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ORIGINAL RESEARCH

Association Between Sleep Quality and Self-Efficacy Trajectories Among Pregnant Women: A Parallel Process Latent Growth Curve Model

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Background: Sleep quality is essential for pregnant women and affects their self-efficacy. However, the longitudinal dynamics between these constructs, particularly regarding personality traits, are not well understood. This study aimed to examine the relationship between sleep quality and self-efficacy trajectories among pregnant women, as well as the role of maternal personality traits.

Methods: A prospective cohort design was employed, utilizing consecutive sampling. Pregnant women were assessed at four-time points from early pregnancy to 42 days postpartum. Self-efficacy, sleep quality, and personality traits were evaluated using validated scales. Latent profile analysis and parallel process latent growth curve modeling were employed for data analysis.

Results: Poorer initial sleep quality negatively predicted initial self-efficacy (β=−0.459, P<0.05) but positively predicted self-efficacy growth rate (β=0.383, P<0.05). Worsening sleep quality over time was associated with lower self-efficacy growth (β=−0.405, P<0.05). These relationships were significant only for women with mild emotional instability, not those with moderate emotional stability.

Conclusion: Sleep quality and self-efficacy are closely linked among pregnant women, with maternal emotional stability moderating this association. Further research is warranted to elucidate the underlying mechanisms.

Keywords: pregnant women, self efficacy, sleep quality

Introduction

Pregnancy is a transformative and challenging period characterized by significant physiological, psychological, and social changes.[1] Adequate sleep is crucial for maintaining overall health and well-being during pregnancy and the postpartum period.[2] However, many pregnant women experience sleep insufficiency and diminished sleep quality due to hormonal fluctuations, physical discomfort, and psychological stress associated with pregnancy and childbirth.[3,4] A systematic review indicates high rates of poor sleep quality during pregnancy, with 40.1% in the first trimester, 53.0% in the second trimester, and 83.9% in the third trimester.[5] Furthermore, sleep difficulties often persist after childbirth, with postnatal women exhibiting a higher prevalence (67.2%) of poor sleep quality compared to women in the perinatal period (44.5%).[6]

The impact of poor sleep quality during pregnancy and the postpartum periods extends beyond negative maternal outcomes and also affects fetal development and postnatal health.[7,8] Extensive research has documented the detrimental effects of poor sleep quality on various aspects of well-being, including gestational diabetes, preeclampsia, impaired cognitive functioning, postpartum depression, and impaired maternal-infant bonding.[7–9] However, the effects of poor sleep quality on pregnant women's self-efficacy, an important psychosocial factor, have received relatively less emphasis.

Self-efficacy refers to an individual's perception of their ability to complete certain tasks and plays a vital role in enhancing persistence and effort in the face of difficulties.[10,11] In the context of pregnancy and early motherhood, self-efficacy is crucial in managing the demands of childbirth, breastfeeding, infant care, and overall maternal adaptation.[12,13] High self-efficacy is

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associated with lower fear of childbirth, improved maternal mental health, enhanced parenting practices, and stronger maternal-infant bonding.[14–16] Previous research has consistently shown a correlation between poor sleep quality and decreased self-efficacy in non-pregnant populations, such as employees and caregivers of stroke inpatients.[17,18] Moreover, Dule et al found a negative correlation between sleep quality and general self-efficacy among pregnant women.[19] Another recent study indicated that improved sleep quality was positively associated with higher breastfeeding self-efficacy in postpartum women.[20]

Individual differences in personality traits may result in varying effects of sleep quality on self-efficacy in pregnant women. Personality refers to an individual's relatively stable internal traits that influence general behavioral tendencies across various situations.[21] Existing evidence suggests that certain personality traits, such as neuroticism, are linked to poorer sleep quality in pregnant women, while traits like extraversion, agreeableness, and conscientiousness are associated with better sleep quality in this population.[22,23] Furthermore, research indicates that pregnant women with positive personality traits, such as extraversion, often have higher levels of self-efficacy.[24] They possess more confidence in overcoming challenges, coping with difficulties, and achieving success. Conversely, negative personality traits (eg, neuroticism, also known as emotional stability) may undermine pregnant women's sense of self-efficacy, leading to self-doubt and self-imposed limitations on their abilities.[25]

Despite these findings, most studies have relied on cross-sectional designs, further emphasizing the need for longitudinal studies that investigate the relationship between sleep quality and self-efficacy across different stages of pregnancy and postpartum, particularly among pregnant women with different personality traits. This study aims to address these gaps by employing a parallel process and multigroup latent growth curve model (LGCM) to comprehensively understand how sleep quality and self-efficacy interact and change over time from early pregnancy to 42 days postpartum. The study proposed the several hypotheses, as shown in Supplementary Figure 1. We anticipated that distinct trajectories of sleep quality and self-efficacy in pregnant women would be identified, with the initial levels of sleep quality predicting both the initial levels and the subsequent development of self-efficacy over time. Additionally, we expected that sleep quality and self-efficacy would increase concurrently, and that the relationship between sleep quality and self-efficacy may vary across maternal personality traits.

Methods

Design and Participants

The prospective cohort analysis was part of our ongoing Be Resilient to Postpartum Depression (BRPD) cohort, which evaluates the mental health of women from early pregnancy to 42 days postpartum, focusing on protective and risk factors. This cohort has been previously described elsewhere.[26–28] Women attending prenatal examinations at the first affiliated hospital of Guangzhou University of Chinese Medicine and Jiangmen Central Hospital were screened and recruited using consecutive sampling from January 2022 to August 2022, with the final follow-up conducted for 42 days postpartum, spanning from September 2022 to May 2023.

Based on the definitions of trimesters during pregnancy, four assessments were carried out in accordance with clinical guidelines. The first trimester (T1, before 13 weeks) is essential for confirming fetal viability and establishing a pregnancy profile.[29] During the second trimester (T2, between 22 and 28 weeks), a four-dimensional ultrasound is recommended for detailed fetal evaluation.[30] In the third trimester (T3, after 32 weeks), fetal heart monitoring is initiated to ensure the fetus's well-being.[31] Finally, a postpartum check-up is conducted 6 weeks after delivery (T4, after 42 days) to assess maternal recovery and the newborn's health.[32] The inclusion criteria were: (1) aged 18 or above; (2) confirmed pregnancy via ultrasound; (3) able to communicate fluently in Mandarin. The exclusion criteria were: (1) presence of diagnosed mental illness confirmed by qualified healthcare professionals; (2) mid-term pregnancy termination.

