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Longitudinal Pathways between Psychological Distress, Mindfulness, Childbirth Trauma, and Postpartum PTSD among Chinese Postpartum Women: A Three-Wave Cross-Lagged Panel Analysis

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Received: 07 January 2026; Accepted: 25 March 2026; Published: 23 June 2026

ABSTRACT: Objectives: This study aims to examine the temporal associations among psychological distress, mindfulness, childbirth trauma, and postpartum post-traumatic stress disorder (PTSD) symptoms across the first three months postpartum and test whether mindfulness mediates these longitudinal pathways. **Methods:** This prospective longitudinal cohort study followed Chinese postpartum women at one week (T1), one month (T2), and three months (T3) after childbirth. A total of 210 women completed baseline assessments, with 173 and 148 participants retained at T2 and T3, respectively. Psychological distress, mindfulness, childbirth trauma, and postpartum PTSD symptoms were assessed using validated self-report measures. Cross-lagged panel models (CLPM) with bootstrapping were applied to examine temporal associations and the mediating role of mindfulness. **Results:** Mindfulness demonstrated a complex mediating role across the postpartum period. Psychological distress at T1 showed a significant negative indirect association with childbirth trauma at T3 via mindfulness at T2 ($\beta = -0.110$, 95% CI $[-0.188, -0.037]$), while simultaneously exerting a positive direct effect ($\beta = 0.151$, 95% CI $[0.030, 0.272]$), resulting in an inconsistent mediation pattern ($\beta = 0.041$, 95% CI $[-0.158, 0.240]$). In contrast, psychological distress at T1 showed a significant indirect longitudinal association with postpartum PTSD symptoms at T3 via mindfulness at T2 ($\beta = -0.206$, 95% CI $[-0.310, -0.101]$). This pattern was consistent with mediation, although the findings should be interpreted cautiously given the CLPM framework and the modest model fit. **Conclusions:** Mindfulness functions as a central but non-uniform mechanism in postpartum mental health. These findings underscore both its protective potential and the methodological and conceptual complexity of interpreting mindfulness in longitudinal postpartum research.

KEYWORDS: Postpartum women; psychological distress; mindfulness; childbirth trauma; postpartum post-traumatic stress disorder; prospective longitudinal cohort study

1 Introduction

Childbirth is typically a natural and joyful experience for many women. However, women may face significant challenges during their pregnancy, including physical changes, psychological stress, role changes, and alterations in family structure [1]. In addition, when childbirth occurs, women can experience it as either a wonderful event or a physically and psychologically traumatic one that provokes emotional stress responses, including psychological distress, childbirth trauma, and postpartum post-traumatic stress disorder (PTSD) [2]. A meta-analysis encompassing postpartum women from various countries worldwide

reported a pooled prevalence of psychological distress, including postpartum depression, at 14.0%, with rates ranging from 5.0% to 26.3% [3]. This condition was characterized by persistent feelings of sadness, anxiety, stress, and fatigue, which could interfere with daily functioning and maternal-infant bonding [4]. Furthermore, the incidence of postpartum PTSD after traumatic childbirth has been on the rise. Estimates indicate that as many as 19.4% (with a 95% confidence interval [CI] ranging from 11.9% to 26.5%) of women might experience symptoms of trauma after giving birth [5], including re-experiencing the traumatic event, avoiding reminders of the event, negative alterations in mood and cognition, and hyperarousal [6]. The results of a national survey conducted in the UK indicated that 20.1% of postpartum women experienced traumatic childbirth [7].

In China, the situation is equally concerning. A meta-analysis of Chinese women reported that the pooled prevalence of perinatal depression was 16.3%, with antenatal depression at 19.7% and postnatal depression at 14.8% [8]. Furthermore, 10.3% of Chinese women who had a natural childbirth experienced a psychological birth trauma [9] and 5.1% of postpartum women screened positive for postpartum PTSD [10, 11]. This could potentially have long-term consequences for maternal well-being, infant development, and family dynamics [9].

Childbirth trauma is defined as the subjective feeling experienced by a woman due to events directly or indirectly related to childbirth. Women may feel overwhelmed and have distressing emotions and reactions that begin during the birth process and persist into the postpartum period, leading to short- and/or long-term negative consequences that impact a woman's health and well-being [6,12]. According to the etiological theoretical framework of post-traumatic stress following childbirth, the influencing factors for experiencing childbirth trauma include vulnerability factors (e.g., depression during pregnancy, fear of childbirth, psychological problems), postnatal factors (e.g., depression and other comorbid symptoms, stress, and poor coping), and risk factors in birth (e.g., birth experiences, operative birth, lack of support, and dissociation) [13]. Beck's theory on birth trauma posits that a traumatic birth experience can lead to the development of postpartum PTSD. This condition can have a cascading effect, influencing not only the mother, including her subsequent childbirth experiences, but also impacting infants, such as the mother–infant bond and breastfeeding [14]. Evidence suggests that women who experience a traumatic birth may develop PTSD, suffer from psychological distress, and have a negative early motherhood experience, which can adversely affect their physical and psychological health [15,16]. Postpartum PTSD, a more severe and persistent condition, can arise from traumatic childbirth experiences and is associated with an increased risk of anxiety disorders, substance abuse, and even suicidal ideation in extreme cases [17]. Importantly, both theoretical frameworks emphasize that the development of childbirth trauma and postpartum PTSD is not determined solely by obstetric events, but by how women attend to, interpret, and emotionally process their internal and external experiences related to childbirth. This emphasis highlights a potential role for mindfulness-related processes in shaping the pathways through which psychological distress is translated into trauma-related outcomes.

Mindfulness, defined as a receptive attention to and awareness of present events and experiences, is regarded as a promising psychological resource for mitigating stress and enhancing emotional regulation [18]. Theoretically, mindfulness may influence trauma-related pathways by modulating attentional deployment and emotional processing in the context of psychological distress [19]. Specifically, present-moment awareness may interrupt automatic, threat-driven cognitive processes that amplify distress and facilitate maladaptive appraisals of childbirth experiences. By fostering awareness of internal reactions as transient mental events rather than overwhelming realities, mindfulness may reduce experiential avoidance and excessive cognitive elaboration processes that are central to the consolidation and maintenance of trauma-related memories [20].

Studies have demonstrated that higher levels of mindfulness are associated with reduced symptoms of anxiety, depression, and trauma-related distress across various populations, including postpartum women [19,21] and can improve mother-infant bonding [22]. Cultural context may further shape how psychological distress, mindfulness, and childbirth-related trauma interact. In Chinese sociocultural settings, emotional restraint and endurance are commonly emphasized during the perinatal period, often encouraging internalization rather than overt expression of distress [23]. Such norms may heighten inward-focused attention and bodily awareness among postpartum women [24]. Within this context, mindfulness-related awareness may not uniformly reflect non-judgmental acceptance, but rather increased attention to internal experiences, which may have both adaptive and distress-amplifying effects depending on timing and context [25]. These culturally shaped patterns may influence the longitudinal associations between psychological distress, childbirth trauma, and postpartum PTSD.

Mindfulness plays a positive role in the health of maternal mental health, but the role of mindfulness has not been explored in relation to childbirth trauma or PTSD following childbirth. The dynamic interplay between psychological distress, mindfulness, and postpartum mental health outcomes remains poorly understood, particularly in longitudinal contexts. Existing research predominantly relies on cross-sectional designs, limiting causal inferences and obscuring temporal relationships among variables [21,22]. However, some studies have identified that mindfulness fosters lower levels of postpartum depression [19,26,27], but few studies have examined how fluctuations in psychological distress influence mindfulness over time, nor how these changes predict subsequent childbirth trauma or postpartum PTSD among postpartum women. Within the context of childbirth-related PTSD, mindfulness may therefore be conceptualized as a psychological mechanism that can potentially disrupt the pathogenic pathways linking early psychological distress to childbirth trauma and postpartum PTSD [17]. Guided by the etiological model of childbirth-related PTSD [13] and Beck's theory of traumatic childbirth [14], the present study therefore to examine the temporal associations among psychological distress, mindfulness, childbirth trauma, and postpartum PTSD symptoms across the first three months postpartum and test whether mindfulness mediates these longitudinal pathways.

We hypothesized that: Hypothesis 1 ($T1 \rightarrow T2$): Higher levels of psychological distress at one week postpartum ($T1$) will predict lower levels of mindfulness at one month postpartum ($T2$). Hypothesis 2 ($T2 \rightarrow T3$): Lower levels of mindfulness at one month postpartum ($T2$) will predict higher levels of childbirth trauma and postpartum PTSD symptoms at three months postpartum ($T3$). Hypothesis 3 ($T1 \rightarrow T2 \rightarrow T3$): Mindfulness at $T2$ will statistically account for the longitudinal association between psychological distress at $T1$ and childbirth trauma at $T3$, constituting an indirect pathway from psychological distress to childbirth trauma via mindfulness. Hypothesis 4 ($T1 \rightarrow T2 \rightarrow T3$): Mindfulness at $T2$ will statistically account for the longitudinal association between psychological distress at $T1$ and postpartum PTSD symptoms at $T3$, such that higher psychological distress is indirectly associated with higher PTSD symptoms through reduced mindfulness.

