Research Article

Longitudinal Trajectories of Sleep Quality and Depressive Symptoms Among Chinese Women: From Late Pregnancy to Early Postpartum

Qi Zhang

Division of Humanities and Social Sciences, Tsinghua Shenzhen International Graduate School/The University of Hong Kong, China

A B S T R A C T

The longitudinal dynamics of sleep and depression during the perinatal period remain understudied in non-Western contexts. This study aimed to identify distinct trajectories of sleep quality and depressive symptoms in Chinese women from late pregnancy to the early postpartum period and to examine the predictive roles of emotion regulation, rumination and social support.

A longitudinal cohort study was conducted with 168 women in Hong Kong. Participants completed assessments at 22 weeks gestation, one month postpartum and four months postpartum. Semi-parametric group-based trajectory modelling (GBTM) was utilized to identify developmental patterns of sleep quality (PSQI) and depressive symptoms (EPDS). Results: Three distinct sleep trajectories were identified: "stable good" (80.3%), "stable mild" (13.0%) and "fluctuating poor" (7.0%). Depressive symptoms followed two trajectories: "low-risk" (48.8%) and "high-risk" (51.2%). Difficulties in emotion regulation (DERS-16) significantly predicted membership in poorer sleep and depression trajectories. It should be notes that, the "fluctuating poor" sleep group reported the highest levels of postpartum social support, suggesting a complex relationship between support and sleep outcomes. Joint trajectory analysis revealed that 83.3% of women with fluctuating poor sleep were concurrently in the high-risk depression group.

To conclude, distinct sleep and depression trajectories exist among Chinese perinatal women. Emotion regulation serves as a key transdiagnostic predictor. The paradoxical finding regarding social support suggests that traditional "doing the month" practices may require adaptation to better align with the needs of modern Chinese mothers.

Keywords: Perinatal chinese women, Perinatal sleep, Postpartum depression

1. Introduction

The relationship between sleep and depressive symptoms during the perinatal period has received substantial research interest due to its impact on maternal and infant health. However, there are still some potential gaps in the existing research, particularly regarding the longitudinal dynamics of these conditions and their cultural contextualization within the Chinese population. Previous research in this area has been limited by the cross-sectional research designs that do not allow for examination of longitudinal trends. Studies conducted in Western countries have found heterogeneity in the sleep trajectories of perinatal women[1,2]. However, the sleep trajectories of women in non-Western countries, particularly in Chinese cultures which have their specific postpartum caring

rituals, have been less extensively studied.

One of the largest studies investigated the trajectories of disturbed maternal sleep before and after childbirth was conducted by Sivertsen and his colleagues[1]. The study involved 1480 women who were part of the Akershus Birth Cohort Study. Participants completed three health surveys at different times: week 32 of pregnancy, week eight of postpartum and two years postpartum. They reported a trend of stable or increased disturbed sleep from pregnancy to eight weeks postpartum. Although participants tended to have less insomnia in two years postpartum compared to the first two time points, there was a high persistence of poor sleep across all three assessment points. The study also found out that sociodemographic and clinical factors, including concurrent maternal depression, did not account for the stability of disturbed sleep from pregnancy through to two years postpartum.

Contrary to Sivertsen et al.'s finding regarding the role of maternal depression on sleep, a more recent study investigated the trajectories of insomnia symptoms and associations with mood from early pregnancy to the postpartum period[3] and found that participants in the clinical insomnia group, which is a group of women experienced consistently high and elevated insomnia symptoms across late pregnancy and the postpartum period, were more likely to also report symptoms of anxiety and depression. Additionally, participants in the clinical insomnia group were more likely to experience symptoms indicative of clinically significant depression. However, the findings may also reflect the homogeneity of racial minority groups within the sample. Future studies may implement this methodology with more racially diverse cohorts of women.

A study from Taiwan explores the patterns of depressive symptoms and fatigue in postpartum women[4]. The study was conducted at a teaching medical centre in central Taiwan and involved 121 women who were assessed during their third trimester of pregnancy and at multiple postpartum time points. Four distinct trajectories of depressive symptoms and three trajectories of fatigue had been identified and a significant co-occurrence of high-risk levels in both conditions had also been reported. Poor sleep quality was identified as a key predictor of these joint trajectories. The significance of these findings emphasizes the need for early identification and differentiated care strategies to address both depressive symptoms and fatigue in postpartum women. It should be noted that the study did not consider the effect of social and cultural backgrounds, including different social support systems, which may significantly affect sleep and mood in perinatal women[5,6]. Many Asian countries follow the Chinese postpartum care practice of "doing the month", which is believed to promote mother's physical and emotional well-being during the early postpartum period[5]. This practice, often guided by an experienced senior female member in the family, emphasizes specific dietary restrictions, hygiene practices and extensive social support[5]. However, it has been suggested that high levels of stigmatizing beliefs towards depression are prevalent among Chinese population, with increasing age being a significant predictor of greater stigma[7]. The senior female family member who is in charge of the "doing the month" practice may underestimate mother's emotional struggles, thus further discouraging women from reporting symptoms of depression. As a result, this cultural stigma can contribute to the underreporting and undertreatment of perinatal

depression among Chinese women. This highlights the need for more research focusing on the impact of cultural factors on the perinatal population in China.

Although study of trajectories of sleep and mood in perinatal population has only begun to receive attention from researchers in the past decade, several research has already identified different sleep and depression trajectories in perinatal women. However, very limited studies have examined both sleep and depression trajectories throughout the perinatal period in Chinese population, who have their specific traditional postpartum caring rituals and few studies have focused on the factors that potentially help to form the trajectories and their interrelation in details.

To address this issue, current study utilized semi-parametric group-based trajectory modelling to identify different sleep and depression trajectories in a group of women in Hong Kong and examined the factors interfering the trajectories of sleep and depressive symptoms from late pregnancy to early postpartum period. The study employed Pearlin's[8] stress process theory to select potential risk factors. This theoretical framework provided a basis for understanding the relationship between stress and health outcomes, describing the model of health conditions through four fundamental concepts: stressors, mediators, stress responses and health outcomes. Previous literature has suggested that sociodemographic status of pregnant women can be salient stressors of PPD[9], while social support and individual's coping ability can be mediators that amplify or mitigate during this process[8]. Therefore, the study incorporated various factors into the analysis, including sociodemographic variables, social support and individual coping abilities such as emotional regulation, rumination and pre-sleep arousal.

We aimed to: a) identify sleep and depression trajectories from late pregnancy to early postpartum, (b) examine the relationship between different sleep and depression trajectories in the perinatal period and (c) identify potential factors that interfere with the trajectories of sleep and depressive symptoms during the perinatal period.

2. Methodology

2.1. Design and procedure

Data collection was conducted between January 10, 2022 and March 10, 2024. During this period, 168 women provided complete data across three time points: 22 weeks of gestation, 1 month postpartum and 4 months postpartum. Ethical approval was granted by the Human Research Ethics Committee (HREC No. EA200024) prior to the commencement of the study and all participants provided online informed consent. To ensure the study was adequately powered to detect meaningful effects, an a priori power analysis was performed using the pwr package in R. Based on prior research regarding sleep disturbances and perinatal depression, the analysis assumed a medium effect size ($f\ 2 = 0.15\ f\ 2 = 0.15$), a statistical power of 0.80 and an alpha level of 0.05. These calculations indicated a minimum required sample size of 150 participants. Consequently, the final sample of 168 participants is sufficient to detect medium effect sizes.