Participants completed the questionnaires at the hospital, with researchers monitoring the process from a distance to ensure independent completion. This approach allowed participants to fill out the questionnaires without assistance while still having access to researchers for any questions. If participants were lost to follow-up, they were excluded from the final analysis. As shown in Figure 1, a total of 443 questionnaires were distributed in T1, yielding 434 valid responses (98.0% validity). However, two pregnant women terminated their pregnancy during the T2 phase and were subsequently excluded from the study. In T2, 430 questionnaires were distributed, with 421 valid responses (97.9% validity). For T3, 415 questionnaires were

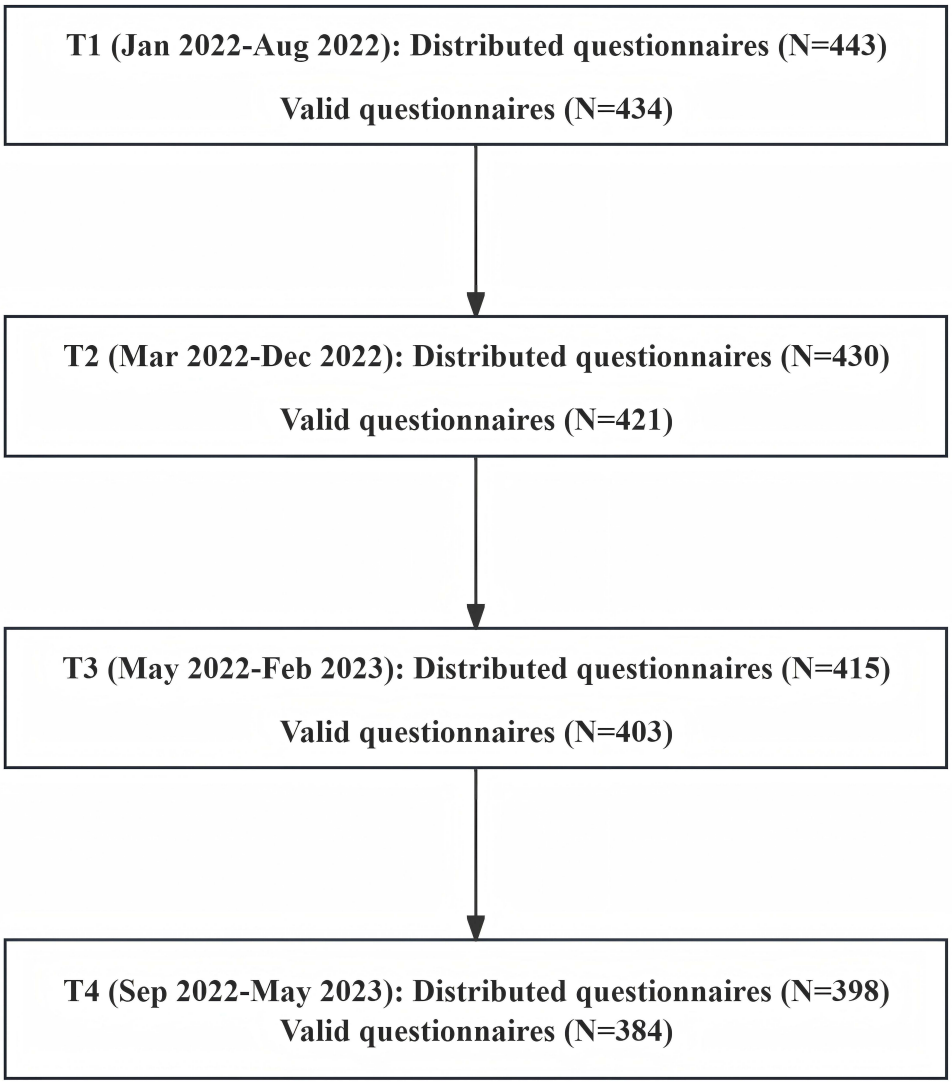

Figure 1 Data collection flowchart.

distributed, leading to 403 valid responses (97.1% validity). In T4, 398 questionnaires were distributed, producing 384 valid responses (96.5% validity). Overall, 372 matched valid questionnaires were collected across all four rounds.

Sample Size

Given that the LGCM is a specific application of structural equation modeling for analyzing change,[33] the sample size was determined using a structural equation model sample size calculator.[34] This calculation was based on an anticipated small to medium effect size (0.3), involving 8 latent variables and 39 observed variables, with a desired statistical power of 0.8 at a significance level of 0.05. Considering a 20% attrition rate, the estimated target sample size was approximately 212 pregnant women.

Instruments

Demographics

Based on previous literature,[35–37] we collected demographics (age, academic degree, employment, marital status, socio-economic status, place of residence) and pregnancy-related information (nulliparity before this pregnancy, pregnancy intent, and type of delivery).

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Self-Efficacy

The General Self-efficacy Scale (GSES) was developed by Schwarzer and Jerusalem in 1995.[38,] Permission to use the GSES in research is granted. It is widely used to assess an individual's self-confidence across various situations.[39] The instrument consists of 10 items rated on a 4-point Likert scale, yielding total scores that range from 10 to 40, with higher scores signifying greater self-efficacy. The Chinese version of the GSES has shown good reliability and validity among pregnant women,[40,41] and our prior studies have successfully employed this scale.[26,42,43] In the present study, the GSES exhibited high internal consistency, as indicated by Cronbach's alpha values of 0.940, 0.936, 0.939, and 0.933 for the four assessment points.

Personality Traits

The Ten-Item Personality Inventory (TIPI), developed by Gosling et al in 2003, is highly valued by researchers for its free availability and conciseness, requiring only approximately one minute to assess personality traits.[44,45] It consists of 10 items that evaluate five dimensions: extraversion, agreeableness, conscientiousness, emotional stability, and openness.[44] Participants rated the items on a 7-point Likert scale. The TIPI has been utilized in studies involving pregnant women,[46,47] and the Chinese version has demonstrated good reliability.[48] In this study, the TIPI was used at T1, and its Cronbach's alpha was 0.688.

Sleep Quality

The Pittsburgh Sleep Quality Index (PSQI), developed by Buysse et al in 1989, is free freely available for non-commercial research.[49] This self-report instrument evaluates sleep quality through seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction.[49] The PSQI generates a total score ranging from 0 to 21, where higher scores reflect poorer sleep quality. The Chinese version of the PSQI has demonstrated satisfactory internal reliability,[49] and our prior study has successfully utilized this scale.[27] The present study yielded Cronbach's alpha values of 0.642, 0.662, 0.710, and 0.692 for the four assessment points, indicating acceptable internal consistency.

Statistical Analyses

First, linear regression, independent samples *t*-test, and one-way ANOVA were employed to examine potential differences in demographic and relevant characteristics related to participants' self-efficacy. Then, Pearson's correlation analysis was performed to explore the associations between self-efficacy (T1-T4), sleep quality (T1-T4), and personal traits (T1).

