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Joint Trajectories of Depression, Anxiety, and Sleep Quality During Pregnancy and Their Risk Factors: A Prospective Longitudinal Study

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Abstract: *Objective*: This study aimed to describe the joint trajectories of depression, anxiety, and sleep quality during pregnancy, identify at-risk trajectory populations, and identify their predictable risk factors. *Methods*: The sample consisted of 146 pregnant women who completed the pregnancy follow-up. Data were collected at four gestational time points. Parallel process latent class growth analysis (PP-LCGA) was employed to identify the synchronous trajectory patterns of depression, anxiety, and sleep quality. Multiple logistic regression models determined the risk factors associated with individuals exhibiting these vulnerable trajectories. *Results*: Three trajectories related to changes in depression, anxiety, and sleep quality during pregnancy were identified as follows: the stable asymptomatic group (34.2%), the general health group (43.8%), and the joint symptoms group (21.9%). The predictors of the joint symptoms group trajectory included abortion experience (OR = 2.366, 95% CI [1.153;4.856]), lower back pain during pregnancy (OR = 3.286, 95% CI [1.296;8.331]), and the impact of pregnancy on daily life (OR = 5.619, 95% CI [1.843;17.128]). *Conclusions*: There is heterogeneity in the trajectories of depression, anxiety, and sleep quality during pregnancy. Previous miscarriage, low back pain in the first trimester, and the impact of pregnancy on life were predictors in the combined trajectory group.

Keywords: Gestational depression; Pregnancy-related anxiety; Sleep quality during pregnancy; Prospective longitudinal study; Joint trajectory analysis; PP-LCGM

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1. Introduction

According to the World Health Organization's 2017 report, the global prevalence of depression has reached approximately 300 million individuals. Among pregnant women, the prevalence of depression is increasing, with one Netherlands-based study showing an increase from approximately 7% in 1988-1989 to 14% in 2012–2014. Studies in China have shown that the prevalence of prenatal depression among women in the second trimester significantly increased from 31.82% to 60.59% between 2016 and 2021 [1], and the most recent umbrella review and meta-analytic synthesis have revealed that the pooled prevalence of antenatal depression is 29% [2]. Depression can be detected early in pregnancy, suggesting that timely interventions can be made during pregnancy to control the risk [3]. However, depression and anxiety can co-occur during pregnancy [4], and poor sleep quality often co-occurs with both [5–9], which complicates the intervention process because anxiety and poor sleep quality are also independent risk factors for depression [10,11]. Compared with those without such risk factors, women who present with multiple risk factors, including sleep disturbances, depressive symptoms, and anxiety, are at a significantly greater risk of developing postpartum depression [12]. In pregnancy health management, if the complex relationships among depression, anxiety, and sleep quality are not considered, some risk groups may be missed. Moreover, cross-sectional screening for depression, anxiety, and sleep quality does not predict how they will change throughout pregnancy.

Advances in longitudinal research methods have provided new support for current mental health care during pregnancy. Via trajectory model studies, we have found significant population heterogeneity in the trajectory of depression, anxiety, and sleep quality during pregnancy [13–15]Bmoderate-stable^ (42.3%. These independent trajectory studies have revealed changes in depression, anxiety, and sleep quality during pregnancy and their respective risk factors, providing an indispensable basis for identifying risk groups throughout pregnancy. However, these studies did not consider the covariant relationships among depression, anxiety, and sleep quality, which could reduce the ability to identify this at-risk group. Moreover, the discrete modeling method for depression, anxiety, and sleep quality increases the number of potential subgroups (3 depression subgroups × 3 anxiety subgroups × 2 sleep subgroups = 18 combinations), significantly reducing clinical operability.

Few studies have examined synchronized trajectories of depression, anxiety, and sleep quality during pregnancy in the same sample. To the best of our knowledge, one study has used the latent growth curve model (LGCM) and the parallel process model to analyze the relationship between depressive symptom trajectory and sleep quality from the second trimester to 3 months postpartum [16]. The results indicated that women with poorer sleep quality were more likely to exhibit more severe depressive symptoms ($\beta = 0.73$, $P < 0.001$). The sleep quality trajectory slope interacted with the depression slope ($\beta = 0.33$, $P < 0.05$), with a greater sleep slope associated with a greater depression slope. These findings suggest that depression during pregnancy and poor sleep quality may change together. Unfortunately, owing to the scope of the purpose of the study, it failed to explore the population heterogeneity of depression trajectories or to fit the change trajectories of depression and sleep quality. Another study, examining postpartum women, has identified four bivariate growth targets for postpartum depression and anxiety through a mixed model of potential category growth, including high comorbidity (5.4%), moderate comorbidity (19.4%), low anxiety and depression symptom reduction (18.6%), and low symptoms (56.6%) [17]. Multiple logistic regression has revealed that mothers who slept less during pregnancy were more likely to fall into the high comorbidity or moderate symptom categories than into the low symptom category.

This prior study did not focus on the pregnant population. Because pregnancy is the early process of the postpartum stage, we speculate that the combined trajectory of depression, anxiety, and sleep in the pregnant population may be similar to the results of these bivariate trajectories, with the possibility of population heterogeneity and joint changes.

The present study employed a potential growth model to analyze the concurrent trajectories of depression, anxiety, and sleep quality during pregnancy. This approach offers two significant advantages over traditional methods. This approach can effectively identify multidimensional patterns of simultaneous changes in these three dimensions, and subgroup optimization on the basis of the Bayesian information criterion (BIC) allows for appropriate balancing of model complexity while maintaining clinical utility. The present study had two primary objectives. First, parallel-process latent class growth analysis was employed to identify the synchronous trajectory patterns of depression, anxiety, and sleep quality. The characteristics of these trajectories were examined to pinpoint vulnerable trajectories. Second, multiple logistic regression models were subsequently used to determine the risk factors associated with individuals exhibiting these vulnerable trajectories, including sociodemographic factors, obstetrical factors, family factors, personal habits, interpersonal factors, and physiological and life changes after pregnancy. The anticipated findings provide a robust foundation for early investigation and intervention within the pre- and post-birth psychological services system.