2.2. Participants

Recruitment targeted women at the Hong Kong Sanatorium and Hospital and through online channels. To recruit both good and poor sleepers, advertisements did not explicitly state

the study's focus on sleep disturbances. Women were eligible if they were at least 18 years old, 22 weeks pregnant, literate in Chinese and free from substance dependence, psychiatric diagnoses or sleep disorders (excluding insomnia). Exclusion criteria also included major pregnancy, fetal or long-term infant complications. Initially, 419 participants met these criteria at Time 1. Following an attrition rate of 38.4% ($n = 161$ n=161), 258 participants completed the Time 2 assessment. By Time 3, an additional 90 participants withdrew, resulting in a final sample of 168 women. This final cohort was aged between 22 and 42 years ($M = 33.01$ M=33.01, $S D = 3.72$ SD=3.72) and 80.3% possessed a bachelor's degree or higher. Comparisons between completers and those who dropped out revealed no evidence of attrition bias. At Time 2, groups did not differ significantly on demographics, EPDS, PSQI or DERS-16 scores. At Time 3, no significant differences were observed regarding birth outcomes (C-section), infant related factors (temperament, breastfeeding) or maternal psychological measures (all $p > .05$ p>.05).

2.3. Demographic variables

`Demographic covariates included self-reported age, education, employment and household income. Lifestyle factors assessed included smoking, alcohol/caffeine consumption and napping habits. Obstetric history was determined by asking if participants had children prior to the current pregnancy and mode of delivery was recorded. Infant variables included maternal perception of temperament, rated as either "relatively easy to care for," "moderately difficult," or "relatively difficult." Breastfeeding status was assessed by asking participants if they were feeding the newborn with their own breast milk. Responses were coded as: (1) Yes, exclusively breast milk; (2) Mostly yes, but sometimes formula; or (3) No, exclusively formula feeding.

3. Measure of Sleep

3.1. The pittsburgh sleep quality index (PSQI)

Habitual sleep quality was assessed using the Pittsburgh Sleep Quality Index[10]. This 19-item self-report instrument evaluates sleep over the past month across seven components including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication and daytime dysfunction. Each component is scored on a scale of 0 to 3. The sum of these component scores yields a global score ranging from 0 to 21, with higher scores indicating worse sleep quality. A global score of >5 is widely used as the cutoff for distinguishing poor sleepers from good sleepers[10]. The Chinese version of the PSQI has demonstrated high internal consistency in recent perinatal populations[11].

4. Measure of Depression

4.1. The edinburgh postnatal depression scale (EPDS)

The Edinburgh Postnatal Depression Scale[12] was used to assess symptoms of depression. The EPDS is a widely used 10-item self-report instrument validated for use in both mothers and fathers[13]. Participants rate their mood over the past seven days on a 4-point scale (0-3). Total scores range from 0 to 30, with higher scores indicating greater symptom severity. The scale has demonstrated high reliability and validity in previous studies[14,15]. For the purpose of this study, EPDS scores were dichotomized using a cutoff of $\geq$ ≥10 to indicate high depressive symptoms, a threshold that has shown good psychometric properties in both men and women[16].

5. Statistical Analysis

To identify distinct trajectories of sleep quality and depressive symptoms among perinatal women, we utilized semi-parametric group-based trajectory modelling[17] via the lcmm package in R, version 4.4.0 (2024-04-24) – "Puppy Cup", along with the dplyr and tidyr packages. Previous study suggested that the estimates from group-based trajectory models using this algorithm are generally unbiased with observations of $\geq$500[18]. The selection of optimal trajectory groups was guided by the principle of parsimony and the Bayesian Information Criterion (BIC), where the smallest absolute BIC indicated a better fit[17]. Participants were classified into different trajectory groups based on the highest posterior probability of each group, with the best model fit indicated by a criterion of $\geq$0.70[19]. Following the semi-parametric group-based trajectory modelling analysis, we then try to investigate the co-occurrence patterns of joint trajectories of sleep and depression.

Logistic regression models were used to identify potential predictors of high- and low-risk trajectories of sleep quality and depressive symptoms. To account for potential confounding factors, we reported adjusted estimates. All statistical tests were two-sided and the significance level was set at 0.05.

6. Results

In total, 168 women were eligible and completed all time points of the study. Descriptive statistics of the sample demographics and characteristics of the participants at three time points are presented in (Tables 1,2). The number of observations recorded was 504 for both the sleep variable and the depression variable, both exceeding the recommended minimum of $\geq$500 observations, as suggested by Loughran & Nagin[18].

Table 1: Descriptive statistics of the sample demographics.

Variable	N	M(SD)	Range	Percentage
Age	168	33.01(3.72)	22-42	-
Education Level	168	-	Secondary 3 to Doctoral Degree	80.3%Bachelor Degree or above
Household income	168	-	Less than 100,000 HKD to > 1,000,000HKD	82.2% 300,000- 499,999HKD or above
Employment	168	-	N/A	79.2% Full-time job
RAS	168	28.57(4.58)	8-35	-
C-Section	168	-	Yes/No	57.7% No C-Section
Infant temperament	168	-	Easy temperament to difficult temperament	60.1% Easy temperament
Breastfeeding	168	-	100% breastfeeding to 100% formula	44.6% Breastfeeding most of the time, also formula
Maternal experience	168	-	Had a baby before / First-time mother	64.9% First-time mother

Caffeine consumption	168	-	Never to Everyday	44% Rarely
Alcohol consumption	168	-	Never to Everyday	100% Never
Smoking behaviour	168	-	Never to Everyday	100% Never
Nap habit	168	-	Never to Most of the time	42.3% Rarely
Pregnancy planning	168	-	Yes/No	79.2% Planned for this pregnancy

Table 2: Sociodemographic and characteristics of the participants at three time points.