Second, unconditional latent growth curve models (LGCM) were separately employed to depict the trajectories of sleep quality and self-efficacy over the four waves.[50] These models captured the between- and within-group variations by latent intercept and latent slope parameters. The mean intercept represented the average initial state, while the variance of the intercept indicated the degree of variation among individuals at a specific point in time, with larger values reflecting more pronounced initial differences.[51] The mean slope indicated the average growth rate, and the variance of the slope reflected the magnitude of the difference in growth rates between individuals, with a larger variance indicating more significant variations in developmental trajectories.[51]

Third, a single parallel process LGCM was conducted to estimate the time-varying effect of sleep quality on self-efficacy. The LGCM model fit was assessed using several fit indices, including the $\chi 2$ test, root mean square error of approximation (RMSEA), comparative fit index (CFI), and Tucker-Lewis Index (TLI).[52] Models with CFI and TLI values exceeding 0.95 were considered to adequately fit the data, while an RMSEA value below 0.08 indicated a satisfactory fit.[52]

Fourth, an unconditional latent profile analysis (LPA) was conducted to identify subgroups of pregnant women's personality traits. It began with a one-class model, continuing until no further improvement in fit indices was observed. Model fit was evaluated using indices such as the Akaike Information Criterion (AIC), Bayesian Information Criteria (BIC), and Sample-Size Adjusted BIC (aBIC).[53] Lower values of AIC, BIC, and aBIC indicated the better model fit. The accuracy of model classification was assessed using Entropy, with values greater than 0.8 suggesting high classification

accuracy.[54] Additionally, the Lo-Mendel-Rubin likelihood ratio test (LMRT) and bootstrapped likelihood ratio test (BLRT) were used to compare the differences between two adjacent category models.[55] If the tests yielded significant results (P<0.05), it meant that a model with an additional category was more appropriate, ie, the K-category model was better than the K-1 category model.

Finally, multigroup LGCM was utilized to examine how the patterns of change in sleep quality and self-efficacy vary among distinct personality trait groups.[56]

SPSS (V.26.0), Mplus (V.8.1), and JASP (V.0.18.3.0) were used for all statistical analyses. Statistical significance was set as a P value less than 0.05.

Ethics

This study was approved by the ethics review committee of the First Affiliated Hospital of Guangzhou University of Chinese Medicine (No: K-2022-024) and was part of the cohort "Be Resilient to Postpartum Depression" study (Registration number: ChiCTR2100048465). Written informed consent was obtained prior to study commencement. Participants were assured that their data would be kept confidential and used anonymously for research purposes.

Results

Demographic Characteristics and Relevant Variables Differences in Self-Efficacy

Among the 372 pregnant women, the average age was 29.70 years (SD=4.06) and the mean pre-pregnancy BMI was 21.30 kg/m^2 (SD=3.31). Approximately 70% of participants lived in household with a monthly average income exceeding 4000 yuan or were employed, and nearly half were nulliparity before this pregnancy. ANOVA revealed significant differences in self-efficacy related to academic degree (second and third trimester, P<0.05). Independent samples t-tests showed significant variations in self-efficacy associated with marital status (third trimester and postpartum period, P<0.05) and place of residence (first and second trimester, P<0.05). Additionally, linear regression analysis indicated significant differences in self-efficacy based on personality traits and sleep quality (all P<0.05). Other details are presented in Table 1.

Associations Among Self-Efficacy, Sleep Quality, and Personality Traits

As shown in Figure 2, a significant negative correlation was observed between PSQI scores and GSES scores across all four time points (correlation coefficients ranging from −0.121 to −0.375, all P<0.05). Notably, emotional stability emerged as the only personality trait significantly correlated with both PSQI (r_{t1}=−0.267, r_{t2}=−0.271, r_{t3}=−0.236, r_{t4}=−0.232, all P<0.001) and GSES scores (r_{t1}=0.357, r_{t2}=0.342, r_{t3}=0.398, r_{t4}=0.365, all P<0.001). Consequently, emotional stability was chosen as the basis for the subsequent latent profile analysis of personality traits.

Latent Growth Curve Modeling for Sleep Quality and Self-Efficacy Trajectory

The LGCM for PSQI demonstrated good fit (χ2=15.2494, df=5, TLI= 0.980, CFI=0.983, RMSEA=0.074).[52] As shown in Figure 3A, significant individual differences were found in both the initial level (variance=6.117, P<0.001) and growth rate (variance=0.453, P<0.001) of sleep quality, but the correlation between the initial status and the rate of change was not significant (β=0.129, P=0.439). The latent growth curve of PSQI is visualized in Figure 3B.

For GSES model, fit was excellent (χ2=5.186, df=5, TLI= 1.000, CFI=1.000, RMSEA=0.010).[52] As presented in Figure 3C, significant individual differences were observed in the initial level (variance=28.801, P<0.001) and growth rate (variance=−0.216, P<0.001) of self-efficacy, with an inverse correlation between initial status and rate of change (β=−0.363, P<0.001). The latent growth curve of PSQI is visualized in Figure 3D.

Parallel Process Latent Growth Curve Model for Joint Development of Sleep Quality and Self-Efficacy

The parallel process LGCM yielded acceptable fit (χ2=46.899, df=22, TLI= 0.979, CFI=0.984, RMSEA=0.055).[52] As presented in Figure 4, initial PSQI negatively predicted initial GSES (β=−0.459, P<0.05) and positively predicted GSES