2 Methods

2.1 Study Design

This study employed a quantitative and longitudinal approach to ascertain the prospective relationship between psychological distress, mindfulness, and childbirth trauma or postpartum PTSD among Chinese postpartum women. Data were collected by means of a questionnaire at one week ($T1$), one month ($T2$), and three months ($T3$) postpartum.

2.2 Study Setting

The study was conducted at two general hospitals (Shiyan Taihe Hospital and Shiyan Renmin Hospital) and one maternal and child hospital (Shiyan Maternal and Child Health Hospital) situated in Shiyan City, Hubei Province, central China. Each of these hospitals delivers approximately 1000 newborns annually. These facilities are equipped with obstetric outpatient clinics, delivery rooms, obstetric wards, neonatology units, and maternal and child health care departments to provide comprehensive care for pregnant women and newborns.

2.3 Participants

An a priori power analysis was conducted using Monte Carlo simulation in Mplus 8.3 (Muthén & Muthén, Los Angeles, CA, USA) to evaluate whether the planned three-wave cross-lagged panel model (CLPM) was adequately powered to detect the targeted longitudinal effects. In the population model, standardized autoregressive paths were set to 0.50 and standardized cross-lagged paths to 0.20, reflecting small-to-moderate effects commonly observed in longitudinal research [28]. Using robust maximum likelihood estimation (MLR), 5000 replications, and $\alpha = 0.05$, the simulation with $N = 200$ yielded power of 0.869 for the path from psychological distress at T1 to mindfulness at T2 and 0.906 for the path from mindfulness at T2 to childbirth trauma at T3 (with power = 0.873 for the path from psychological distress at T2 to childbirth trauma at T3). Therefore, a baseline sample size of approximately 200 was deemed sufficient to detect the primary cross-lagged effects that underpin the hypothesized indirect longitudinal pathways. Given the achieved baseline sample size ($N = 210$), the study was considered adequately powered for the main longitudinal analyses.

Convenience sampling was used to recruit eligible postpartum women in one week following delivery. The inclusion criteria for the participants were as follows: (1) age ≥ 18 years; (2) one week postpartum; (3) a singleton pregnancy; (4) absence of fetal anomalies and disorders as determined by ultrasonography during pregnancy; (5) no drug or alcohol addiction; (6) women without psychiatric illness or taking psychiatric medications. The exclusion criteria were: (1) women who experienced stillbirth, neonatal death, or underwent a hysterectomy during delivery; (2) gave birth to a child requiring intensive care, such as neonatal asphyxia; (3) women suffered from severe complications during delivery, such as heart, liver, and kidney dysfunction; (4) planning to have the child adopted.

2.4 Data Collection Procedure

The data collection was conducted over a period from September 2024 to July 2025. Questionnaires were sent via WeChat to postpartum women using the WenJuanXing platform (<https://www.wjx.cn/>) and could be completed directly on smartphones.

2.4.1 Initial Information Dissemination and Consent Acquisition (T1: One Week after Delivery)

At the T1 stage (one week postpartum), eligible participants were approached by an experienced obstetrics nurse who provided both written and verbal information about the study. Key study concepts, including childbirth trauma, were explained in plain language with illustrative examples to ensure comprehension. The nurse emphasized that participation was entirely voluntary, that all data would be kept confidential, and that participants had the right to withdraw from the study at any time without any impact on their medical care. Participants were encouraged to ask questions, which were answered thoroughly by the nurse. After being given sufficient time to consider their participation, women who agreed to take part provided informed consent. For the online survey, informed consent was obtained

electronically prior to questionnaire completion. Participants were invited to add the researcher's WeChat for future communication and follow-up data collection. They then scanned the WenJuanXing QR code via WeChat so they could access and independently complete the electronic questionnaire at T1 on mobile devices, taking about 15–20 min.

2.4.2 Subsequent Data—Collection Time Points

During the subsequent data collection phases (T2 at one month postpartum and T3 at three months postpartum), time-specific WenJuanXing QR codes were sent to participants via WeChat. WeChat messages reminded them of upcoming data collection time points, and they were encouraged to complete the questionnaires at their convenience within the specified time frame for each phase. Each questionnaire took approximately 10 min to fill out at each of these data collection time points. Details on the number of participants and data collected at each time point are shown in Fig. 1.

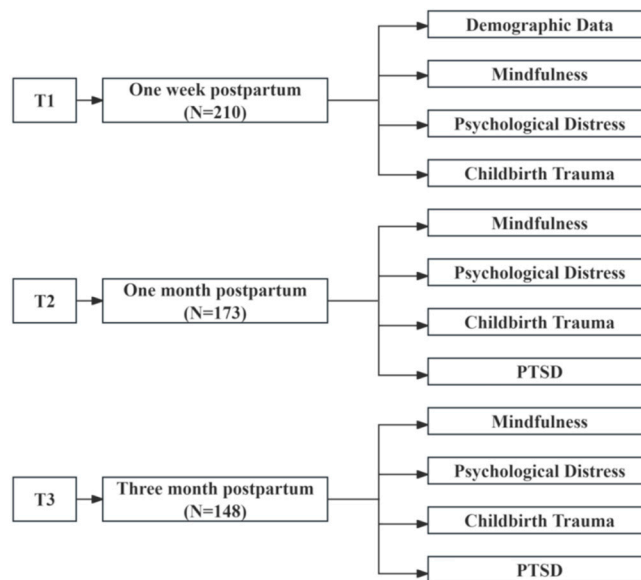


Figure 1: Data collection timeline flowchart.

2.5 Measurements

2.5.1 Demographic Data

Demographic data included sociodemographic variables (age, marital status, primary care providers, education, current residence, payment of medical expenses, total monthly household income), obstetric variables (total number of pregnancies, abortion experience, disease during pregnancy, childbirth training), and delivery outcomes (gestational week at delivery, gender of the newborn, delivery mode, perineal incision, duration from contractions to birth, duration in the delivery room, companion during delivery, perceptions of childbirth as traumatic).

2.5.2 The Mindful Attention Awareness Scale (MAAS)

The Mindful Attention Awareness Scale (MAAS) was utilized to assess *mindfulness* in postpartum women and consists of 15 items [29]. Responses to each item range from “always (1)” to “never (6),” with

scores summed to create a scale score where higher scores indicate greater mindfulness. The Cronbach's α for the Chinese MAAS version is 0.93 [30].

2.5.3 Depression, Anxiety, and Stress Scale-21 Items (DASS-21)

Depression, Anxiety, and Stress Scale-21 items (DASS-21) was used for screening the *psychological distress* symptom severity of the postpartum women. The measurement has 21 questions, with seven items for each of the three subscales: stress (7 items), depression (7 items), and anxiety (7 items) [31]. Responses ranged from 0 (not applicable) to 3 (highly applicable), with higher scores indicating more negative experiences in the past week. The score of each dimension is added up and then multiplied by 2 to obtain the score value of this dimension. The psychological distress score is calculated by summing the total scores of the three dimensions. The higher the total score is, the more serious the psychological distress symptoms are. The Cronbach's α of the Chinese version of DASS-21 was 0.92 [32].

2.5.4 The Birth Trauma Scale (BTS)

The Birth Trauma Scale (BTS) assessed women's *psychological childbirth trauma* after childbirth [33]. It comprised 15 items across four dimensions: "being neglected" (4 items), "out of control" (3 items), "physiological emotional response" (4 items), and "cognitive behavioral response" (4 items). Higher scores reflect higher levels of birth trauma. The total Cronbach's α coefficient of the Chinese scale was 0.874.

2.5.5 The Perinatal Posttraumatic Stress Disorder Questionnaire (PPQ)

The Perinatal Posttraumatic Stress Disorder Questionnaire (PPQ), which was originally developed based on DSM-IV criteria, was used to assess *postpartum PTSD symptom severity* in women [34]. It remains one of the most widely used instruments for assessing childbirth-related PTSD symptoms and has demonstrated good psychometric properties in postpartum populations, including validated Chinese versions [35]. Moreover, the PPQ captures core PTSD symptom domains (e.g., re-experiencing, avoidance, and hyperarousal) and comprises 14 items with a 4-point rating to calculate the total score. Higher scores reflect higher levels of postpartum PTSD. The Cronbach's α coefficient of the Chinese PPQ version was 0.84 [35].

2.6 Statistical Analysis

Data were analyzed using IBM SPSS 27.0 (version 27.0, IBM Corp., Armonk, NY, USA) and Mplus 8.3 (Muthén & Muthén, Los Angeles, CA, USA). A two-tailed p -value of less than 0.05 was regarded as statistically significant.

We described the characteristics of participants using mean (standard deviation) for continuous variables and number (proportion) for categorical variables. Attrition analyses were performed to examine whether baseline characteristics predicted retention at T2 and T3. Retention (retained = 1 vs. lost = 0) was compared using χ^2 /Fisher's exact tests for categorical variables and t tests for continuous variables. As a descriptive indicator of score reliability at each assessment point, internal consistency was evaluated for each scale at T1, T2, and T3. Cronbach's alpha coefficients were calculated separately for psychological distress, mindfulness, childbirth trauma, and postpartum PTSD symptoms at each wave.