Characteristics	Time 1 (Baseline measures)	Time 2 (one month postpartum)	Time 3 (four months postpartum)
N	419	258	168
Maternal age (y), Mean ± SD	32.70± 3.81	32.47 ± 3.87	33.01 ± 3.72
Education level, n (%)			
Junior high school or below	6 (1.4%)	5 (1.9%)	1 (0.6%)
High school	34 (8.1%)	23 (8.8%)	10 (6.0%)
College	51 (12.2%)	30 (11.5%)	22 (13.1%)
Bachelor's degree	195 (46.5%)	127 (48.8%)	74 (44%)
Master's degree	126 (30.1%)	67 (25.8%)	59 (35.1%)
Doctoral degree or higher	7 (1.7%)	6 (2.3%)	2 (1.2%)
Household income, n (%)			
Less than 100,000 HKD	18 (4.3%)	12 (4.6%)	6 (3.6%)
100,000 HKD to 299,999 HKD	57 (13.6%)	35 (13.5%)	24 (14.3%)
300,000 HKD to 499,999 HKD	97 (23.2%)	54 (20.8%)	45 (26.8%)
500,000 HKD to 799,999 HKD	106 (25.3%)	63 (24.2%)	39 (23.2%)
800,000 HKD to 999,999 HKD	54 (12.9%)	34 (13.1%)	24 (14.3%)
1,000,000 HKD or more	87 (20.8%)	60 (23.1%)	30 (17.9%)
Employment, n (%)			
Employed full-time (40 hours per week or more)	318 (75.9%)	92 (73.8%)	133 (79.2%)
Employed part-time (up to 39 hours per week)	20 (4.8%)	13 (5.0%)	9 (5.4%)
Self-employed	3 (0.7%)	2 (0.8%)	1(0.6%)
Housewife	3 (0.7%)	3 (1.2%)	-
Student	4 (1.0%)	3 (1.2%)	2 (1.2%)
Retired	-	-	-
Unemployed, looking for work	51 (12.2%)	33 (12.7%)	16 (9.5%)
Unemployed, not looking for work	16 (3.8%)	10 (3.8%)	5 (3.0%)
Unable to work	4 (1.0%)	2 (0.8%)	2 (1.2%)
Marital status, n (%)			
Single (never married)	10 (2.4%)	7 (2.7%)	3 (1.8%)
Married or domestic partner	407 (97.1%)	249 (95.8%)	165 (98.2%)
Widowed	-	-	-
Divorced	2 (0.5%)	2 (0.8%)	-
Separated	-	-	-
Smoking, n (%)			
I do not smoke	412 (98.3%)	253 (97.3%)	165 (98.2%)
Have tried once or twice	3 (0.7%)	2 (0.8%)	1 (0.6%)
Smoke occasionally	2 (0.5%)	2 (0.8%)	-
Smoke almost every day	2 (0.5%)	1 (0.4%)	2 (1.2%)
Exercise, n (%)			
Never or rarely	210 (50.1%)	129 (49.6%)	86 (51.2%)
1 to 2 times per week	139 (33.2%)	79 (30.4%)	62(36.9%)
2 to 3 times per week	27 (6.4%)	21 (8.1%)	6 (3.6%)
3 to 5 times per week	25 (6.0%)	16 (6.2%)	8 (4.8%)
Daily or almost daily	18 (4.3%)	13 (5.0%)	6 (3.6%)
Alcohol consumption, n (%)			
Never	407 (97.1%)	249 (95.8%)	164 (97.6%)
Rarely	11 (2.6%)	8 (3.1%)	4 (2.4%)

Only on specific occasions	1 (0.2%)	1 (0.4%)	-
Almost every month	-	-	-
Almost every week	-	-	-
Almost every day	-	-	-
Caffein consumption, n (%)			
Never	48 (11.5%)	30 (11.5%)	19 (11.3%)
Rarely	194 (46.3%)	125 (48.1%)	7 (4.2%)
Only on specific occasions	18 (4.3%)	11 (4.2%)	-
Almost every month	24 (5.7%)	12 (4.6%)	11 (6.5%)
Almost every week	91 (21.7%)	53 (20.4%)	37 (22%)
Almost every day	11 (10.5%)	27 (10.4%)	20(11.9%)
Nap, n (%)			
Never	50 (11.9%)	32 (12.3%)	21 (12.5%)
Rarely	160 (38.2%)	96 (36.9%)	71 (42.3%)
Sometimes	152 (36.3%)	100 (38.5%)	50 (29.8%)
Often	42 (10.0%)	22 (8.5%)	20 (11.9%)
Most of the time	15 (3.6%)	8 (3.1%)	6 (3.6%)
Planned Pregnancy, n (%)			
Planned	348 (83.1%)	219 (84.2%)	133 (79.2%)
Unplanned	71 (16.9%)	39 (15.0%)	35 (20.8%)
Have given birth to a child before (not including this pregnancy)			
Yes	145 (34.6%)	88 (33.8%)	59 (35.1%)
No	274 (65.4%)	170 (65.4%)	109 (64.9%)

7.1. Trajectory classes of sleep and depressive symptoms

A cubic three-class model was identified as the best-fitting model for changes in sleep quality over time, based on the lowest Bayesian Information Criterion (BIC) value (BIC = 2492.6) compared to the two-class model (BIC = 2503.1), the four-class model (BIC = 2504.4), the five-class model (BIC = 2556.7), the six-class model (BIC = 2570.6) and the seven-class model (BIC = 2572.4). Figure 1 illustrates the three identified classes of sleep quality trajectories.

Class 1, referred to as the "stable good" group, included 134 participants (80.3% of the total sample, N = 168). This group was characterized by low PSQI scores at Time 1 (M ≈ 6) and maintained relatively low scores across Time 2 and Time 3 (Figure 1). Class 2, referred to as the "stable mild" group, included 22 participants (13% of the total sample). Participants in this group began the study at Time 1 with a mean PSQI score of 12.64 (above the PSQI cutoff score of 5), which gradually decreased at Time 2 and Time 3. Finally, Class 3, referred to as the "fluctuating poor" group, included 12 participants (7% of the total sample). Participants in this group started with a mean PSQI score of 6.42 at Time 1, peaked at 16.25 at Time 2, indicating significantly poor sleep quality and then decreased to a mean score of 9.33 at Time 3.

For depressive symptoms, a two-class model was identified as the best-fitting model for changes in depressive symptoms during the perinatal period across three time points, based on the lowest Bayesian Information Criterion (BIC) value (BIC = 3151.86) compared to the three-class model (BIC = 3159.4) and the four-class model (BIC = 3176.4). (Figure 2) illustrates the two distinct trajectories of depressive symptoms over time, plotted across the three time points.
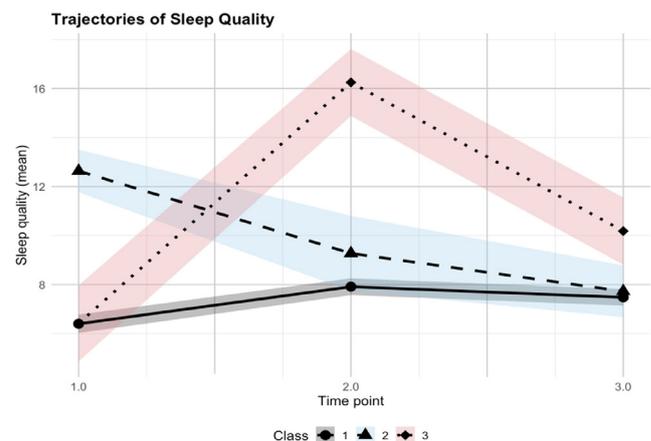

Figure 1: Three classes of sleep trajectories among perinatal women (N = 168). The proportion of participants in each class was Class 1 (80.3%), Class 2 (12.7%) and Class 3 (7%). Sleep quality was measured by the Pittsburgh Sleep Quality Index.

Eighty-two participants (48.8% of the total sample, N = 168) were classified as Class 1, referred to as the "low-risk" group, while 86 participants (51.2% of the total sample) were classified as Class 2, referred to as the "high-risk" group. The "low-risk" group began with moderate depressive symptom levels, with a mean score of 8.07 at Time 1 and exhibited a steady decline, reaching a mean score of 4.46 by Time 3. In contrast, the "high-risk" group started with a mean depressive symptom score slightly above 12 at Time 1 (exceeding the EPDS cutoff score of 10), increased slightly to peak above 13 at Time 2 and then declined slightly, stabilizing at a mean score of 12.29 by Time 3.