Table 1 Demographic and Relevant Characteristics Differences in Self-Efficacy

Variable	Model 1 (First Trimester)			Model 2 (Second Trimester)			Model 3 (Third Trimester)			Model 4 (Postpartum Period)		
	M±SD (GSES)	N (%) / M±SD	*P* value	M±SD (GSES)	N (%) / M±SD	*P* value	M±SD (GSES)	N (%) / M±SD	*P* value	M±SD (GSES)	N (%) / M±SD	*P* value
Age, M±SD	26.29±6.52	29.70 (4.06)	0.606	25.94±5.96	29.70 (4.06)	0.869	25.66±5.91	29.70 (4.06)	0.322	25.63±5.80	29.70 (4.06)	0.712
Pre-pregnancy BMI, M±SD	26.29±6.52	21.30 (3.31)	0.342	25.94±5.96	21.30 (3.31)	0.150	25.66±5.91	21.30 (3.31)	0.520	25.63±5.80	21.30 (3.31)	0.180
Academic degree, N(%)			0.071			0.045			0.025			0.090
High school or less	25.11±7.02	112(30.1%)		24.88±6.18	112(30.1%)		24.45±5.94	112(30.1%)		24.67±5.73	112(30.1%)	
Junior college degree	26.71±6.04	139(37.4%)		26.01±5.98	139(37.4%)		25.91±5.92	139(37.4%)		25.81±5.87	139(37.4%)	
Bachelor or above	26.88±6.49	121(32.5%)		26.82±5.61	121(32.5%)		26.49±5.75	121(32.5%)		26.30±5.71	121(32.5%)	
Employment, N(%)			0.056			0.051			0.373			0.294
Yes	26.68±6.34	271 (72.8%)		26.30±5.75	271 (72.8%)		25.82±5.74	271 (72.8%)		25.81±5.68	271 (72.8%)	
No	25.23±6.91	101 (27.2%)		24.95±6.40	101 (27.2%)		25.21±6.36	101 (27.2%)		25.11±6.10	101 (27.2%)	
Whether one is an only child, N(%)			0.345			0.052			0.722			0.408
Yes	27.29±6.48	34 (9.1%)		27.82±5.87	34 (9.1%)		26.00±5.27	34 (9.1%)		26.41±5.98	34 (9.1%)	
No	26.18±6.53	338 (90.9%)		25.75±5.94	338 (90.9%)		25.62±5.98	338 (90.9%)		25.55±3.78	338 (90.9%)	
Marital status, N(%)			0.390			0.538			0.005			0.013
Married	26.21±6.50	351 (94.4%)		25.89±5.91	351 (94.4%)		25.44±5.83	351 (94.4%)		25.44±5.71	351 (94.4%)	
Unmarried	27.48±6.97	21 (5.6%)		26.71±6.75	21 (5.6%)		29.19±6.26	21 (5.6%)		28.67±6.41	21 (5.6%)	
Monthly average household income, N(%)			0.245			0.106			0.142			0.304
≤4000 RMB	25.60±7.17	92 (24.7%)		25.07±6.70	92 (24.7%)		24.87±6.24	92 (24.7%)		25.09±6.16	92 (24.7%)	
>4000 RMB	26.51±6.30	280 (75.3%)		26.22±5.67	280 (75.3%)		25.91±5.79	280 (75.3%)		25.80±5.67	280 (75.3%)	
Place of residence, N(%)			0.026			0.009			0.102			0.093
City or town	27.20±6.54	150 (40.3%)		26.97±6.11	150 (40.3%)		26.27±5.81	150 (40.3%)		26.24±5.60	150 (40.3%)	
Countryside	25.67±6.46	222 (59.7%)		25.28±5.77	222 (59.7%)		25.24±5.96	222 (59.7%)		25.21±5.91	222 (59.7%)	
Nulliparity before this pregnancy, N(%)			0.453			0.544			0.375			0.099
Yes	26.54±6.57	185 (49.7%)		26.12±6.07	185 (49.7%)		25.93±5.99	185 (49.7%)		26.12±5.94	185 (49.7%)	
No	26.03±6.49	187 (50.3%)		25.75±5.85	187 (50.3%)		25.39±5.84	187 (50.3%)		25.13±5.63	187 (50.3%)	
Pregnancy intent, N(%)			0.638			0.107			0.267			0.260
Planned pregnancy	26.34±6.37	332 (89.2%)		26.11±5.91	332 (89.2%)		25.77±5.92	332 (89.2%)		25.74±5.81	332 (89.2%)	
Unplanned pregnancy	25.83±7.76	40 (10.8%)		24.50±6.21	40 (10.8%)		24.68±5.87	40 (10.8%)		24.65±5.66	40 (10.8%)	
Delivery, N(%)			–			–			–			0.781
Vaginal delivery	–	–		–	–		–	–		25.69±5.88	228 (61.3%)	
Cesarean section	–	–		–	–		–	–		25.52±5.69	144 (38.7%)	
Extraversion, M±SD	26.29±6.52	8.59 (2.03)	<0.001	25.94±5.96	8.59 (2.03)	0.001	25.66±5.91	8.59 (2.03)	<0.001	25.63±35.80	8.59 (2.03)	<0.001
Agreeableness, M±SD	26.29±6.52	10.57 (1.84)	<0.001	25.94±5.96	10.57 (1.84)	<0.001	25.66±5.91	10.57 (1.84)	<0.001	25.63±35.80	10.57 (1.84)	<0.001
Conscientiousness, M±SD	26.29±6.52	9.51 (2.06)	<0.001	25.94±5.96	9.51 (2.06)	<0.001	25.66±5.91	9.51 (2.06)	<0.001	25.63±35.80	9.51 (2.06)	<0.001
Emotional stability, M±SD	26.29±6.52	9.06 (2.03)	<0.001	25.94±5.96	9.06 (2.03)	<0.001	25.66±5.91	9.06 (2.03)	<0.001	25.63±35.80	9.06 (2.03)	<0.001
Openness, M±SD	26.29±6.52	9.24 (1.79)	<0.001	25.94±5.96	9.24 (1.79)	<0.001	25.66±5.91	9.24 (1.79)	<0.001	25.63±35.80	9.24 (1.79)	<0.001
PSQI, M±SD (first trimester)	26.29±6.52	6.23 (2.75)	<0.001	25.94±5.96	6.23 (2.75)	<0.001	25.66±5.91	6.23 (2.75)	<0.001	25.63±35.80	6.23 (2.75)	0.020
PSQI, M±SD (second trimester)	–	–	–	25.94±5.96	6.37 (2.88)	<0.001	25.66±5.91	6.37 (2.88)	<0.001	25.63±35.80	6.37 (2.88)	<0.001
PSQI, M±SD (third trimester)	–	–	–	–	–	–	25.66±5.91	7.16 (3.09)	<0.001	25.63±35.80	7.16 (3.09)	<0.001
PSQI, M±SD (postpartum period)	–	–	–	–	–	–	–	–	–	25.63±35.80	7.45 (3.35)	<0.001