The cross-lagged panel model (CLPM) of structural equation modelling was used to examine the mediating effect of mindfulness in the relationships of psychological distress with childbirth trauma or postpartum PTSD. Separate models were specified for childbirth trauma and postpartum PTSD. In the postpartum PTSD model, postpartum PTSD was only measured after childbirth, so the direction was set

from psychological distress (earlier) to postpartum PTSD (later). There were two specified paths in all models: autoregressive paths, controlling for the measures of variables at each prior wave, and cross-lagged paths between psychological distress, mindfulness, childbirth trauma, and postpartum PTSD. Concurrent correlations between variables at the same wave were also specified.

Utilizing the Robust Maximum Likelihood Estimation (MLR) method to construct a CLPM within the framework of structural equation modeling through Mplus 8.3. The model fit was assessed by three indexes: root mean squared error of approximation (RMSEA), comparative fit index (CFI), and Tucker-Lewis index (TLI). CFI/TLI values close to or above 0.90, and RMSEA values close to or below 0.08 were considered indicative of acceptable fit; however, slightly lower incremental fit indices (e.g., TLI > 0.80) were interpreted as acceptable when RMSEA was within an acceptable range, and the constrained model was theoretically and empirically justified [36,37]. To obtain robust estimates and increase the parsimony of the model, we compared the fit indices Loglikelihood between an unconstrained model (Model 1) and a constrained model (Model 2), where equality over time was constrained for all autoregressive and cross-lagged paths. Model fit differences were evaluated by examining changes in Loglikelihood values between the two models with the Chi-Square Test [38]. The Full Information Maximum Likelihood (FIML) was used to handle missing data. The BOOTSTRAP analysis with 5000 iterations was applied to determine the indirect effect, direct effect, and total effect [39]. When all path coefficient tests were performed, the 95% confidence interval (95% CI) did not include zero, and a p -value less than 0.05 indicated a statistically significant difference.

The selection of covariates was guided by prior theoretical models of childbirth-related PTSD and empirical evidence indicating potential confounding effects on both psychological distress and trauma-related outcomes. Based on previous literature and data availability [17], the following baseline variables measured at T1 were considered as potential confounders: maternal age, education level, household income, mode of delivery, pregnancy complications (e.g., gestational diabetes, gestational hypertension, anemia), perceived social support (operationalized by primary caregiver during the perinatal period and companionship during delivery), and attitudes towards whether childbirth is a traumatic event. These variables are plausibly associated with both psychological distress and childbirth trauma/postpartum PTSD and therefore may act as confounders in longitudinal associations.

Given the relatively modest sample size and the complexity of three-wave cross-lagged panel models, including a large number of time-invariant covariates directly in the CLPM could substantially reduce statistical power and model stability. Therefore, covariates were handled using a two-step strategy. First, attrition and baseline comparability across waves were examined to assess systematic differences related to these variables. Second, sensitivity analyses were conducted by adjusting key cross-lagged paths for selected covariates that showed theoretical relevance and sufficient variability. All covariates were measured at baseline (T1) and treated as exogenous variables.

2.7 Ethics Statement

Study participation was entirely voluntary, and all data were collected anonymously to ensure participant privacy. Given the online survey format, participants were informed that clicking on either the “yes” or “no” box on the initial page of the survey to indicate their consent constituted their informed consent for participation. Moreover, participants were informed of their right to withdraw from the study at any time without penalty and were assured that their responses would be kept strictly confidential and would not be disclosed to any third parties. The study was approved by the Ethics Committee of Shiyan Taihe Hospital (Affiliated Hospital of Hubei University of Medicine) (Approval No. 2024KS45).

3 Results

3.1 Characteristics of the Postpartum Women and Attrition Analysis

At T1, one week after delivery, 210 postpartum women participated. Among them, 173 postpartum participants finalized the 1-month postpartum follow-up (T2), and 148 provided responses at the 3-month postpartum interval (T3). The participants' ages ranged from 19 to 38 years old. The average age of the postpartum women was 30.1 ± 3.7 years, and 98.6% were married. The postpartum women's delivery week ranged from 36 to 41 weeks, with an average delivery age of 38.8 ± 0.9 weeks. The other characteristics of the postpartum women are presented in Table 1.

Attrition analyses showed no significant differences between participants retained and those lost to follow-up at either T2 (retained $n = 173$; lost $n = 37$) or T3 (retained $n = 148$; lost $n = 62$) in baseline sociodemographic, obstetric, or childbirth-related characteristics (all $p > 0.05$). These variables included age, gestational week, number of pregnancies, pregnancy complications, delivery mode, neonatal gender, perceived traumatic childbirth, and related delivery experiences (See Table 1 for details).

Table 1: Attrition analysis comparing baseline characteristics of participants across T1, T2, and T3.

Items		T1 (N = 210), Mean ± SD or n (%)					p	T3 (Retained N = 148), T2 (Lost N = 62), Mean ± SD or n (%)				
		T2 (Retained N = 173), Mean ± SD or n (%)		T2 (Lost N = 37), Mean ± SD or n (%)		χ ² /t		T2 (Retained N = 148), Mean ± SD or n (%)		T2 (Lost N = 62), Mean ± SD or n (%)		χ ² /t
Age of pregnant women		30.1 ± 3.7	30.0 ± 3.8	31.0 ± 3.1	-1.60	0.114 ^a	30.1 ± 3.7	30.4 ± 3.6	-0.55	0.583 ^a		
Pregnant week		36.2 ± 1.8	36.1 ± 1.8	36.7 ± 1.8	-1.96	0.055 ^a	36.2 ± 1.8	36.2 ± 1.8	-0.20	0.843 ^a		
Who will take care of you and your baby in the long-term during pregnancy and after delivery	Husband	165 (78.6)	135 (78.0)	30 (81.1)	0.17	0.682 ^c	116 (78.4)	49 (79.0)	0.01	0.916 ^c		
	Yourself	102 (48.6)	81 (46.8)	21 (56.8)	1.20	0.272 ^c	72 (48.6)	30 (48.4)	0.00	0.972 ^c		
	Parents	51 (24.3)	44 (25.4)	7 (18.9)	0.70	0.402 ^c	36 (24.3)	15 (24.2)	0.00	0.984 ^c		
	Parents-in-law	117 (55.7)	97 (56.1)	20 (54.1)	0.05	0.823 ^c	81 (54.7)	36 (58.1)	0.20	0.657 ^c		
	Others	9 (4.3)	7 (4.0)	2 (5.4)	0.14	0.660 ^b	6 (4.1)	3 (4.8)	0.07	0.725 ^b		
Current residence	Urban	186 (88.6)	151 (87.3)	35 (94.6)	1.61	0.264 ^b	131 (88.5)	55 (88.7)	0.00	0.967 ^c		
	Town	24 (11.4)	22 (12.7)	2 (5.4)			17 (11.5)	7 (11.3)				
Education level	Junior middle school or below	15 (7.1)	15 (8.7)	0 (0.0)	4.91	0.285 ^b	11 (7.4)	4 (6.5)	0.95	0.934 ^b		
	Senior middle school/technical secondary school/technical school	27 (12.9)	24 (13.9)	3 (8.1)			21 (14.2)	6 (9.7)				
	Junior college	45 (21.4)	36 (20.8)	9 (24.3)			31 (20.9)	14 (22.6)				
	Bachelor's degree	111 (52.9)	88 (50.9)	23 (62.2)			77 (52.0)	34 (54.8)				
	Master's degree or above	12 (5.7)	10 (5.8)	2 (5.4)			8 (5.4)	4 (6.5)				
Total monthly household income (RMB, Yuan)	≤5000	27 (12.9)	24 (13.9)	3 (8.1)	2.60	0.646 ^b	19 (12.8)	8 (12.9)	0.64	0.940 ^b		
	5000–10,000	108 (51.4)	90 (52.0)	18 (48.6)			78 (52.7)	30 (48.4)				
	10,000–15,000	54 (25.7)	41 (23.7)	13 (35.1)			36 (24.3)	18 (29.0)				
	15,000–20,000	15 (7.1)	13 (7.5)	2 (5.4)			11 (7.4)	4 (6.5)				
	≥20,000	6 (2.9)	5 (2.9)	1 (2.7)			4 (2.7)	2 (3.2)				
Medical expenses payment method	Self-funded	51 (24.3)	45 (26.0)	6 (16.2)	2.04	0.423 ^b	37 (25.0)	14 (22.6)	0.17	0.919 ^c		
	Rural or urban resident medical treatment	21 (10.0)	18 (10.4)	3 (8.1)			15 (10.1)	6 (9.7)				
	Employee medical insurance	138 (65.7)	110 (63.6)	28 (75.7)			96 (64.9)	42 (67.7)				
Total number of pregnancies	1	114 (54.3)	94 (54.3)	20 (54.1)	1.48	0.477 ^c	79 (53.4)	35 (56.5)	0.82	0.663 ^c		
	2	63 (30.0)	54 (31.2)	9 (24.3)			47 (31.8)	16 (25.8)				
	≥3	33 (15.7)	25 (14.5)	8 (21.6)			22 (14.9)	11 (17.7)				

Table 1: Cont.