7.2. Relationships between sleep quality and depressive symptoms trajectories

The joint trajectory analysis was performed to examine

the association between sleep quality and depressive symptom trajectories and to estimate the proportion of participants who followed different combinations of these trajectories. The results are presented in **(Table 3)**. The Pearson Chi-Square test indicated a marginally significant association between the two trajectories (chi-squared = 5.68, p =.058). While the statistical association did not reach the traditional threshold for significance, the descriptive overlap between adverse outcomes was notable. Specifically, as shown in **(Table 4)**, 83.3% of women in the 'fluctuating poor' sleep class were concurrently classified into the 'high-risk' depression trajectory. This suggests that acute sleep deterioration is a critical marker for depression risk, a relationship that may be obscured when analysing the sample as a whole where the association appears borderline.
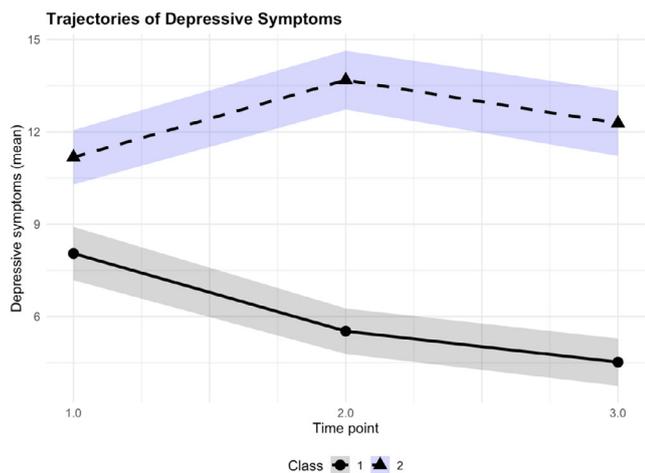

Figure 2: Two classes of depressive symptoms trajectories among perinatal women (N = 168). The proportion of participants in each class was Class 1 (48.8%) and Class 2 (51.2%). Depressive symptoms was measured by Edinburgh Postnatal Depression Scale (EPDS).

(Table 4) presents the transition probabilities for classification in the sleep quality and depressive symptoms trajectories. A majority (52.2%) of participants in the "stable good" sleep trajectory group (Class 1) were also classified in the "low-risk" depression trajectory group. Participants in the "stable mild" sleep trajectory group (Class 2) demonstrated a near-balanced distribution, with 45.5% classified in the "low-risk" depression trajectory group (Class 1) and 54.5% in the "high-risk"

depression trajectory group (Class 2). It should be noted that the "fluctuating poor " sleep trajectory group (Class 3) exhibited a distinct pattern, with a significant majority (83.3%) classified in the "high-risk" depression trajectory group (Class 2).

Table 3: The results of Chi-Square Tests between the sleep quality and depressive symptom trajectories (N=168).

Test	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	5.69	2	.058
Likelihood Ratio	6.17	2	.046*
Linear-by-Linear Association	4.94	1	.026*

*p<.05

7.3. Predictors & characteristics of sleep quality and depressive symptoms trajectories

Table 5 and Table 7 present the relationships between baseline variables and the sleep and depression trajectory groups, as analysed through logistic regression modelling. The results indicate that both difficulties in emotion regulation (as measured by the DERS-16) and postpartum social support (as measured by the PSSQ) significantly predict membership in sleep trajectory groups from Class 1 to Class 3 (B = 0.54, SE = 0.27, p = 0.05, 95% CI [1.01, 2.91]; B = -0.17, SE = 0.08, p = 0.03, 95% CI [0.72, 0.99]) and from Class 2 to Class 3 (B = -0.19, SE = 0.08, p = 0.03, 95% CI [0.70, 0.98]; B = -0.07, SE = 0.04, p = 0.04, 95% CI [0.87, 1.00]). Emotion regulation (as measured by the DERS-16) significantly predicted membership in Class 1 ("stable good" group) compared to Class 3 ("fluctuating poor" group) and was a borderline significant predictor of membership in Class 2 ("stable mild" group) compared to Class 3. Higher DERS-16 scores were associated with lower odds of being in Class 1 compared to Class 3, but higher odds of being in Class 2 compared to Class 3. Similarly, postpartum social support (as measured by the PSSQ) significantly predicted membership in Class 1 ("stable good" group) compared to Class 3 ("fluctuating poor" group) and was also a significant predictor of membership in Class 2 ("stable mild" group) compared to Class 3. Higher PSSQ scores were associated with lower odds of being in Class 1 compared to Class 3 and lower odds of being in Class 2 compared to Class 3.

Table 4: Joint and transitional probability (%) of depressive symptoms group membership on sleep trajectory group membership among perinatal women (N = 168)

Sleep Trajectories (Class1, 2 3)	Depression Trajectories (Class 1&2)	Count	Expected Count	% within Sleep Trajectories
1	1	70	67.4	52.2%
	2	64	70.6	47.8%
2	1	10	10.7	45.5%
	2	12	11.3	54.5%
3	1	2	5.9	16.7%
	2	10	6.1	83.3%

Descriptive statistics for DERS-16 and PSSQ scores are presented in **(Table 6)**. The baseline mean scores for DERS-16 in Class 1 (stable good sleep group; M = 31.33) were lower than those in Class 2 (stable mild sleep group; M = 49.82) and Class 3

(fluctuating poor sleep group; M = 39). The baseline mean scores for PSSQ in Class 3 (fluctuating poor sleep group; M = 69.67) were higher than those in Class 2 (stable mild sleep group; M = 57.91) and Class 1 (stable good sleep group; M = 61.94).

An ANOVA was conducted to compare the effects of different sleep trajectory groups on DERS-16 and PSSQ scores. There was a significant effect of sleep trajectory groups on DERS-16 scores, $F_{(2, 169)} = 37.98$, $p < .001$. However, no significant effect of sleep trajectory groups was found on PSSQ scores, $F_{(2, 169)} = 1.51$, $p = .23$.

Table 6: Descriptive statistics for DERS-16 and PSSQ across three sleep trajectories groups (Class 1, Class 2& Class 3).

Measure	Class	N	Minimum	Maximum	M	SD
DERS-16	1	134	14.0	54.0	31.33	8.74
	2	22	31.0	68.0	49.82	9.37
	3	12	17.0	67.0	39.00	15.87
PSSQ	1	134	0.0	101.0	61.94	18.34
	2	22	0.0	113.0	57.91	23.71
	3	12	38.0	86.0	69.67	14.69

(Table 7) shows that several baseline characteristics significantly predicted depression trajectory group membership between Class 1 ("low-risk" group) and Class 2 ("high-risk" group). Higher scores on rumination (as measured by the RRS; $B = -0.09$, $SE = 0.03$, $p < .01$, 95% CI [0.86, 0.97]), pre-sleep arousal (as measured by the C-PSAS; $B = -0.04$, $SE = 0.02$, $p = .049$, 95% CI [0.92, 1.00]), emotion regulation (as measured by the DERS-16; $B = -0.082$, $SE = 0.02$, $p < .01$, 95% CI [0.88, 0.96]) and the somatic arousal subscale of the C-PSAS ($B = -0.11$, $SE = 0.05$, $p = .01$, 95% CI [0.82, 0.98]) were associated with lower odds of being in Class 1 ("low-risk" group) compared to Class 2 ("high-risk" group). In contrast, the cognitive arousal subscale of the C-PSAS was not a significant predictor.