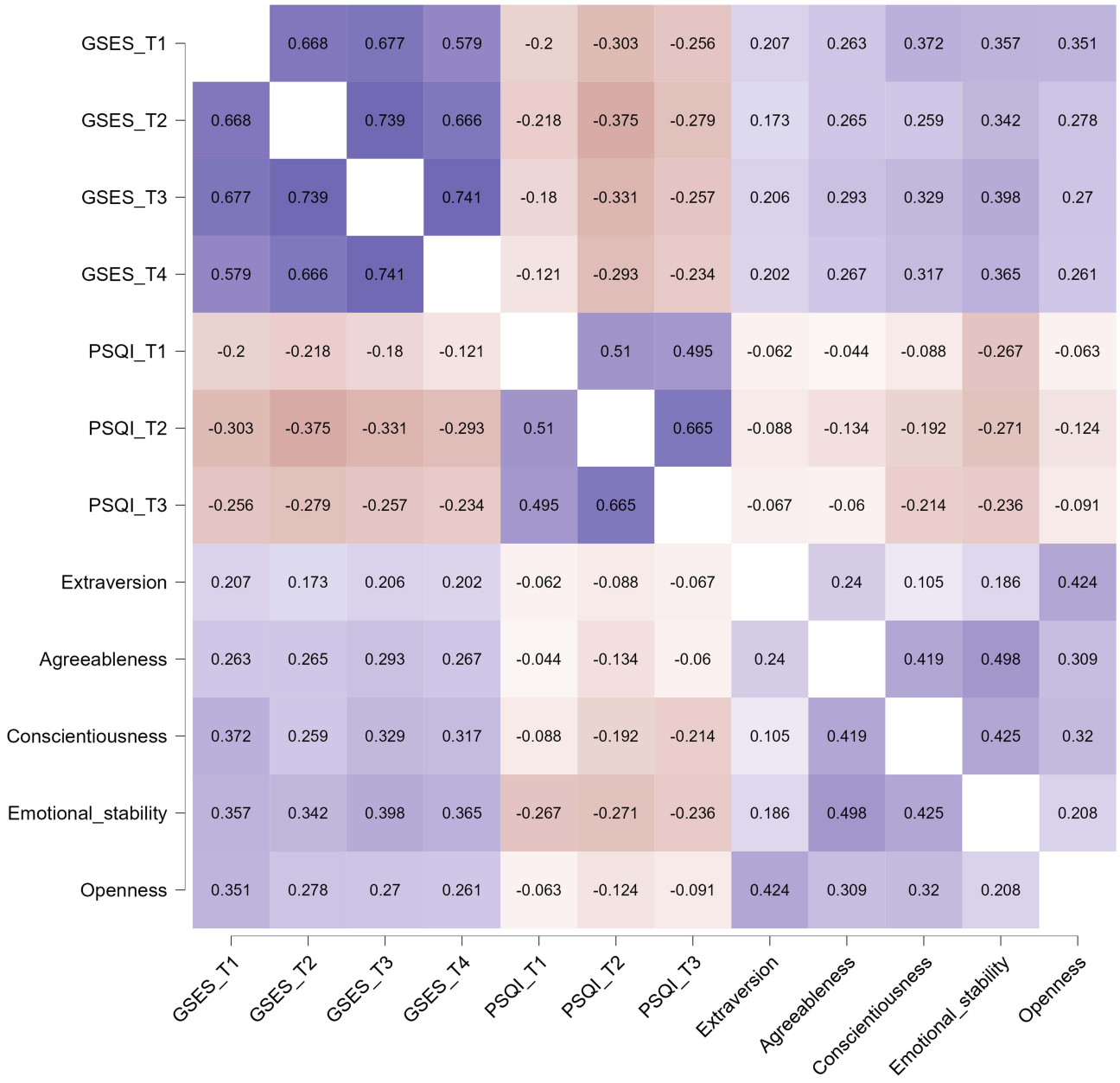

Figure 2 Correlations between variables.
Notes: Using Pearson's correlation analysis; *$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

growth rate (β=0.383, P<0.05). Conversely, PSQI growth rate did not predict initial GSES (β=−0.001, P=0.977) but negatively predicted GSES growth rate (β=−0.405, P <0.05). These findings indicate that the initial level of sleep quality influences both the starting point and trajectory of self-efficacy.

Latent Profile Analysis of Personality Traits

In Figure 5A, the LMRT indicated that the two-profile model fit better than the one-profile model (P=0.0001), while the four-profile model was superior to the three-profile model (P=0.0049). However, due to higher entropy and a profile comprising only 4.8% of the sample in the four-profile model, the two-profile solution was adopted.[57] This identified a mild emotional stability group (73.4%) and a moderate emotional stability group (26.6%), as depicted in Figure 5B.

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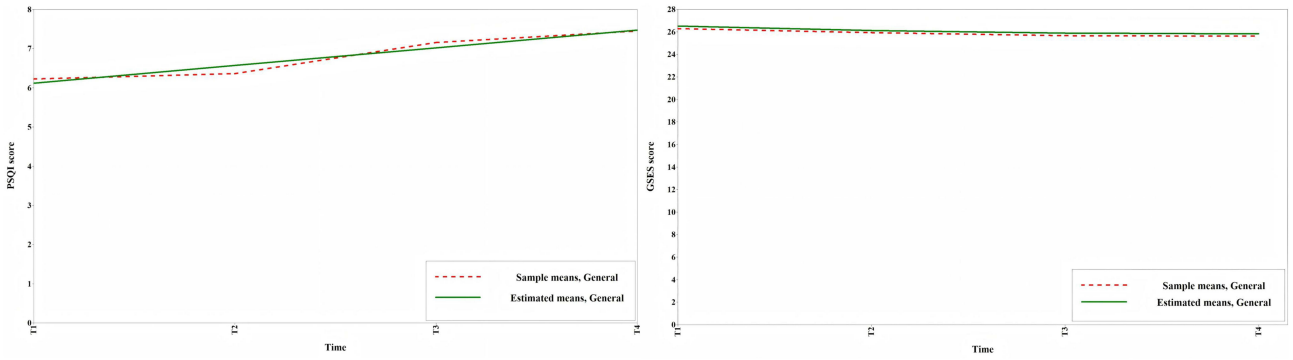
χ^2 (*df*)	CFI	TLI	RMSEA(95%CI)
15.244(5)	0.983	0.980	0.074(0.033-0.118)
Parameters	**Estimate**	**S.E.**	***P***
Variances			
Intercept	6.117	0.134	<0.001
Slop	0.453	0.054	<0.001
Intercept			
PSQI (T1)	0.710	0.036	<0.001
PSQI (T2)	0.714	0.037	<0.001
PSQI (T3)	0.661	0.039	<0.001
PSQI (T4)	0.587	0.041	<0.001
Slop			
PSQI (T1)	0.000	0.000	-
PSQI (T2)	0.219	0.032	<0.001
PSQI (T3)	0.405	0.056	<0.001
PSQI (T4)	0.539	0.077	<0.001
Slop with Intercept	0.129	0.167	0.439

(A)

χ^2 (*df*)	CFI	TLI	RMSEA(95%CI)
5.186(5)	1.000	1.000	0.010(0.000-0.073)
Parameters	**Estimate**	**S.E.**	***P***
Variances			
Intercept	28.801	0.318	<0.001
Slop	-0.216	0.092	0.020
Intercept			
GSES (T1)	0.817	0.023	<0.001
GSES (T2)	0.894	0.026	<0.001
GSES (T3)	0.936	0.036	<0.001
GSES (T4)	0.910	0.047	<0.001
Slop			
GSES (T1)	0.000	0.000	-
GSES (T2)	0.165	0.027	<0.001
GSES (T3)	0.345	0.056	<0.001
GSES (T4)	0.503	0.084	<0.001
Slop with Intercept	-0.363	0.091	<0.001

(C)



(B)

(D)

Figure 3 Latent growth curve model results. (**A**) Parameter estimation based on latent growth curve model (PSQI). (**B**) Latent growth curve model (PSQI). (**C**) Parameter estimation based on latent growth curve model (GSES). (**D**) Latent growth curve model (GSES).
Abbreviations: PSQI, Pittsburgh sleep quality index; GSES, generalized self-efficacy scale.