Items		T1 (N = 210), Mean ± SD or n (%)			T2 (Retained N = 173), Mean ± SD or n (%)			T2 (Lost N = 37), Mean ± SD or n (%)			χ^2/t	p	T3 (Retained N = 148), Mean ± SD or n (%)			T2 (Lost N = 62), Mean ± SD or n (%)			χ^2/t	p
Abortion experience	Yes	75 (35.7)	60 (34.7)	15 (40.5)	0.46	0.500 ^c	53 (35.8)	22 (35.5)	0.00	0.964 ^c	No	135 (64.3)	113 (65.3)	22 (59.5)	95 (64.2)	40 (64.5)				
	Whether you have gestational hypertension during pregnancy	Yes	15 (7.1)	11 (6.4)			4 (10.8)	0.91			0.309 ^b	11 (7.4)	4 (6.5)	0.06	>0.99 ^b	No	195 (92.9)	162 (93.6)	33 (89.2)	137 (92.6)
Whether you have gestational diabetes during pregnancy	Yes	60 (28.6)	54 (31.2)	6 (16.2)	3.36	0.067 ^c	43 (29.1)		17 (27.4)	0.06		0.811 ^c	No			150 (71.4)	119 (68.8)	31 (83.8)	105 (70.9)	45 (72.6)
Whether you have anemia during pregnancy	Yes	87 (41.4)	68 (39.3)	19 (51.4)			1.82	0.177 ^c	61 (41.2)		26 (41.9)		0.01	0.923 ^c	No	123 (58.6)	105 (60.7)	18 (48.6)	87 (58.8)	36 (58.1)
Whether there is intrahepatic cholestasis of pregnancy during pregnancy	Yes	6 (2.9)	4 (2.3)	2 (5.4)	1.05	0.286 ^b			4 (2.7)	2 (3.2)	0.04	>0.99 ^b			No	204 (97.1)	169 (97.7)	35 (94.6)	144 (97.3)	60 (96.8)
	Whether it is placenta previa	Yes	36 (17.1)	27 (15.6)			9 (24.3)	1.63	0.202 ^c	24 (16.2)			12 (19.4)	0.30	0.582 ^c	No	174 (82.9)	146 (84.4)	28 (75.7)	124 (83.8)
Whether you have participated in childbirth training classes held by a hospital before delivery	Yes	12 (5.7)	12 (6.9)	0 (0.0)	2.72	0.131 ^b	10 (6.8)			2 (3.2)	1.01	0.516 ^b	No			198 (94.3)	161 (93.1)	37 (100.0)	138 (93.2)	60 (96.8)
	Gender of the newborn	Female	120 (57.1)	99 (57.2)			21 (56.8)	0.00	0.958 ^c	85 (57.4)			35 (56.5)	0.02	0.896 ^c	Male	90 (42.9)	74 (42.8)	16 (43.2)	63 (42.6)
Whether the gender of the newborn meets your expectations		Yes	192 (91.4)	159 (91.9)	33 (89.2)	0.29	0.530 ^b			136 (91.9)	56 (90.3)	0.14	0.711 ^c			No	18 (8.6)	14 (8.1)	4 (10.8)	12 (8.1)
Delivery mode	Natural vaginal delivery	75 (35.7)	60 (34.7)	15 (40.5)	5.34			0.120 ^b	52 (35.1)	23 (37.1)	0.21			0.971 ^b	Planned cesarean section	99 (47.1)	82 (47.4)	17 (45.9)	71 (48.0)	28 (45.2)
	Vaginal conversion to cesarean section delivery	12 (5.7)	8 (4.6)	4 (10.8)		8 (5.4)	4 (6.5)													
	Emergency cesarean section	24 (11.4)	23 (13.3)	1 (2.7)		17 (11.5)	7 (11.3)													

Table 1: Cont.

Items		T1 (N = 210), Mean ± SD or n (%)	T2 (Retained N = 173), Mean ± SD or n (%)	T2 (Lost N = 37), Mean ± SD or n (%)	χ^2/t	<i>p</i>	T3 (Retained N = 148), Mean ± SD or n (%)	T2 (Lost N = 62), Mean ± SD or n (%)	χ^2/t	<i>p</i>
Whether there was a lateral perineal incision (Natural vaginal delivery)	Yes	48 (64.0)	38 (63.3)	10 (66.7)	0.06	0.810 ^c	33 (63.5)	15 (65.2)	0.02	0.884 ^c
	No	27 (36.0)	22 (36.7)	5 (33.3)			19 (36.5)	8 (34.8)		
From the onset of stomach pain (contractions) to the birth of the baby, it took approximately hours¹		17.8 ± 12.6	16.9 ± 12.3 (n = 60)	21.4 ± 14.0 (n = 15)	-1.13	0.274 ^a	17.7 ± 12.5 (n = 52)	18.1 ± 13.2 (n = 23)	-0.13	0.899 ^a
You have been in the delivery room (waiting room and delivery room) for about hours¹		8.1 ± 4.7	8.1 ± 4.9 (n = 60)	8.2 ± 4.1 (n = 15)	-0.09	0.926 ^a	8.2 ± 4.7 (n = 52)	8.0 ± 5.0 (n = 23)	0.14	0.890 ^a
Who accompanied you during the delivery process (Natural vaginal delivery)	Nobody	12 (16.0)	10 (16.7)	2 (13.3)	0.42	0.715 ^b	9 (17.3)	3 (13.0)	0.22	0.885 ^b
	Husband	60 (80.0)	48 (80.0)	12 (80.0)			41 (78.8)	19 (82.6)		
	Others	3 (4.0)	2 (3.3)	1 (6.7)			2 (3.8)	1 (4.3)		
Perceptions of childbirth as traumatic	Yes	135 (64.3)	113 (65.3)	22 (59.5)	0.46	0.500 ^c	95 (64.2)	40 (64.5)	0.00	0.964 ^c
	No	75 (35.7)	60 (34.7)	15 (40.5)			53 (35.8)	22 (35.5)		

Note: Table 1 presents a formal attrition analysis comparing participants retained at each follow-up wave. All variables were measured at baseline (T1). Percentages may sum to more than 100% because the variable (e.g., caregivers during pregnancy and postpartum) allowed multiple responses and were not mutually exclusive. a: independent samples *t*-test; b: Fisher's exact test if the expected frequency is less than 5; c: Pearson. χ^2 test. ¹: The participants filled in how many hours it took.

3.2 Scores and Reliability of Study Variables across Time

Cronbach's alpha coefficients for all study measures at each assessment point are presented in Table 2. Internal consistency was acceptable to good across T1, T2, and T3 for psychological distress, mindfulness, childbirth trauma, and postpartum PTSD symptoms (all $\alpha \geq 0.80$), indicating adequate internal consistency of the scales at each assessment point. The means and standard deviations for all variables across the three time points are shown in Table 2.

Table 2: The scores and internal consistency (Cronbach's α) of study variables across three time points.

Variable	Time	N	Mean \pm SD	Cronbach's α
DASS-21	T1	210	17.23 \pm 7.08	0.879
	T2	173	18.18 \pm 7.30	0.832
	T3	148	21.19 \pm 12.04	0.817
MAAS	T1	210	70.93 \pm 11.64	0.901
	T2	173	71.46 \pm 16.09	0.893
	T3	148	64.18 \pm 23.43	0.876
BTS	T1	210	26.19 \pm 9.85	0.895
	T2	173	23.30 \pm 8.77	0.873
	T3	148	24.61 \pm 12.21	0.882
PPQ	T2	173	10.11 \pm 4.13	0.925
	T3	148	9.43 \pm 4.36	0.845

Note: Cronbach's alpha coefficients were calculated separately at each assessment point. T1 = 1 week postpartum; T2 = 1 month postpartum; T3 = 3 months postpartum. DASS-21, Depression, Anxiety, and Stress Scale-21 items; MAAS, The Mindful Attention Awareness Scale; BTS, The Birth Trauma Scale; PPQ, The Perinatal Posttraumatic Stress Disorder Questionnaire.

3.3 Bidirectional Longitudinal Associations between Psychological Distress and Childbirth Trauma: Evidence for Inconsistent Mediation via Mindfulness

In this model, we utilized the adjusted model, which incorporates the following covariates: maternal age, education level, household income, mode of delivery, pregnancy complications (e.g., gestational diabetes, gestational hypertension, anemia), perceived social support (operationalized by primary caregiver during the perinatal period and companionship during delivery), and attitudes towards whether childbirth is a traumatic event. A comparison of the unconstrained and constrained cross-lagged panel models indicated no significant difference in model fit ($p > 0.05$). Therefore, the constrained model was retained for reasons of parsimony, although the fit indices indicated only modest model fit rather than strong fit ($\chi^2/df = 3.67$, $p < 0.001$; RMSEA = 0.048; CFI = 0.877; TLI = 0.818). Standardized path coefficients are presented in Fig. 2.