Other variables, including age, education, household income, marital status, smoking behaviour before pregnancy, supplement intake, exercise frequency, C-section during delivery, breastfeeding, infant temperament, relationship satisfaction, cognitive pre-sleep arousal and perceived stress, were not significant predictors of sleep and depression trajectory group membership.

Table 7: Relationships of baseline characteristics with depression trajectories (only significant variables are presented).

Predictor	B	SE	Wald	df	p	Exp (B)	95% CI for Exp(B)
Class 1 vs. Class 2							
RRS	-0.09	0.03	9.07	1	<0.01	0.91	[0.86, 0.97]
C-PSAS	-0.04	0.02	3.89	1	.049	0.96	[0.92, 1.00]
DERS-16	-0.08	0.02	14.11	1	<0.01	0.92	[0.88, 0.96]
Somatic C-PSAS	-0.11	0.05	6.19	1	0.01	0.89	[0.82, 0.98]

Descriptive statistics for the DERS-16, the pre-sleep somatic arousal subscale, the RRS and the C-PSAS scores are presented in **(Table 8)**. The table shows that the baseline mean scores for the DERS-16, the somatic pre-sleep arousal subscale and the C-PSAS are lower in Class 1 ("low-risk" group) compared to Class 2 ("high-risk" group). An independent-samples Mann-Whitney U test was conducted to compare DERS-16, C-PSAS, RRS and somatic arousal subscale scores across depression trajectories. The results showed significant differences for the DERS-16 ($U = 5019.5$, $Z = 4.06$, $p < .01$), the C-PSAS ($U = 4393.5$, $Z = 2.14$, $p = .03$), the RRS ($U = 4803$, $Z = 3.40$, $p < .01$) and the somatic arousal subscale ($U = 4467.5$, $Z = 2.37$, $p = .02$). These findings suggest that emotion regulation (as measured by the DERS-16), pre-sleep arousal (as measured by the C-PSAS), rumination (as measured by the RRS) and the somatic arousal subscale vary significantly across the two depression trajectory groups, highlighting their important roles in distinguishing between the "low-risk" and "high-risk" depression trajectories.

8. Discussion

Current study prospectively examined the time course of changes in sleep quality and depressive symptoms among 168 Chinese perinatal women in Hong Kong. Although no strong association was found between sleep quality trajectory and depressive symptoms trajectory, our results still suggested distinct patterns of perinatal sleep quality and depressive

symptoms changes across late pregnancy to early postpartum period.

Table 8: Descriptive statistics for DERS-16, Somatic C-PSAS, RRS and PSAS scores (Class 1 is the low-risk depression group, Class 2 is the high-risk depression group).

Measure	Class	N	Mean	SD
DERS-16	1	82	30.64	9.53
	2	86	37.66	11.85
Somatic C-PSAS	1	82	12.08	3.70
	2	86	13.86	5.10
RRS	1	82	17.65	5.51
	2	86	20.78	5.92
C-PSAS	1	82	27.01	9.41
	2	86	30.80	11.73

8.1. Sleep trajectories

The results of the current study indicated three dynamic sleep quality trajectories. By adopting cutoff scores suggested in previous studies (a cutoff score of 5 or more is indicative of poor overall sleep quality)[10], the majority of the perinatal women in the current study reported having poor sleep quality

from late-pregnancy to 4 months postpartum. The results were consistent with a previous study reported that only 18.4% of the women were in the "stable good" group which began with and maintained low PSQI scores across 28 weeks of pregnancy to 3 months postpartum[6]. In some earlier studies investigating sleep quality during the perinatal period, researchers identified both three-class[6,20] and four-class trajectories[2] suggesting that consistent sleep trajectory patterns were observed in perinatal women. Both the three- and four-class trajectories in the previous studies and the current study evidenced that perinatal women experienced a significant increase in sleep complaints during the late pregnancy period and the majority also reported consistently poor sleep quality until months after postpartum. This consistent finding across different studies highlights the importance of focusing on sleep care during this critical period to address the increased sleep-related complaints reported by expectant mothers.

While the trajectories of changes in sleep quality over time for the three sleep class groups were similarly shaped in earlier studies[6,20], the current study identified three distinct patterns of sleep trajectory classes: "stable good," "stable mild," and "fluctuating poor" sleep classes. The "stable good" and "stable mild" sleep classes shared similar patterns and represented up to 93% of the study population. These classes were characterized by a low to mild PSQI score at Time 1, which remained relatively low or gradually decreased across Time 2 and Time 3. However, the "fluctuating poor" sleep class (Class 3), which included 12 participants (7% of 168) showed an unusual pattern. At Time 1, Class 3 starts with a relatively high mean sleep quality score. However, by Time 2, the mean sleep quality score for Class 3 increased dramatically and reaching its highest point (M= 16.25). This suggests a significant deterioration in sleep quality at one month postpartum. At Time 3, the mean sleep quality score for Class 3 reduces but remains the highest compared to the 'stable good' and 'stable mild' sleep classes. The significant fluctuations in sleep quality for Class 3, along with the overall poor sleep quality observed across all three time points, suggest that participants in Class 3 may have some unique characteristics compared to participants in Class 1 and Class 2.

The results from the logistic regression modelling suggest that difficulties in emotion regulation (as measured by the DERS-16) and postpartum social support (as measured by the PSSQ) may help explain the different patterns of sleep trajectories observed in the study population. When comparing DERS-16 mean scores, Class 2 ("stable mild") had the highest score (mean = 49.82), indicating greater difficulties in emotion regulation compared to Class 1 ("stable good") (mean = 31.33) and Class 3 ("fluctuating poor") (mean = 39). Indeed, Class 2 also had the highest baseline (Time 1) PSQI scores compared to Class 1 and Class 3. These findings suggest that participants in Class 2 may have faced significant challenges in managing their emotions, which could have negatively impacted their sleep quality at Time 1. Previous studies have evidenced the association between emotion regulation difficulties and sleep disturbances[21,22]. It has been suggested that individuals suffering from insomnia often experience higher levels of emotional distress and poorer emotional regulation compared to those with healthy sleep patterns and better sleep quality. Emotional stimuli may also affect circadian drives for sleep through the interaction between brain regions responsible for affect regulation, such as the amygdala and prefrontal cortex and those responsible for

sleep regulation, including the hypothalamus. This interplay may lead to a cycle where emotional distress exacerbates sleep quality, which in turn further impairs emotional regulation[21,22].

Cultural factors and the different postpartum care rituals between Asian countries and Western countries may also contribute to the discrepancies between trajectory studies. Many Asian countries have the traditional Chinese postpartum care practice of "doing the month," which including specific dietary restrictions, hygiene practices as well as extensive social support provided by family members and is believed to promote the mother's physical and emotional well-being during the early postpartum period[5]. The beliefs and practices of "doing the month" originate from Chinese women's cultural understanding and social interactions[23]. During the first month after childbirth, mothers are thought to benefit both physically and psychologically from the care and guidance of experienced female family members, as well as support from other members of the family[24]. "Doing the month" may influence how sleep patterns change during the postpartum period. During the first month after childbirth, mothers may have better sleep quality when family members provide timely support and take on some of the responsibilities of infant care. Mothers may experience less fragmented sleep when others assist with nighttime infant care. This social support can help mothers recover more quickly from physical discomfort following delivery and late-pregnancy sleep deficits, leading to a steadier sleep trajectory during the postpartum period. With structured support from the family, mothers may even experience gradual improvements in their sleep trajectories as their infant's sleep patterns begin to stabilize.