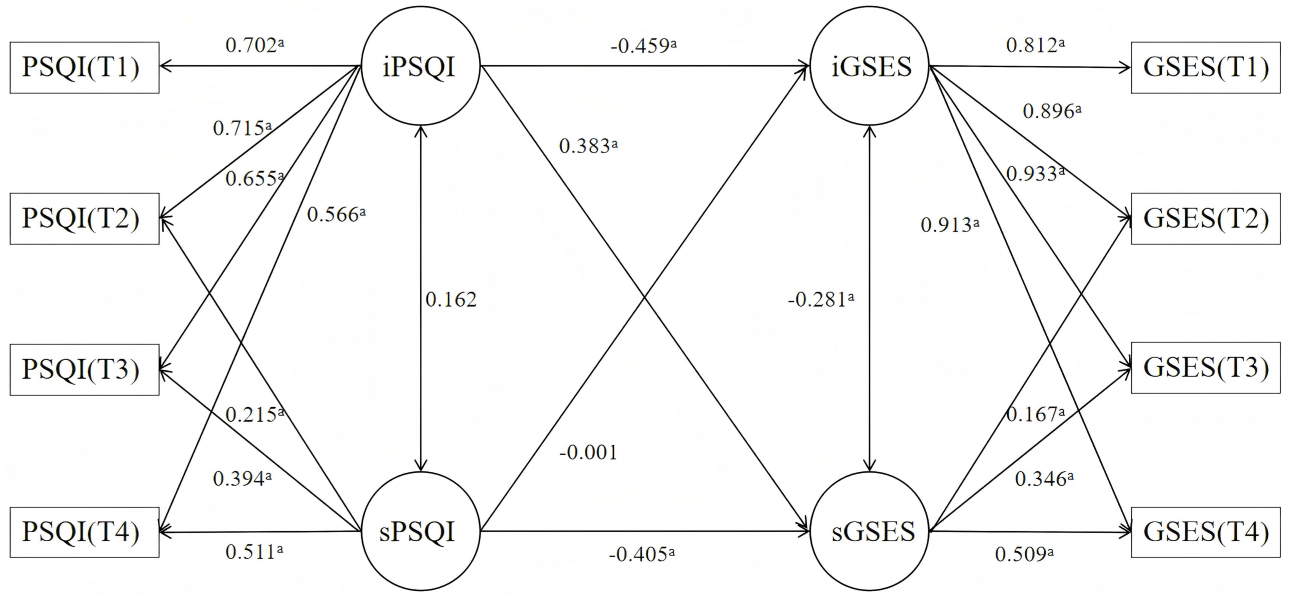
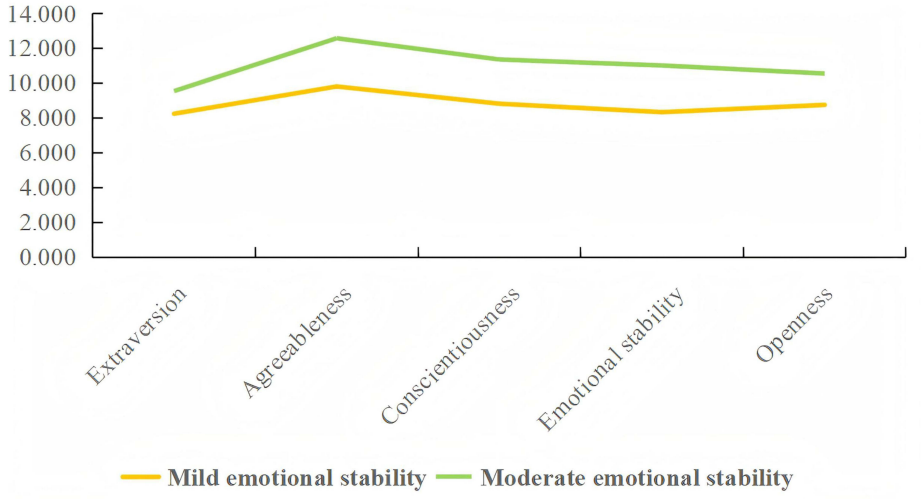


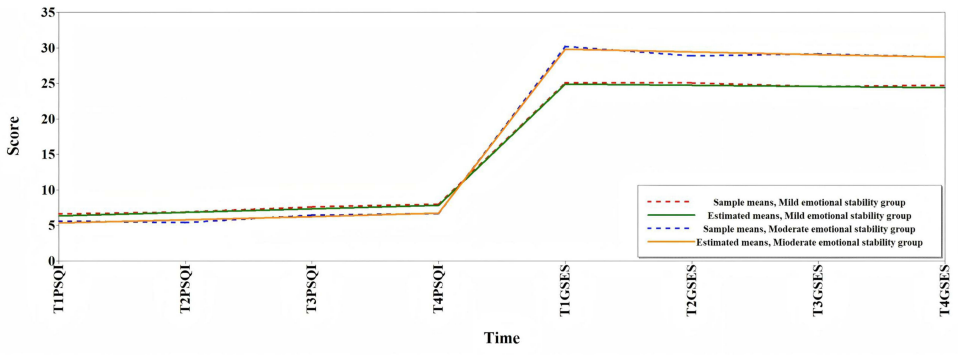
Figure 4 Parallel process latent growth curve model for PSQI and GSES.
Notes: [a]$P < 0.05$.
Abbreviations: i, intercept; s, slope; PSQI, Pittsburgh sleep quality index; GSES, generalized self-efficacy scale.