Longitudinally, psychological distress demonstrated significant autoregressive stability from T1 to T2 ($\beta = 0.626$, $p < 0.05$) and from T2 to T3 ($\beta = 0.319$, $p < 0.05$). In Hypothesis 1, we hypothesized that higher levels of psychological distress at one week postpartum (T1) would predict lower levels of mindfulness at one month postpartum (T2). However, the study results did not support our research hypothesis. Psychological distress at T1 was positively associated with mindfulness at T2 ($\beta = 0.425$, $p < 0.05$), and this association remained significant from T2 to T3 ($\beta = 0.498$, $p < 0.05$). In addition, higher psychological distress at T2 predicted greater childbirth trauma symptoms at T3 ($\beta = 0.244$, $p < 0.05$), whereas higher mindfulness at T2 predicted lower childbirth trauma symptoms at T3 ($\beta = -0.259$, $p < 0.05$). This result was consistent with our Hypothesis 2 (Lower levels of mindfulness at one month postpartum (T2) will predict higher levels of childbirth trauma at three months postpartum (T3)).

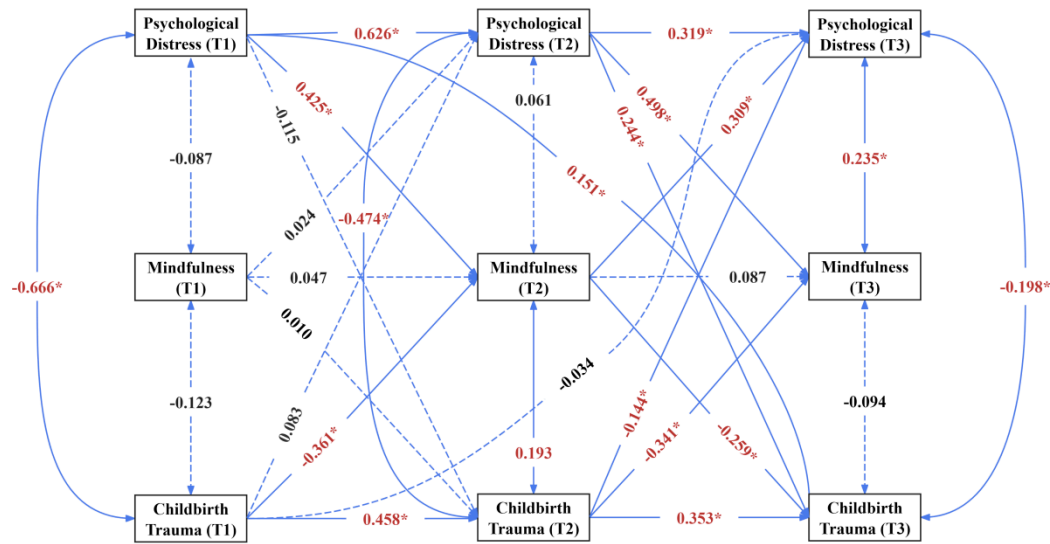


Figure 2: Longitudinal association between psychological distress, mindfulness, and childbirth trauma. Note: Values represent standardized path coefficients. For parsimony, autoregressive and cross-lagged paths were constrained to be equal across time ($*p < 0.05$). Black figures indicate no statistical significance, and red figures indicate statistical significance. A dashed line indicates no statistical significance, and a solid line indicates statistical significance.

Mediation analyses revealed an inconsistent mediation pattern in the longitudinal association between psychological distress and childbirth trauma. Specifically, psychological distress at T1 had a significant positive direct effect on childbirth trauma at T3 ($\beta = 0.151$, 95% CI [0.030, 0.272]). At the same time, psychological distress at T1 was indirectly associated with lower childbirth trauma at T3 through increased mindfulness at T2, resulting in a significant negative indirect effect ($\beta = -0.110$, 95% CI [-0.188, -0.037]). These findings supported our research Hypothesis 3 (Mindfulness at T2 will statistically account for the longitudinal association between psychological distress at T1 and childbirth trauma at T3, constituting an indirect pathway from psychological distress to childbirth trauma via mindfulness). Because the direct and indirect effects operated in opposite directions, the total effect of psychological distress at T1 on childbirth trauma at T3 was non-significant ($\beta = 0.041$, 95% CI [-0.158, 0.240]).

In the reverse direction, childbirth trauma also showed significant autoregressive paths from T1 to T2 ($\beta = 0.458$, $p < 0.05$) and from T2 to T3 ($\beta = 0.353$, $p < 0.05$). Higher childbirth trauma at T1 predicted lower mindfulness at T2 ($\beta = -0.361$, $p < 0.05$), and lower mindfulness at T2 was associated with higher psychological distress at T3 ($\beta = 0.309$, $p < 0.05$). The indirect effect of childbirth trauma at T1 on psychological distress at T3 via mindfulness at T2 was significant ($\beta = -0.112$, 95% CI [-0.177, -0.054]); however, neither the direct effect ($\beta = -0.034$, 95% CI [-0.153, 0.085]) nor the total effect ($\beta = -0.146$, 95% CI [-0.308, 0.016]) reached statistical significance (details in Table 3).

3.4 Indirect Longitudinal Association between Psychological Distress and Postpartum PTSD via Mindfulness

For the model examining postpartum PTSD, we utilized the adjusted model, which incorporates the following covariates: maternal age, education level, household income, mode of delivery, pregnancy complications (e.g., gestational diabetes, gestational hypertension, anemia), perceived social support (operationalized by primary caregiver during the perinatal period and companionship during delivery), and attitudes towards whether childbirth is a traumatic event. In this model, the constrained model did not

differ significantly from the unconstrained model in terms of fit ($p > 0.05$) and was therefore retained for reasons of parsimony. The fit indices of the final model indicated modest overall fit ($\chi^2/df = 4.30$, $p < 0.001$; RMSEA = 0.051; CFI = 0.880; TLI = 0.871). Standardized path coefficients are shown in Fig. 3.

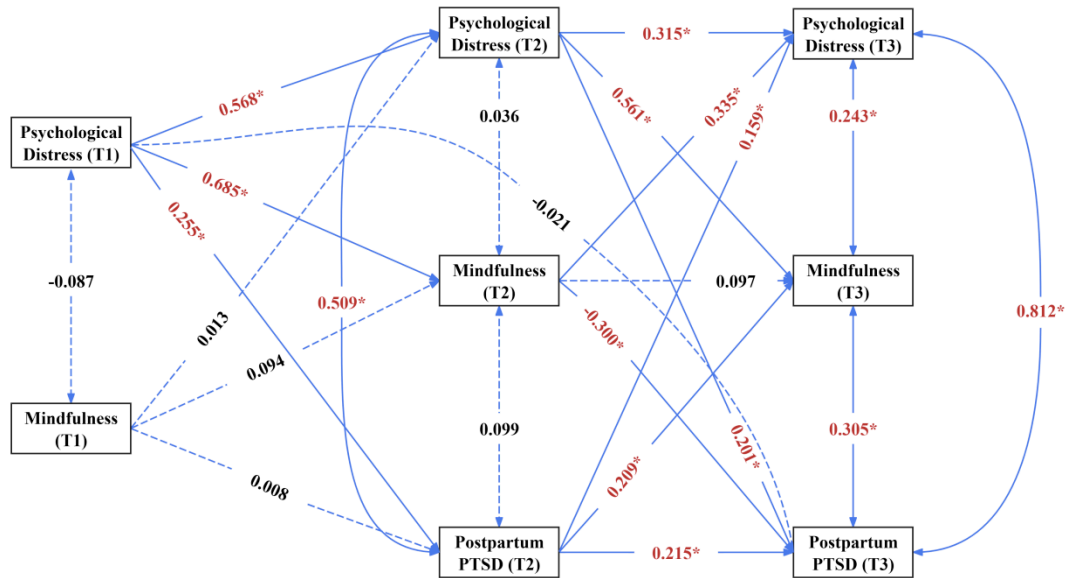


Figure 3: Longitudinal association between psychological distress, mindfulness, and postpartum PTSD. Note: Values represent standardized path coefficients. For parsimony, autoregressive and cross-lagged paths were constrained to be equal across time ($*p < 0.05$). Black figures indicate no statistical significance, and red figures indicate statistical significance. A dashed line indicates no statistical significance, and a solid line indicates statistical significance.

Psychological distress showed significant autoregressive stability over time and was positively associated with mindfulness from T1 to T2 ($\beta = 0.685$, $p < 0.05$) and from T2 to T3 ($\beta = 0.561$, $p < 0.05$). Higher mindfulness at T2 was associated with lower postpartum PTSD symptoms at T3 ($\beta = -0.201$, $p < 0.05$). This result was consistent with our Hypothesis 2 (Lower levels of mindfulness at one month postpartum (T2) will predict higher levels of postpartum PTSD symptoms at three months postpartum (T3)).