Alternatively, the association between high social support and poor sleep in Class 3 may reflect a **reverse causality mechanism**, often described as the "reactive mobilization" of support[25]. Rather than social support causing sleep disturbances, it is plausible that women exhibiting severe sleep problems and visible distress elicited greater concern and involvement from their family. In the context of Chinese culture, a mother struggling with "doing the month" rituals or infant care is likely to receive intensified and potentially intrusive assistance from everyone around her. Thus, the elevated PSSQ scores in the "fluctuating poor" group may represent a family's response to the mother's crisis, rather than a contributing cause of her sleep problems.

Based on the results of the current study, the "fluctuating poor" sleep group (Class 3) had the highest mean score for postpartum social support (M = 69.67, as measured by the PSSQ), suggesting that these participants received higher levels of social support compared to the "stable good" (M = 61.94) and "stable mild" (M = 57.91) sleep groups. However, despite receiving extensive social support, participants in the "fluctuating poor" sleep group still exhibited a poor sleep quality trajectory, which peaked at one month postpartum (Time 2). This discrepancy may suggest that the type or method of social support received by participants in the "fluctuating poor" group may not adequately address their specific needs related to sleep quality. A study conducted by Dennis and Ross reveals an important aspect of delivering effective social support. That is the need for problem-focused informational support, which includes providing practical information to help the receivers manage specific problems, such as sleep disturbances[26]. When applying to postpartum care, this problem-focused informational support could include providing

study sessions for new mothers about sleep hygiene practices, communication techniques between mothers and their parents or parents in law, stress management session and ways to balance traditional care practices with modern care providers. Although previous empirical studies have suggested that social support is crucial for postpartum women in reducing postpartum mental disorders, the type and quality of support also play an important role in its effectiveness[5,26-28].

Interestingly, participants in the "fluctuating poor" sleep group (Class 3) exhibited a peak score in sleep disturbances at Time 2 (one month postpartum), which coincides with the period when traditional postpartum care, often referred to as "doing the month," is most intensive. Compared to the "stable good" sleep group (M = 61.94, as measured by the PSSQ) and the "stable mild" sleep group (M = 57.91), the highest PSSQ score observed in the "fluctuating poor" sleep group (M = 69.67), indicating that greater social support was associated with poorer sleep quality. While social support has a positive influence on women's childbearing experience and it is shown to be a preventive factor of postpartum depression[29] and reduces anxiety and stress and improve self-efficacy[30], "excessive" social support may have an adverse effect on mothers' sleep quality for the following reason. The traditional "doing the month" practice among Chinese postpartum women often includes extreme dietary and activity restrictions that may potentially affect sleep. For example, traditional beliefs may restrict activities such as bathing or outdoor exercise that promote relaxation or sleep hygiene. Moreover, the sudden extensive attention received by the mothers and the pressure to adhere to traditional practices might increase stress and rumination at night, which may further affect their sleep quality. Nonetheless, it is also possible that the observed finding may indicate that mothers with poorer sleep elicited greater social support from families and friends. The impact of the unique doing the moth practice on sleep quality and wellbeing in Chinese women requires further investigations[31,32].

8.2. Depression trajectories

In the current study, two distinct and stable trajectories of depressive symptoms that continued from late pregnancy to early postpartum were identified. This finding is not aligned with conclusions drawn from an earlier meta-analysis study that suggested a cubic three-trajectory pattern of depression is the most common pattern observed in the perinatal population[33]. Differences in sample characteristics might potentially affect the observed trajectories, as well as differences in study design, including the timing of the measurements and the instruments used to evaluate perinatal depression levels. The current study sample consisted of highly educated participants, with 80.35% holding a bachelor's degree or higher. Additionally, 55.4% reported a household income of 500,000 HKD or above and 17.3% had an annual household income exceeding 1,000,000 HKD. Higher education levels and socioeconomic status (SES) are often associated with better coping strategies for mental health and illness and more access to social support, potentially resulting in a larger "stable low" trajectory and fewer "stable high/chronic high" cases relative to lower-SES populations[34,35]. Glasheen, et al.[35] reported a predominance of low-SES women in their study sample, with majority of the participants classified in a stable high-symptom trajectory. Moreover, the statistical methods conducted in the current study might differ from some of those studies in the meta-analysis, potentially affecting the identification of the trajectory patterns[35].

Among the participants, 48.8% were identified as Class 1, the "low-risk" group, while 86 participants (51.2% of the total sample, N = 168) were identified as Class 2, the "high-risk" group. The "low-risk" group exhibited a steady decline in depressive symptoms over time, whereas the "high-risk" group began with a high EPDS score, which peaked at Time 2 before gradually decreasing at Time 3. Results from logistic regression modelling suggested that difficulty in emotion regulation (as measured by the DERS-16), rumination (as measured by the RRS), somatic pre-sleep arousal and pre-sleep arousal (including both cognitive and somatic components, as measured by the C-PSAS) may help explain the different patterns of depression trajectories observed in the study population.

Similar to the factors predicting sleep trajectory membership, difficulty in emotion regulation (DERS-16) significantly distinguished between the depression trajectory classes, with the "low-risk" group demonstrating better emotion regulation. Greater difficulties in emotion regulation were associated with an increased likelihood of being in the "high-risk" depression group, highlighting the critical role of emotion regulation in depressive symptom trajectories. Previous research has reported that attempts to suppress the outward display of emotions without properly regulating internal emotional experiences may contribute to the development and maintenance of anxiety and mood disorders[36].

Similarly, having trouble implementing appropriate emotion regulatory strategies such as rumination and suppression may also contribute to psychopathology and sleep disturbances[37]. Meanwhile, the results of current study also indicated that rumination was a significant predictor for the depression trajectories group membership. It significantly differentiated the two depression trajectories, with the participants in "low-risk" group having lower average scores on RRS (M =17.65) compared to the participants in the "high-risk" depression group (M =20.78). Previous research suggested that higher nocturnal rumination observed among insomniac women, who showed more depressive symptoms, is associated with a higher risk of developing suicidal ideation during perinatal period compared to healthy controls[38]. Infant-related nighttime rumination has been shown to be implicated in both poor sleep and perinatal depression[37,39]. Certain processes that regulate sleep (e.g. homeostatic systems, cognition, arousal regulation) are impaired among insomniac individuals[40] and these impairments may promote worrying and rumination at night, which may exacerbate emotion dysregulation and thereby increasing the likelihood of mood disorders such as depression[40]. Interestingly, the results of the current study also suggested that pre-sleep arousal was a significant predictor of depression trajectory group membership. Similar to emotion regulation and rumination. Participants in the 'low-risk' group also had lower average scores on pre-sleep arousal (as measure by C-PSAS) (M=20.01) compared to the participants in the 'high-risk' depression group (mean=30.80).