Indicators	Unconditional Model					
	1-Class	2-Class	3-Class	4-Class	5-Class	6-Class
Fit statistics						
LL	-3874.544	-3724.129	-3696.673	-3663.989	-3650.255	-3637.879
AIC	7769.089	7480.259	7437.345	7383.978	7368.51	7355.758
BIC	7808.278	7542.961	7523.561	7493.707	7501.753	7512.514
aBIC	7776.551	7492.198	7453.762	7404.871	7393.881	7385.606
Entropy	1	0.802	0.734	0.795	0.823	0.827
BLRT	—	0.0000	0.0000	0.0000	0.0000	0.0000
LMR	—	0.0001	0.4560	0.0049	0.3362	0.3638
Group size(%)						
C1	372(100.0)	273(73.4%)	215(57.8%)	218(58.6%)	219(58.9%)	214(57.6%)
C2	—	99(26.6%)	101(27.1%)	93(25.0%)	5(1.3%)	5(1.3%)
C3	—	—	56(15.1%)	18(4.8%)	44(11.8%)	79(21.2%)
C4	—	—	—	43(11.6%)	18(4.9%)	48(12.9%)
C5	—	—	—	—	86(28.1%)	19(5.1%)
C6	—	—	—	—	—	7(1.9%)

(A)



(B)



(C)

Figure 5 Latent profile analysis for personality traits. (**A**) Fitting index and group size of latent profile analysis of personality traits. (**B**) Two-profile model for personality traits. (**C**) Visualization of the differences in sleep quality and self-efficacy between mild (red) and moderate (blue) emotional stability.

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Multi-Group Parallel Process Latent Growth Curve Model for Joint Development of Sleep Quality and Self-Efficacy

To explore differences in the joint development of sleep quality and self-efficacy among pregnant women with different personality traits, personality trait groups were included as covariates. The model fit was good ($\chi 2$=79.568, df=44, TLI=0.968, CFI=0.975, RMSEA=0.062).[52] Figure 5C illustrates the observed differences between the two groups. In the mild emotional stability group (Figure 6A), initial PSQI negatively predicted initial GSES (β=−0.437, P<0.05) and positively predicted GSES growth rate (β=0.398, P<0.05). These relationships were not significant in the moderate emotional stability group (Figure 6B).

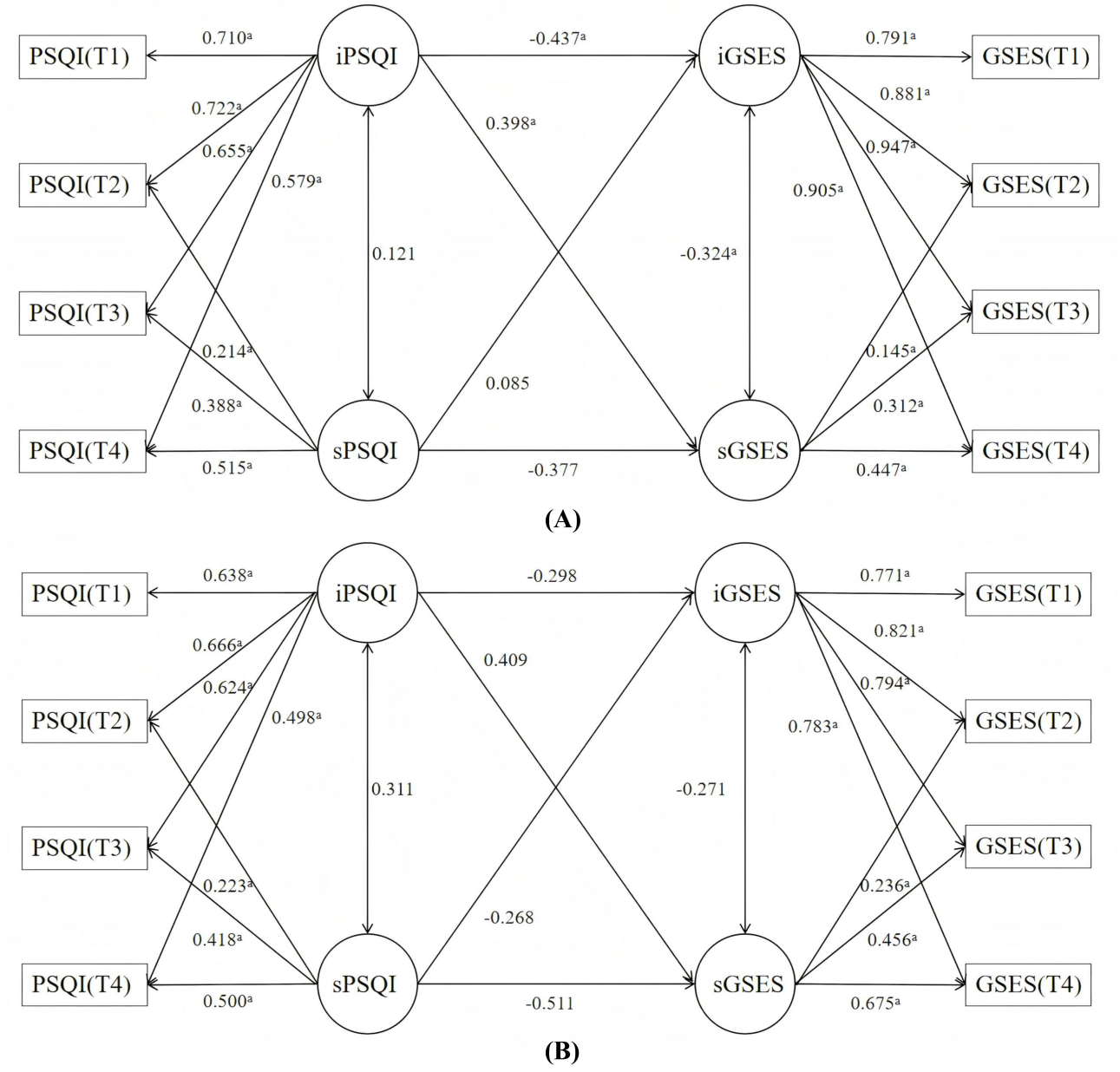

Figure 6 Parallel process latent growth curve model for PSQI and GSES in mild and moderate emotional stability groups. (**A**) Mild emotional stability group. (**B**) Moderate emotional stability group.

Notes: [a]P < 0.05.

Abbreviations: i, intercept; s, slope; PSQI, Pittsburgh sleep quality index; GSES, generalized self-efficacy scale.

Discussion

In this study, we employed LGCM and parallel process LGCM to examine the developmental trajectories of sleep quality and self-efficacy in pregnant women and the impact of sleep quality on self-efficacy. Additionally, latent profile analysis was utilized to identify the heterogeneity of personality traits. Furthermore, a multi-group parallel process analysis was conducted to reveal differences between pregnant women with mild emotional stability and those with moderate emotional stability in terms of the impact of sleep quality on self-efficacy. The findings of this study contribute to the existing body of knowledge in the field of sleep quality, self-efficacy, and personality traits in women from pregnancy to the postpartum period, enhancing our understanding of the associations among these variables.