Mediation analysis indicated a significant indirect longitudinal association between psychological distress and postpartum PTSD via mindfulness. Psychological distress at T1 did not exert a significant direct effect on postpartum PTSD at T3 ($\beta = -0.021$, 95% CI [-0.113, 0.073]). However, psychological distress at T1 was indirectly associated with postpartum PTSD at T3 through mindfulness at T2, yielding a significant indirect effect ($\beta = -0.206$, 95% CI [-0.310, -0.101]). The total effect of psychological distress at T1 on postpartum PTSD at T3 was also significant ($\beta = -0.227$, 95% CI [-0.389, -0.065]). Together with the significant indirect effect and non-significant direct effect, these findings are consistent with an indirect longitudinal association via mindfulness, although a strong causal mediation interpretation should be avoided given the CLPM framework and the modest model fit (details in Table 3). Research Hypothesis 4 was partially supported by this result. The existence of an indirect pathway from psychological distress at T1 and postpartum PTSD symptoms at T3 through mindfulness at T2 was supported, but the direction contradicted the original hypothesis.

Table 3: Statistical results of the longitudinal mediation.

Pathway	Indirect Effect		Direct Effect		Total Effect	
	β	95%CI	β	95%CI	β	95%CI
The Model: Psychological distress, Mindfulness, and Childbirth trauma						
Psychological Distress (T1) → Mindfulness (T2) → Childbirth Trauma (T3)	-0.110	-0.188, -0.037	0.151	0.030, 0.272	0.041	-0.158, 0.240
Childbirth Trauma (T1) → Mindfulness (T2) → Psychological Distress (T3)	-0.112	-0.177, -0.054	-0.034	-0.153, 0.085	-0.146	-0.308, 0.016
The Model: Psychological Distress, Mindfulness, and Postpartum PTSD						
Psychological Distress (T1) → Mindfulness (T2) → Postpartum PTSD (T3)	-0.206	-0.310, -0.101	-0.021	-0.113, 0.073	-0.227	-0.389, -0.065

4 Discussion

From the results, we found that mindfulness demonstrated a complex mediating role throughout the postpartum period. Psychological distress at T1 showed a significant negative indirect association with childbirth trauma at T3 via mindfulness at T2 ($\beta = -0.110$, 95% CI $[-0.188, -0.037]$), while simultaneously exerting a positive direct effect ($\beta = 0.151$, 95% CI $[0.030, 0.272]$), resulting in an inconsistent mediation pattern ($\beta = 0.041$, 95% CI $[-0.158, 0.240]$). In contrast, psychological distress at T1 showed a significant indirect longitudinal association with postpartum PTSD symptoms at T3 via mindfulness at T2 ($\beta = -0.206$, 95% CI $[-0.310, -0.101]$). This pattern was consistent with mediation, although the findings should be interpreted cautiously given the CLPM framework and the modest model fit.

4.1 Mindfulness as a Dynamic Mechanism across the Postpartum Period

Rather than serving as a uniformly protective psychological resource, mindfulness emerged in this study as a dual-function construct embedded in a complex longitudinal system linking psychological distress, childbirth trauma, and postpartum PTSD. Across three postpartum time points, mindfulness simultaneously operated as (1) a protective pathway that attenuated the progression from early psychological distress to later trauma-related outcomes, and (2) a vulnerable target that was eroded by childbirth trauma and, under certain conditions, associated with subsequent psychological distress.

The results showed that mindfulness statistically mediated the longitudinal association between T1 distress and T3 childbirth trauma, but the significant indirect effect was negative ($\beta = -0.110$) and opposed the positive direct effect ($\beta = 0.151$), yielding an inconsistent mediation pattern with a non-significant total effect. This indicates that Hypothesis 3 was supported. This pattern was most clearly reflected in the inconsistent mediation observed between psychological distress and childbirth trauma, where a positive direct effect of distress on trauma coexisted with a negative indirect effect via mindfulness, resulting in a null total effect. Hypothesis 4 was partially supported in that a significant indirect effect via mindfulness was observed; however, the direction of this effect contradicted the original hypothesis. Thus, the findings are consistent with an indirect longitudinal association between psychological distress and postpartum PTSD via mindfulness, rather than supporting a strong claim of full mediation. Together, these findings suggest that mindfulness does not function as a static trait with uniformly salutary effects, but rather as a dynamic, context-sensitive process whose psychological meaning and consequences may shift across the postpartum period [40,41].

4.2 Interpreting the Distress–Mindfulness Association

Hypothesis 1 (T1 psychological distress \rightarrow lower T2 mindfulness) is not supported by the results from this study. Instead, higher psychological distress predicts higher subsequent mindfulness as measured by the MAAS [42], in both models (T1 \rightarrow T2 $\beta = 0.425$; $\beta = 0.685$). This suggests that psychological distress may be accompanied by increased present-moment attention that is not necessarily acceptance-based. At face value, this result appears to contradict dominant theoretical models that conceptualize mindfulness as an inverse correlate of distress. However, a closer, measurement-informed interpretation suggests that this association may not reflect an increase in adaptive mindfulness, but rather a change in the quality of present-moment attention captured by the MAAS [43].

The MAAS primarily assesses the frequency of attention to present-moment experience, with items reverse-scored to indicate less automaticity and greater moment-to-moment awareness [44]. Importantly, it does not directly assess the attitudinal components of mindfulness—such as non-judgment, acceptance, or compassion—that are central to mindfulness-based interventions [45]. Consequently, elevated MAAS scores in highly distressed postpartum women may reflect heightened self-focused attention, hypervigilance to bodily and emotional states, or painful awareness of ongoing distress, rather than an acceptance-based or decentered form of mindfulness [22].

From this perspective, increased mindfulness following psychological distress may represent a state of distress-driven attentional narrowing, in which women become acutely attuned to internal sensations, intrusive thoughts, and emotional fluctuations during the vulnerable early postpartum period [46]. Such heightened awareness is theoretically compatible with trauma-related processes, including threat monitoring and somatic vigilance, and may coexist with emotional suffering rather than alleviate it [11]. This interpretation helps reconcile the present finding with the reverse longitudinal pathway observed in this study, whereby childbirth trauma predicted lower subsequent mindfulness, suggesting that once distress escalates into trauma, even this heightened attentional capacity may fragment or collapse.

Thus, the apparent contradiction dissolves when mindfulness is understood not as a monolithic protective trait, but as a multifaceted attentional process whose adaptiveness depends on the presence of acceptance, emotional regulation capacity, and contextual support.

4.3 Theoretical Implications for the Childbirth-Related PTSD Model

These nuanced findings align closely with contemporary theoretical frameworks of childbirth-related PTSD [47]. According to the aetiology of post-traumatic stress following childbirth, psychological vulnerability factors and postnatal cognitive-emotional processes jointly shape whether distress consolidates into trauma-related pathology. Although the results support Hypothesis 2 (lower T2 mindfulness \rightarrow higher T3 childbirth trauma/PTSD), as mindfulness at T2 negatively predicted childbirth trauma at T3 ($\beta = -0.259$) and postpartum PTSD symptoms at T3 ($\beta = -0.201$), mindfulness-related processes—particularly attentional deployment and emotional processing—are not inherently protective from the perspective of the overall research findings. Instead, they may either interrupt or amplify trauma pathways depending on how internal experiences are attended to and interpreted [21].

Similarly, the middle-range theory of traumatic childbirth emphasizes the cascading “ripple effects” of traumatic birth experiences, extending from immediate emotional responses to longer-term disruptions in self-concept, maternal functioning, and relational processes [14]. Within this framework, the present findings suggest that mindfulness occupies a pivotal position: when awareness is accompanied by acceptance, it may buffer the ripple effects of early distress; when awareness is unaccompanied by acceptance, it may instead intensify emotional exposure and vulnerability [41].

Importantly, the significant indirect longitudinal association observed in the postpartum PTSD model suggests that mindfulness may represent one potential mechanism linking early psychological distress with later PTSD symptoms [48], although this interpretation should remain cautious. This underscores the theoretical relevance of integrating mindfulness-related processes into etiological models of childbirth-related PTSD, not as a uniformly protective factor, but as a conditional mechanism whose effects depend on its qualitative characteristics.

4.4 Clinical Implications for Trauma-Informed Mindfulness Interventions

The clinical implications of these findings are inherently nuanced. While mindfulness-based approaches hold promise for mitigating postpartum trauma-related outcomes [45,48], the present results caution against assuming that increases in mindfulness—particularly as measured by attentional awareness alone—are invariably beneficial.

First, interventions should explicitly distinguish awareness from acceptance [49]. Early postpartum women experiencing high psychological distress may already possess heightened awareness of internal states; introducing mindfulness practices that further intensify attention without adequate scaffolding may risk amplifying distress in the short term [50]. Trauma-informed mindfulness interventions should therefore emphasize grounding, self-compassion, and emotional safety, rather than sustained inward attention alone [49].

Second, the timing of mindfulness interventions appears critical. For women with elevated distress but limited trauma exposure, cultivating acceptance-based mindfulness may prevent the progression toward childbirth trauma and PTSD [20]. In contrast, for women with pronounced childbirth trauma, phased or integrative approaches that combine mindfulness with cognitive-behavioral or stabilization strategies may be more appropriate, acknowledging the potential for transient symptom exacerbation [51].