While many studies have demonstrated that, compared to pre-sleep somatic arousal, pre-sleep cognitive arousal tends to have a greater negative impact on sleep quality and that individuals who score high on both insomnia and cognitive arousal scales are at the highest risk of developing depression later on[41,42], the current study's results did not suggest a significant role for cognitive arousal in either sleep or depression trajectories. In contrast, pre-sleep somatic arousal appeared

to play a role in predicting group membership in depression trajectories. While this discrepancy between the current study and previous studies on the role of pre-sleep somatic arousal may arise from methodological factors, including differences in sample characteristics, instruments used and choice of statistical analysis, it may also be due to the fact that high somatic arousal is uniquely associated with early morning awakenings and being unable to return to sleep after waking[43]. The disrupted sleep patterns resulting from early morning awakening may contribute to later postpartum depression. This feature was not captured by the C-PSAS used in the study, as it only measured arousals before nocturnal sleep time. Furthermore, pre-sleep cognitive arousal does not seem to play a significant role in early morning awakenings, suggesting that physical symptoms are more critical in this aspect of sleep disruption[43]. Future research could explore the role of somatic arousal in sleep more comprehensively, with a particular focus on its association with early morning awakenings and difficulties returning to sleep.

9. Limitations

There are several methodological limitations to consider when interpreting the results of the current study. The use of semi-parametric group-based trajectory modeling (GBTM) also presents certain limitations. When compared to other well-established model that measured trajectories such as growth mixture modeling (GMM), GBTM assumes within-group homogeneity, which may oversimplify the underlying continuous nature of the factors being measured. One of the reasons why GBTM was selected for its study was due to limited sample size. Indeed, the sample size (N=168) is one of a major limitation. Although repeated measurements were used at three time points with >500 observations each for the sleep and depression variables, a previous study suggested that the estimates from group-based trajectory models using this algorithm are generally reliable with ≥500 observations (Loughran & Nagin, 2006). With a sample of only 168 participants, our study is at the lower threshold for this method. Furthermore, a limited study sample makes it harder to account for contextual influences that might affect the trajectories. The statistical model fit is also more challenging with a small study sample, which can affect the reliability of the trajectory estimates.

It is also important to consider the sociodemographic characteristics of our sample, which was predominantly highly educated (80.3% holding a bachelor's degree or above). This demographic profile may introduce a unique stressor. Highly educated women may be more likely to question the scientific validity of restrictive "doing the month "rituals (e.g., prohibitions against bathing or wind exposure). Being pressured by older generations to follow to these practices while holding conflicting modern health beliefs may generate psychological distress and family conflict, potentially exacerbating both sleep disturbances and depressive symptoms. This issue might be less prevalent in lower-SES populations who may be more likely to accept traditional practices without the same degree of questioning.

Moreover, although the EDPS has been widely used among the perinatal population and has been proven to have high reliability and validity, this assessment does not represent clinical diagnoses of postpartum depression. The study also excluded participants reported having perinatal complications or severe medical diseases; consequently, the results of the study may not fully capture the sleep-depression dynamics in the targeted population. Future research is encouraged to include women with high-risk pregnancies to provide a more comprehensive understanding of how these factors affect the association between sleep and depression during pregnancy and the postpartum period. Furthermore, the three time points spaced months apart may not be sensitive enough to capture the dynamic nature of emotion regulation, pre-sleep arousal or rumination during this period. Future studies with more frequent, weekly or even daily assessments would improve the accuracy and provide a more in-depth understanding of the interplay between sleep and depression trajectories in the perinatal population.

10. Implications & Future Directions

While the results of the current study should be considered preliminary, this research makes an important contribution by enhancing the understanding of sleep-depression dynamics among Chinese perinatal women who lived in Hong Kong. Distinct patterns of sleep and depression trajectories were identified. Several factors that play significant roles in predicting the group memberships of sleep and depressive trajectories were also identified, highlighting the need for further investigation into the roles of rumination, pre-sleep arousal, emotion regulation and social support underlying sleep and depression. Our findings revealed several significant predictors of sleep and depression trajectory group membership-including rumination, pre-sleep arousal, emotion regulation and social support. This finding may provide valuable mechanistic insights into the association between perinatal disturbed sleep and depressive symptoms, advancing our understanding about the two conditions beyond simple correlational associations. Unlike prior studies that primarily emphasized demographic predictors of trajectory class membership (e.g., age, socioeconomic status), our research uniquely establishes difficulty in emotion regulation (DERS-16) as a transdiagnostic mechanism differentiating both sleep trajectory patterns and depression trajectories. This provides more important mechanistic insight about the role of emotion regulation into the perinatal sleep-depression association.

This study also provides some new insights into how cultural and social factors uniquely influence sleep and depressive symptoms among Chinese women who follow the traditional Chinese rituals "doing the month." In Chinese population, "doing the month" is prevalent and plays a significant role in shaping maternal experiences. An early study reported that up to 70.9% of interviewed women in Hong Kong followed traditional 'doing the month' practices[31]. A more recent study of mainland Chinese women also found that up to 59.5% of participants adhered to certain postpartum practices and 36.5% of participants had dietary-related postpartum practices[32]. However, based on the results of current study, extensive social support may not adequately address the specific needs of the mother and it may even worsen their sleep quality and mood. Although previous empirical studies have suggested that social support is crucial for postpartum women in reducing sleep disturbances and postpartum depression, the type and quality of support also play an important role in its effectiveness[26-28]. Future studies may focus on developing culturally tailored interventions that integrate traditional Chinese postpartum care with modern psychological and medical approaches to deliver more timely and culturally appropriate interventions for local

mothers in need. Future studies may also include mothers with high-risk pregnancies, such as women with eclampsia or gestational diabetes. Including these subgroups of mothers may provide a more comprehensive understanding of how these additional stressors affect sleep quality and postpartum depression levels. Moreover, future studies may extend the follow-up period beyond the early postpartum period to a year postpartum, which may provide a more complete picture of how sleep and depression trajectories develop over time.

To conclude, although with several limitations, the present study still offers valuable new insights into the dynamics of sleep and depression patterns across late pregnancy to early postpartum period. These insights may have the potential to guide the development of more targeted prevention and intervention strategies aimed at supporting women's mental health during this critical life period.

11. Acknowledgments

12. Declaration of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

13. Funding Declaration

14. References

1. Sivertsen B, Hysing M, Dørheim SK, et al. Trajectories of maternal sleep problems before and after childbirth: A longitudinal population-based study. BMC Pregnancy and Childbirth, 2015.

2. Tomfohr LM, Buliga E, Letourneau NL, et al. Trajectories of sleep quality and associations with mood during the perinatal period. Sleep, 2015;38: 1237-1245.

3. Sedov ID, Tomfohr-Madsen LM. Trajectories of insomnia symptoms and associations with mood and anxiety from early pregnancy to the postpartum. Behavioral Sleep Medicine, 2021;19: 395-406.

4. Kuo SY, Yang YL, Kuo PC, et al. Trajectories of depressive symptoms and fatigue among postpartum women. JOGNN - Journal of Obstetric, Gynecologic and Neonatal Nursing, 2012;4: 216-226.

5. Ding G, Niu L, Vinturache A, et al. Doing the month and postpartum depression among Chinese women: A Shanghai prospective cohort study. Women and Birth, 2020;33: 151-158.

