Second, while the model presented in this study is informative, it may not account for all variances in CR. Variables not included in our model, such as newborn-related factors, may influence CR. This highlights the need for future studies to explore these additional variables. Third, although the model demonstrated adequate fit based on our sample size, assessing its validity using a larger sample size is likely to enhance the robustness of the findings. In addition, this study relied solely on self-report scale measurements, which may not fully capture the complexity of PND. Future research should improve accuracy and reliability by incorporating psychiatric diagnoses conducted by professionals. Finally, CR was measured twice in this study, while all other measures were taken only once. The repeated use of the same scale for CR may have introduced biases due to increased familiarity or recall effects, which could have influenced participants' responses. This could impact the reliability and validity of the CR measurements. Future studies may consider using alternative methods or additional measures to minimize potential biases associated with repeated testing.

# **Relevance for clinical practice**

One of the major strengths of this study is the extended analysis of the mediating effect of CR in a sample of perinatal women, which expands understanding of CR in the perinatal context and contributes to effective management of PND. The results of this study provide a theoretical basis for the development of multifaceted interventions aimed at preventing or reducing depression in perinatal women.

Our findings suggest that CR is an important predictor and mediator of the occurrence and development of PND. Therefore, to effectively reduce the incidence of PND, medical staff need to pay attention to the CR level and its related factors and adopt targeted interventions. For example, healthcare professionals could focus on improving family functioning and sleep quality in women in their third trimester. Healthcare providers could help boost mindfulness levels in pregnant women through mindfulness-based stress reduction or cognitive behavioural therapy, which may help alleviate CR. Furthermore, healthcare professionals should encourage pregnant women under stress to adopt positive coping styles and provide the necessary tools and resources to effectively alleviate CR, thereby reducing depression.

Importantly, while this study did not directly measure mother-child bonding, it is crucial to recognize the significant role of a strong mother-child bond in both maternal and child well-being. Research has consistently shown that disruptions in mother-child bonding, often associated with maternal depression, can have long-term consequences for the child's emotional regulation, behavioral development, and even physical health [51]. Therefore, interventions targeting PND should not only address maternal mental health but also incorporate strategies to support healthy mother-child interactions, as this may have far-reaching benefits for both the mother and child.

However, it should be acknowledged that this study only focused on specific psychosocial factors associated with CR. Therefore, there may be other influential factors that were not considered. In particular, future studies should explore the role of child-related variables, such as newborn character, health status, and parenting stress, as well as the dynamics of mother-child bonding, as these factors may interact with maternal CR and PND symptoms. In summary, the findings of this study provide valuable insights for health care professionals involved in the care of women with PND. To address issues arising in relation to family function, perceived stress, mindfulness, and insomnia more effectively, healthcare providers can

<sup>&</sup>lt;sup>a</sup>p <.001

develop targeted interventions to reduce CR and improve depression among perinatal women.

# Conclusions

This study showed that CR levels in the third trimester served as stable predictors and mediators of postpartum depression, offering a theoretical foundation for the mitigation of depression in perinatal women. Overall, effective interventions aimed at reducing CR levels in perinatal women should prioritise the enhancement of family function, mindfulness, and sleep quality. Additionally, guiding women to adopt positive coping strategies to alleviate stress can reduce the occurrence and progression of postnatal depression.

#### Abbreviations

PND Perinatal depression CR Cognitive reactivity

#### Acknowledgements

We are grateful to all the study participants and the English editing services from Editage.

#### Author contributions

FFH and YL contributed to the research design, revision and revision of the manuscript. QHC and HLH conducted data analysis and manuscript writing. YYL, YLL and PG contributed to data collection and proofreading. JQZ conducted data analysis. All authors read and approved the final manuscript.

#### Funding

This work did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

#### Data availability

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

#### Declarations

#### Ethics approval and consent to participate

This study was approved by the Institutional Review Board of the Second Affiliated Hospital of Fujian Medical University (No. 2022085), and all participants provided signed informed consent.

#### **Consent for publication**

The data used in this study were all approved by participants prior to publication.

#### **Competing interests**

The authors declare no competing interests.

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# Received: 7 July 2024 / Accepted: 24 February 2025 Published online: 15 March 2025

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