Finally, clinicians should be attentive to individual differences in how mindfulness is experienced and expressed, particularly within cultural contexts that emphasize emotional restraint and internalization [52]. Mindfulness-based care in postpartum populations should therefore be flexible, culturally sensitive, and responsive to women's evolving psychological states across the postpartum trajectory.

4.5 Limitations and Future Directions

This study has several limitations that should be acknowledged. First, attrition across the three measurement waves was non-trivial, with approximately 30% of participants lost by the final follow-up. Although baseline attrition analyses did not reveal significant differences in observed characteristics, and FIML was used to handle missing data under the MAR assumption, selective dropout related to unmeasured psychological or contextual variables cannot be ruled out. This may limit the generalizability of the findings and bias longitudinal estimates.

Second, our study relied on self-report measures, which may be subject to response biases. Postpartum PTSD symptoms were assessed using the PPQ, which is based on DSM-IV criteria rather than DSM-5. Although the PPQ has been widely used and validated in postpartum populations, including in China, it may not fully capture DSM-5-specific symptom clusters (e.g., negative alterations in cognition and mood). Therefore, the findings should be interpreted as reflecting trauma-related symptom severity rather than formal DSM-5 PTSD diagnoses.

Third, although three-wave cross-lagged panel models (CLPM) enabled the examination of temporal associations among key variables, a fundamental limitation of traditional CLPM is that it conflates within-person change and between-person differences. Consequently, the observed cross-lagged effects

may partly reflect stable individual differences rather than pure intra-individual dynamics, particularly for constructs such as mindfulness and psychological distress that contain both trait-like and state-like components.

Lastly, we did not formally test longitudinal measurement invariance (configural/metric/scalar) for the scales across T1–T3. Cronbach's α reflects internal consistency but does not establish invariance; therefore, because we used observed total scores, changes over time and cross-lagged/indirect effects should be interpreted cautiously as they may be influenced by time-varying item functioning or response thresholds. Future work should examine item-level CFA invariance (at least configural/metric/scalar, with partial invariance if needed) or model constructs as latent variables in longitudinal SEM. Future studies should apply modeling approaches that explicitly separate these effects, such as the Random Intercept Cross-Lagged Panel Model (RI-CLPM), and include more measurement waves to more precisely capture within-person processes underlying postpartum psychological adjustment.

5 Conclusions

This study advances understanding of postpartum mental health by mapping the dynamic, longitudinal mediation pathways linking psychological distress, mindfulness, childbirth trauma, and postpartum PTSD. The findings demonstrate that mindfulness functions as a central but non-uniform mechanism, simultaneously buffering trauma-related outcomes while remaining sensitive to the disruptive effects of childbirth trauma. Importantly, the results highlight a critical caveat in interpreting mindfulness in this context. Higher mindfulness scores following psychological distress may reflect heightened attentional vigilance rather than adaptive, acceptance-based mindfulness, underscoring the complexity of measuring and conceptualizing mindfulness in the postpartum period. Future research should refine mindfulness measurement and apply longitudinal models that better disentangle within-person processes. Clinically, trauma-informed and timing-sensitive mindfulness interventions are needed to ensure that increased awareness supports, rather than exacerbates, postpartum psychological adjustment.

Acknowledgement: The authors would like to extend their deepest gratitude to the pregnant and postpartum women who generously participated in this study and provided the foundation for our research. Their willingness to share their experiences has been crucial in advancing our understanding of childbirth trauma. We are also profoundly thankful to the medical staff at the participating hospitals for their invaluable support and cooperation throughout the data collection process. Additionally, we acknowledge the significant contributions of graduate students Jinhui Li and Lvman Xiao, who diligently collected the data that made this study possible. Without their dedication and hard work, this research would not have been completed. We are truly grateful for their efforts and commitment.

Funding Statement: This study was supported by the Science Research Foundation of Department of Education of Hubei Province (B2024106) and the Natural Science Foundation of Hubei Province, China (2025AFB537).

Author Contributions: The individual contribution of each of the authors in the study: Xiaofei Nie: Research Design, Data Collection and Analysis, Writing—original draft. Amir Pakpour: Research Design, Conceptualization, Data Analysis, Methodology. Yanqiong Ouyang: Research Design, Methodology, Validation, Supervision. Maria Björk: Research Design, Conceptualization, Writing—review & editing, Supervision. All authors reviewed and approved the final version of the manuscript.

Availability of Data and Materials: The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Ethics Approval: Study participation was entirely voluntary, and all data were collected anonymously to ensure participant privacy. Given the online survey format, participants were informed that clicking on either the “yes” or “no” box on the initial page of the survey to indicate their consent constituted their informed consent for participation.

Moreover, participants were informed of their right to withdraw from the study at any time without penalty and were assured that their responses would be kept strictly confidential and would not be disclosed to any third parties. The study was approved by the Ethics Committee of Shiyan Taihe Hospital (Affiliated Hospital of Hubei University of Medicine) (Approval No. 2024KS45).

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Kuipers Y, Thomson G, Škodová Z, Bozic I, Lísá Sigurðardóttir V, Goberna-Tricas J, et al. A multidisciplinary evaluation, exploration, and advancement of the concept of a traumatic birth experience. *Women Birth*. 2024;37(1):51–62. [[CrossRef](#)].
2. Beck CT. Lexicon of metaphors: an innovative approach to detect the aftermath of traumatic childbirth. *Issues Ment Health Nurs*. 2023;44(5):366–72. [[CrossRef](#)].
3. Liu X, Wang S, Wang G. Prevalence and risk factors of postpartum depression in women: a systematic review and meta-analysis. *J Clin Nurs*. 2022;31(19–20):2665–77. [[CrossRef](#)].
4. O’Dea GA, Youssef GJ, Hagg LJ, Francis LM, Spry EA, Rossen L, et al. Associations between maternal psychological distress and mother-infant bonding: a systematic review and meta-analysis. *Arch Womens Ment Health*. 2023;26(4):441–52. [[CrossRef](#)].
5. Lai X, Chen J, Li H, Zhou L, Huang Q, Liao Y, et al. The incidence of post-traumatic stress disorder following traumatic childbirth: a systematic review and meta-analysis. *Int J Gynaecol Obstet*. 2023;162(1):211–21. [[CrossRef](#)].
6. Horsch A, Garthus-Niegel S, Ayers S, Chandra P, Hartmann K, Vaisbuch E, et al. Childbirth-related posttraumatic stress disorder: definition, risk factors, pathophysiology, diagnosis, prevention, and treatment. *Am J Obstet Gynecol*. 2024;230(3S):S1116–27. [[CrossRef](#)].
7. Webb R, Uddin N, Constantinou G, Cheyne H, Ayers S. Prevalence of birth trauma and childbirth-related post-traumatic stress disorder in UK women: results from the international survey of childbirth-related trauma. *Women’s Reprod Health*. 2025:1–12. [[CrossRef](#)].
8. Nisar A, Yin J, Waqas A, Bai X, Wang D, Rahman A, et al. Prevalence of perinatal depression and its determinants in Mainland China: a systematic review and meta-analysis. *J Affect Disord*. 2020;277:1022–37. [[CrossRef](#)].
9. Wang Y, Liu C, Sun Y, Yuan Y, Chen L. The mediating role of coping style in the relationship between fear of childbirth and psychological birth trauma among natural childbirth women in China: a structural equation model analysis. *BMC Pregnancy Childbirth*. 2025;25(1):18. [[CrossRef](#)].
10. Nie XF, Xu LL, Guo WP, Li JH, Cheng L, Zhang TT, et al. Unveiling postpartum PTSD: predicting risk factors using decision trees and logistic regression in Chinese women. *BMC Psychiatry*. 2025;25(1):798. [[CrossRef](#)].
11. Wei W, Feng X, Qin H, Yang X. Perception of traumatic childbirth of women, influencing factors and its relationship with post-traumatic stress disorder. *Front Public Health*. 2025;12:1485766. [[CrossRef](#)].
12. Sun X, Fan X, Cong S, Wang R, Sha L, Xie H, et al. Psychological birth trauma: a concept analysis. *Front Psychol*. 2023;13:1065612. [[CrossRef](#)].
13. Ayers S, Bond R, Bertullies S, Wijma K. The aetiology of post-traumatic stress following childbirth: a meta-analysis and theoretical framework. *Psychol Med*. 2016;46(6):1121–34. [[CrossRef](#)].
14. Beck CT. Middle range theory of traumatic childbirth: the ever-widening ripple effect. *Glob Qual Nurs Res*. 2015;2:2333393615575313. [[CrossRef](#)].
15. Ozcalik HB, Aksoy YE. The relationship between maternal functioning and birth memory and trauma. *Midwifery*. 2024;132:103974. [[CrossRef](#)].
16. Peng Z, Liu J, Liu B, Zhou J, Zhang L, Zhang Y. Psychological interventions to pregnancy-related complications in patients with post-traumatic stress disorder: a scoping review. *BMC Psychiatry*. 2024;24(1):478. [[CrossRef](#)].
17. Ayers S, Horsch A, Garthus-Niegel S, Nieuwenhuijze M, Bogaerts A, Hartmann K, et al. Traumatic birth and childbirth-related post-traumatic stress disorder: international expert consensus recommendations for practice, policy, and research. *Women Birth*. 2024;37(2):362–7. [[CrossRef](#)].
18. Brown KW, Ryan RM, Creswell JD. Mindfulness: theoretical foundations and evidence for its salutary effects. *Psychol Inq*. 2007;18(4):211–37. [[CrossRef](#)].