6. Lin-Lewry M, Tzeng YL, Li CC, et al. Trajectories of sleep quality and depressive symptoms in women from pregnancy to 3 months postpartum: A prospective cohort study. Journal of Sleep Research, 2023;32.

7. Yang F, Yang BX, Stone TE, et al. Stigma towards depression in a community-based sample in China. Comprehensive Psychiatry, 2020;97.

8. Pearlin LI. The Stress Process Revisited: Reflections on Concepts and Their Interrelationships. Kluwer Academic Publishers, 1999.

9. Abdollahi F, Sazlina SG, Zain AM, et al. Postpartum depression and psycho-socio-demographic predictors. Asia-Pacific Psychiatry, 2014;6: 425-434.

10. Buysse DJ, Reynolds CF 3rd, Monk TH, et al. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Research, 1989;28: 193-213.

11. Ho KY, Lam KKW, Xia W, et al. Psychometric properties of the Chinese version of the Pittsburgh Sleep Quality Index (PSQI) among Hong Kong Chinese childhood cancer survivors. Health and Quality of Life Outcomes, 2021;19.

12. Cox JL, Holden JM, Sagovsky R. Detection of Postnatal Depression. British Journal of Psychiatry, 1987;150(6): 782-786.

13. Loscalzo Y, Giannini M, Contena B, et al. The Edinburgh Postnatal Depression Scale for fathers: A contribution to the validation for an Italian sample. General Hospital Psychiatry, 2015;37(3): 251-256.

14. Boyce P, Stubbs J, Todd A. The Edinburgh Postnatal Depression Scale: Validation for an Australian Sample. Australian & New Zealand Journal of Psychiatry, 1993;27: 472-476.

15. Murray L, Carothers AD. The Validation of the Edinburgh Post-natal Depression Scale on a Community Sample. British Journal of Psychiatry, 1990;157: 288-290.

16. Matthey S, Barnett B, Kavanagh DJ, et al. Validation of the Edinburgh Postnatal Depression Scale for men and comparison of item endorsement with their partners. Journal of Affective Disorders, 2001;64: 175-184.

17. Nagin DS. Group-Based Modelling of Development. Harvard University Press, 2005.

18. Loughran T, Nagin DS. Finite sample effects in group-based trajectory models. Sociological Methods and Research, 2006;35: 250-278.

19. Jones BL, Nagin DS. Advances in group-based trajectory modelling and an SAS procedure for estimating them. Sociological Methods and Research, 2007;35: 542-571.

20. Wang G, Deng Y, Jiang Y, et al. Trajectories of sleep quality from late pregnancy to 36 months postpartum and association with maternal mood disturbances: A longitudinal and prospective cohort study. Sleep, 2018;41.

21. Saper CB, Cano G, Scammell TE. Homeostatic, circadian and emotional regulation of sleep. Journal of Comparative Neurology, 2005;493: 92-98.

22. Scott BA, Judge TA. Insomnia, emotions and job satisfaction: A multilevel study. Journal of Management, 2006;32: 622-645.

23. Callister LC. Doing the Month. MCN, The American Journal of Maternal/Child Nursing, 2006;31: 390.

24. Heh SS, Chin YL, Fu YY. Postpartum social support experience while Doing the month in Taiwanese women. Journal of Nursing Research, 2001;9: 13-24.

25. Gordon AM, Carrillo B, Barnes CM. Sleep and social relationships in healthy populations: A systematic review. Sleep Medicine Reviews, 2021;57: 101428.

26. Dennis CL, Ross L. Women's perceptions of partner support and conflict in the development of postpartum depressive symptoms. Journal of Advanced Nursing, 2006;56: 588-599.

27. Kent de Grey RG, Uchino BN, Trettevik R, et al. Social support and sleep: A meta-analysis. Health Psychology, 2018;37: 787-798.

28. Prati G, Pietrantoni L. The relation of perceived and received social support to mental health among first responders: a meta-analytic review. Journal of Community Psychology, 2010;38: 403-417.

29. Reid KM, Taylor MG. Social support, stress and maternal postpartum depression: A comparison of supportive relationships. Social Science Research.

30. Xiao H, Zhang Y, Kong D, et al. The effects of social support on sleep quality of medical staff treating patients with coronavirus disease 2019 (COVID-19) in January and February 2020 in China. Medical Science Monitor, 2020;26: 1-8.

31. Leung SSK, Martinson IM, Arthur D. Postpartum depression and related psychosocial variables in Hong Kong Chinese women: Findings from a prospective study. Research in Nursing & Health, 2004;28: 27-38.

32. Zhao A, Huo S, Tan Y, et al. The Association between Postpartum Practice and Chinese Postpartum Depression: Identification of a Postpartum Depression-Related Dietary Pattern. Nutrients, 2022;14: 903.

33. Baron E, Bass J, Murray SM, et al. A systematic review of growth curve mixture modelling literature investigating trajectories of perinatal depressive symptoms and associated risk factors. Journal of Affective Disorders, 2017;223: 194-208.

34. Lund HG, Reider BD, Whiting AB, et al. Sleep Patterns and Predictors of Disturbed Sleep in a Large Population of College Students. Journal of Adolescent Health, 2010;46: 124-132.

35. Glasheen C, Richardson GA, Kim KH, et al. Exposure to maternal pre- and postnatal depression and anxiety symptoms: Risk for major depression, anxiety disorders and conduct disorder in adolescent offspring. Development and Psychopathology, 2013;25: 1045-1063.

36. Gross JJ. Emotion Regulation: Conceptual and Empirical Foundations. 2nd ed. Vol 28. Guilford Press, 2014.

37. Sladek MR, Doane LD, Breitenstein RS. Daily rumination about stress, sleep and diurnal cortisol activity. Cognition and Emotion, 2020;34(2): 188-200.

38. Kalmbach DA, Cheng P, Ong JC, et al. Depression and suicidal ideation in pregnancy: exploring relationships with insomnia, short sleep and nocturnal rumination. Sleep Medicine, 2020;65: 62-73.

39. Kalmbach DA, Roth T, Cheng P, et al. Mindfulness and nocturnal rumination are independently associated with symptoms of insomnia and depression during pregnancy. Sleep Health. 2020;6(2):185-191.

40. Woznica AA, Carney CE, Kuo JR, et al. The insomnia and suicide link: Toward an enhanced understanding of this relationship. Sleep Medicine Reviews, 2015;22: 37-46.

41. Kalmbach DA, Ahmedani BK, Gelaye B, et al. Nocturnal cognitive hyperarousal, perinatal-focused rumination and insomnia are associated with suicidal ideation in perinatal women with mild to moderate depression. Sleep Medicine, 2021;81: 439-442.

42. Kalmbach DA, Cheng P, Drake CL. A pathogenic cycle between insomnia and cognitive arousal fuels perinatal depression: Exploring the roles of nocturnal cognitive arousal and perinatal-focused rumination. Sleep, 2021;44: 1-14.

43. Kalmbach DA, Cheng P, Roth A, et al. DSM-5 insomnia disorder in pregnancy: Associations with depression, suicidal ideation and cognitive and somatic arousal and identifying clinical cutoffs for detection. SLEEP Advances, 2022;3.