Hypothesis 1 was partially supported by our findings. Initially, pregnant women exhibited poor sleep quality, which worsened progressively over time, consistent with previous research indicating an increasing trend of poor sleep quality from the first trimester to the third trimester.[58] Another cohort study also supported these findings by demonstrating an upward trajectory of maternal sleep disorders from the second trimester to the postpartum period.[59] However, contrary to our expectations, the initial sleep quality did not significantly predict the rate of change in sleep quality over time. This suggests that dynamic and time-varying factors, such as physical discomfort (eg, frequent urination) and lifestyle changes (eg, increased energy intake and breastfeeding),[60,61] may exert a stronger influence on the temporal change in sleep quality compared to the initial sleep quality itself. Moreover, our study revealed a gradual decline in self-efficacy among pregnant women from the first trimester to the postpartum period, which aligns with previous research indicating a decrease in self-efficacy during this phase.[62] Importantly, our study contributes by highlighting the differential impact of initial self-efficacy levels on the rate of decline. Specifically, pregnant women with higher initial self-efficacy experienced a slower decline in self-efficacy compared to those with lower initial self-efficacy. These findings are consistent with Bandura's social cognitive theory, which posits that individuals with higher self-efficacy are more likely to persevere and adapt in the face of challenges, thus maintaining higher levels of self-efficacy over time.[63]

Furthermore, our study observed that poorer initial sleep quality was associated with lower initial levels of self-efficacy and a steeper decline in self-efficacy over time, supporting our hypothesis 2. These results align with previous research that has consistently demonstrated the negative impact of poor sleep on various aspects of psychological well-being.[4,64] Poor sleep quality can lead to increased fatigue, mood disturbances, and memory impairments,[8,65] which subsequently undermine pregnant women's confidence in their ability to cope effectively with challenges and achieve desired outcomes.[66,67] Moreover, our study confirmed hypothesis 3, highlighting the contribution of deteriorating sleep quality to decreased self-efficacy. The persistence of sleep problems can further impact their emotional well-being and daytime functioning, potentially giving rise to heightened self-doubt and negative emotions, ultimately leading to a decline in self-efficacy levels from pregnancy to the postpartum period.[68,69] Recognizing the detrimental impacts of poor sleep on self-efficacy, healthcare professionals can develop targeted interventions to improve sleep quality and enhance self-efficacy among pregnant women. These interventions may involve sleep hygiene education,[68] cognitive-behavioral approaches,[69] and relaxation techniques[70] that address both sleep disturbances and self-efficacy beliefs.

Additionally, our study validated hypothesis 4 by demonstrating that the effects of initial sleep quality on the initial level and rate of change of self-efficacy were significant only in the group of pregnant women with mild emotional stability. In contrast, these effects were not significant in the group of pregnant women with moderate emotional stability. This finding indicates that emotional stability moderates the relationship between sleep quality and self-efficacy, supported by evidence that related emotional traits, such as optimism and emotional intelligence, impact this dynamic.[71,72] Emotional stability is known to be a key factor in pregnant women's psychological well-being and their ability to cope with stressors.[73] Pregnant women with lower emotional stability may experience a more pronounced negative impact on their self-efficacy and psychological well-being when they have poor sleep quality.[74] On the other hand, pregnant women in the high emotional stability group may have stronger emotional regulation and coping mechanisms, enabling them to better adapt to the negative effects of poor sleep quality.[75] These findings underscore the importance of considering individual differences, such as emotional stability, when examining the relationship between sleep quality and self-efficacy. By taking into account individual differences in emotional stability levels, interventions that improve sleep quality and enhance self-efficacy may yield more desirable results.[76]

Limitations

Several limitations should be acknowledged in this study. Firstly, the findings may not be generalizable, as the study focused on a specific population of pregnant women attending prenatal care at two hospitals. Secondly, reliance on self-report measures for assessing sleep quality, self-efficacy, and personality traits introduces potential bias, which may not accurately reflect participants' experiences. Thirdly, the sample size may have limited statistical power to detect small or moderate effects, suggesting that a larger sample could enhance the robustness of the results. Lastly, while the study utilized a longitudinal design, assessments were limited to four time points and did not account for other organic pathologies during pregnancy, which may influence sleep quality and self-efficacy.

Implications for Further Research

The current study highlights several implications for further research and clinical practice. Firstly, future investigations should include a more diverse population of pregnant women from multiple healthcare settings to improve generalizability. Incorporating objective measures of sleep, such as the use of wearable technology,[77] alongside self-report tools will mitigate bias and provide a more accurate assessment. Additionally, increasing the sample size will enhance statistical power, allowing for the detection of smaller or moderate effects. Longitudinal studies should extend follow-up periods beyond the immediate postpartum phase to explore the long-term impacts of sleep quality on self-efficacy and maternal well-being. Furthermore, future research should account for other organic pathologies and psychosocial factors, such as prenatal complications and levels of social support, as well as coping strategies.[78,79] Addressing these aspects will contribute to a more nuanced understanding of the mechanisms underlying the relationship between sleep quality and self-efficacy in pregnant women.

Conclusion

This study investigated the relationship between sleep quality, self-efficacy, and personality traits in a sample of Chinese pregnant women, revealing significant associations among these variables. The findings, derived from a parallel process LGCM, highlight the initial level of sleep quality is closely linked to both the initial value and growth rate of self-efficacy, while changes in sleep quality correspondingly impact the rate of change in self-efficacy. Furthermore, individual personality traits may moderate the effect of sleep quality on self-efficacy. These findings underscore the importance of considering sleep quality and personality traits in promoting the psychological well-being of pregnant women.

Data Sharing Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Ethics Approval and Informed Consent

This study was approved by the ethics review committee of the First Affiliated Hospital of Guangzhou University of Chinese Medicine (No: K-2022-024) and was part of the "Be Resilient to Postpartum Depression" study (Registration number: ChiCTR2100048465, registered on 09/07/2021). Written informed consent was obtained from all participants, who were assured that their information would remain confidential. Participants were allowed to withdraw from the study at any time. The study was conducted in accordance with national legislation, institutional requirements, and the principles of the Declaration of Helsinki.

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Author Contributions

Xiaoxiao Mei: Conceptualization, data curation, formal analysis, methodology, software, writing-original draft.

Yan Li: Methodology, writing-review, and editing.

Xiaona Wu: Investigation, resources, software, writing-review, and editing.

Minyu Liang: Investigation, resources, writing-review, and editing.

Qianwen Chen: Investigation, resources, writing-review, and editing.

Limei Kang: Investigation, resources, validation, supervision, writing-review, and editing.

Zengjie Ye: Conceptualization, funding acquisition, methodology, project administration, validation, supervision, writing-review, and editing.

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Disclosure

The authors declare no competing interests.

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