19. Mennitto S, Ditto B, Da Costa D. The relationship of trait mindfulness to physical and psychological health during pregnancy. *J Psychosom Obstet Gynaecol*. 2021;42(4):313–9. [[CrossRef](#)].
20. Kachadourian LK, Harpaz-Rotem I, Tsai J, Southwick S, Pietrzak RH. Mindfulness as a mediator between trauma exposure and mental health outcomes: results from the National Health and Resilience in Veterans Study. *Psychol Trauma*. 2021;13(2):223–30. [[CrossRef](#)].
21. Leyland AF, Boekhorst MGBM, Offermans JE, Emerson LM, Hulsbosch LP, Potharst ES. The protective value of trait mindfulness for mothers' anxiety during the perinatal period. *Acta Psychol*. 2023;240:104034. [[CrossRef](#)].
22. Boekhorst MGBM, de Waal N, Smit L, Hulsbosch LP, van den Heuvel MI, Schwabe I, et al. A longitudinal study on the association between trait mindfulness and maternal bonding across the perinatal period. *J Reprod Infant Psychol*. 2025;43(5):1197–213. [[CrossRef](#)].
23. Xin JKY, Shian GY, Han TT, San WTW. Experiences of postpartum Chinese women undergoing confinement practices: a qualitative meta-synthesis. *Int J Nurs Pract*. 2024;30(6):e13251. [[CrossRef](#)].
24. Nan Y, Yang L, Nisar A, Zhang J, Gao Y, Zhang M, et al. Psychological dilemmas and distress among Chinese primiparas during the postpartum transition underlying implicit cultural norms: a phenomenological inquiry. *BMC Psychol*. 2025;13(1):911. [[CrossRef](#)].
25. Keng SL, Smoski MJ, Robins CJ. Effects of mindfulness on psychological health: a review of empirical studies. *Clin Psychol Rev*. 2011;31(6):1041–56. [[CrossRef](#)].
26. Godbout N, Paradis A, Rassart CA, Sadikaj G, Herba CM, Drapeau-Lamothe M. Parents' history of childhood interpersonal trauma and postpartum depressive symptoms: the moderating role of mindfulness. *J Affect Disord*. 2023;325:459–69. [[CrossRef](#)].
27. Kantrowitz-Gordon I, Abbott S, Hoehn R. Experiences of postpartum women after mindfulness childbirth classes: a qualitative study. *J Midwifery Womens Health*. 2018;63(4):462–9. [[CrossRef](#)].
28. Luo X, Liu H, Hu Y. From cross-lagged effects to feedback effects: further insights into the estimation and interpretation of bidirectional relations. *Behav Res Methods*. 2024;56(4):3685–705. [[CrossRef](#)].
29. Olivera-Figueroa LA, Muro A, Feliu-Soler A, Chishima Y, Jankowski KS, Allen MT, et al. The role of time perspective and mindfulness on life satisfaction in the United States of America, Spain, Poland and Japan: a cross-cultural study. *Curr Psychol*. 2023;42(21):17682–99. [[CrossRef](#)].
30. Black DS, Sussman S, Johnson CA, Milam J. Psychometric assessment of the mindful attention awareness scale (MAAS) among Chinese adolescents. *Assessment*. 2012;19(1):42–52. [[CrossRef](#)].
31. Lovibond PF, Lovibond SH. The structure of negative emotional states: comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behav Res Ther*. 1995;33(3):335–43. [[CrossRef](#)].
32. Wang K, Shi HS, Geng FL, Zou LQ, Tan SP, Wang Y, et al. Cross-cultural validation of the depression anxiety stress scale-21 in China. *Psychol Assess*. 2016;28(5):e88–100. [[CrossRef](#)].
33. Zhang K, Wu M, Zeng T, Yuan M, Chen Y, Yang L. Development and psychometric testing of a scale for assessing the psychological birth trauma. *Front Psychol*. 2023;14:1071336. [[CrossRef](#)].
34. DeMier RL, Hynan MT, Harris HB, Manniello RL. Perinatal stressors as predictors of symptoms of posttraumatic stress in mothers of infants at high risk. *J Perinatol*. 1996;16(4):276–80.
35. Zhang D, Zhang J, Gan Q, Wang Q, Fan N, Zhang R, et al. Validating the psychometric characteristics of the perinatal posttraumatic stress disorder questionnaire (PPQ) in a Chinese context. *Arch Psychiatr Nurs*. 2018;32(1):57–61. [[CrossRef](#)].
36. Hu LT, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct Equ Model A Multidiscip J*. 1999;6(1):1–55. [[CrossRef](#)].
37. Wu Y, Kong X, Feng W, Xing F, Zhu S, Lv B, et al. A longitudinal study of the mediator role of physical activity in the bidirectional relationships of cognitive function and specific dimensions of depressive symptoms. *J Affect Disord*. 2024;366:146–52. [[CrossRef](#)].
38. Chen FF. Sensitivity of goodness of fit indexes to lack of measurement invariance. *Struct Equ Model A Multidiscip J*. 2007;14(3):464–504. [[CrossRef](#)].
39. Preacher KJ, Hayes AF. Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behav Res Methods*. 2008;40(3):879–91. [[CrossRef](#)].

40. Bartlett L. Employee stress, mental health, wellbeing and performance [dissertation]. Dynnyrne, Australia: University of Tasmania; 2020.
41. Ma Y, Fang S. Adolescents' mindfulness and psychological distress: the mediating role of emotion regulation. *Front Psychol.* 2019;10:1358. [[CrossRef](#)].
42. Eidman L, Rodriguez de Behrends M, Seif G. Propiedades psicométricas de la Mindful Attention Awareness Scale (MAAS) en estudiantes universitarios argentinos. *CienciasPsi.* 2022;16(1):e-2560. [[CrossRef](#)].
43. Borgdorf KSA, Küchler G, Wrzus C, Aguilar-Raab C. Intervention-induced changes in state mindfulness do not predict trait changes in mindfulness, self-compassion, or perceived stress. *Sci Rep.* 2025;15(1):41174. [[CrossRef](#)].
44. DeMarree KG, Naragon-Gainey K. Individual differences in the contents and form of present-moment awareness: the multidimensional awareness scale. *Assessment.* 2022;29(3):583-602. [[CrossRef](#)].
45. Oskoui BS, Mehrabi E, Nourizadeh R, Esmailpour K. The effect of mindfulness-based counseling on the childbirth experience of primiparous women: a randomized controlled clinical trial. *BMC Pregnancy Childbirth.* 2023;23(1):274. [[CrossRef](#)].
46. Van der Meulen RT, Veringa-Skiba IK, Van Steensel FJA, Bögels SM, De Bruin EI. Mindfulness-based childbirth and parenting for pregnant women with high fear of childbirth and their partners: outcomes of a randomized controlled trial assessing short- and longer-term effects on psychological well-being, birth and pregnancy experience. *Midwifery.* 2023;116:103545. [[CrossRef](#)].
47. Froeliger A, Deneux-Tharoux C, Sutter-Dallay AL, Bouchghoul H, Loussert L, Madar H, et al. Childbirth-related posttraumatic stress disorder and postpartum depression following cesarean delivery. *Am J Obstet Gynecol.* 2026;233(6S):S199-215. [[CrossRef](#)].
48. Min W, Jiang C, Li Z, Wang Z. The effect of mindfulness-based interventions during pregnancy on postpartum mental health: a meta-analysis. *J Affect Disord.* 2023;331:452-60. [[CrossRef](#)].
49. Bahadır Yılmaz E. The effects of mindfulness-based stress reduction program on pregnant women. *J Nurs Care Res.* 2025;2(3):76-80. [[CrossRef](#)].
50. Feitosa FVV, da Silva RM, de Oliveira Carvalho WB, Paixão DP, Herculano MMS, Presado MHCV, et al. Mindfulness practices for alleviating distress among postpartum women. *Rev Bras Enferm.* 2025;78(suppl 3):e20240525. [[CrossRef](#)].
51. Furuta M, Horsch A, Ng ESW, Bick D, Spain D, Sin J. Effectiveness of trauma-focused psychological therapies for treating post-traumatic stress disorder symptoms in women following childbirth: a systematic review and meta-analysis. *Front Psychiatry.* 2018;9:591. [[CrossRef](#)].
52. Sansone A, Stapleton P, Patching A. A qualitative investigation of a prenatal mindfulness relationship-based (PMRB) program to support maternal mental health and mother-baby relationship during pregnancy and post-partum. *Mindfulness.* 2024;15(7):1759-77. [[CrossRef](#)].