2. Method

2.1. Population description

The present study used convenience sampling to sample 203 women in the first trimester of pregnancy who underwent prenatal care at all five community hospitals in a city in western China between June 2023 and December 2023.

The inclusion criteria were as follows: participants who possessed normal expressive and comprehension abilities, and participants who intended to reside in the city throughout their pregnancy. The exclusion criteria included twin or multiple pregnancies, individuals diagnosed with mental or personality disorders, individuals with intellectual disabilities, those with a history of substance or alcohol abuse, and women who experienced severe infections or fetal abnormalities during pregnancy.

2.2. Data collection

Data were obtained via an electronic questionnaire. At 11–13 weeks of gestation (T1), researchers collected basic information and depression, anxiety, and sleep quality data from pregnant women after they completed a pregnancy examination and signed an informed consent form. Follow-up was performed at 20–22 weeks (T2), 30–32 weeks (T3), and 36–38 weeks (T4) of gestation. These specific assessment times were selected to capture the progression of depression, anxiety, and sleep quality throughout pregnancy; these time points are consistent with clinical follow-up visits during pregnancy and can contribute to early detection and ongoing monitoring of depression, anxiety, and sleep quality during pregnancy.

As with any longitudinal study, sample depletion was inevitable. The sample sizes for the four measurements were 203, 177, 167, and 146, respectively. In the present study, the main reason for sample loss was that during pregnancy, such as during teratological examination and predelivery examination, some pregnant women chose a tertiary hospital rather than a community hospital for examination to obtain more

reliable results. To determine whether the missing samples were biased, the differences in depression, anxiety, and sleep quality scores were analyzed between the participating and missing samples, which revealed no statistical significance. Missing data were identified as random missing data.

The basic information covered the following six areas: sociodemographic factors (e.g., age, education, income and expenditure); obstetric factors (e.g., number of births, history of miscarriage, and whether pregnancy was planned); personal habit factors (e.g., time of daily activity, frequency of smoking, frequency of drinking, and frequency of exercise); interpersonal factors (e.g., extroversion, sociability, and relationship); family factors (e.g., number of family members living together, satisfaction with living conditions, and disturbance of sleep by family members); and physical, psychological and life changes after pregnancy (e.g., fatigue, low back pain, leg cramps, abdominal discomfort, the impact of pregnancy on daily life, birth fears, happiness, and other discomforts). All the information was gathered through a structured questionnaire, and the participants selected the most suitable options on the basis of their individual situations.

In this study, depression, anxiety, and sleep quality were evaluated using standardized scales.

The Self-Rating Depression Scale (SDS), developed by William W.K. Zung in 1965 [18], is a standardized self-rating scale used to assess the severity of depressive states and their changes during treatment. The scale contains 20 declarative sentences and corresponding question items. The item scores are summed and multiplied by 1.25 to obtain the standard score. The abnormal threshold of the SDS standard score is set at 53 points according to the results of the Chinese norm. Specifically, a score ranging from 53 to 62 points indicates mild depression, a score ranging from 63 to 72 points suggests moderate depression, and a score of 72 points or more indicates severe depression. In this study, the Cronbach's α coefficients of the SDS at the four measurement time points were 0.877, 0.880, 0.871, and 0.880.

The Self-rating Anxiety Scale (SAS), compiled by William W.K. Zung in 1971 [19], is a standardized self-rating scale that accurately reflects the subjective feelings of patients with anxiety tendencies. The scale consists of 20 declarative sentences and corresponding question items. The scores of the 20 questions are summed and multiplied by 1.25 to obtain a standard score. In accordance with the results of the Chinese norm, we set the cutoff value of the SAS standard score at 50 points. Specifically, a score between 50 and 59 is classified as mild anxiety, a score between 60 and 69 is classified as moderate anxiety, and a score of 70 or above is classified as severe anxiety. In this study, the Cronbach's α coefficients of the SDS at the four measurement time points were 0.880, 0.871, 0.871, and 0.872.

The Pittsburgh Sleep Quality Index (PSQI) was used to assess sleep quality [20]. The scale is composed of 19 self-rated items and five other rated items. The 18 self-rated items included seven factors, namely, sleep quality, time to fall asleep, sleep duration, sleep efficiency, sleep disorders, use of hypnotic drugs, and daytime function, to assess the subjective sleep quality of individuals in the last month. Each factor in the scale is scored on a scale of 0–3, and the score of each factor is summed to obtain the PSQI total score, which ranges from 0–21 points. The higher the score is, the worse the sleep quality. A score of more than 5 indicates a sleep quality problem. In this study, the Cronbach's α coefficients of the SDS at the four measurement time points were 0.893, 0.893, 0.892, and 0.895.

2.3. Ethical considerations

The study was approved by the Ethics Committee of Xinjiang Medical University, China (2023 Ethics Approval Number XJYKDXR20230303010). All female participants in the study signed informed consent forms and were informed of their right to withdraw at any time. Their personal information was only used for

this study and will remain strictly confidential.

2.4. Statistical analyses

Following the first research objective, Mplus 7.4 software was utilized to investigate the joint trajectory of depression, anxiety, and sleep quality during pregnancy via parallel process latent class growth modeling analysis (PP-LCGM). This method extends traditional single-variable latent class growth modeling (LCGM) by constructing a parallel process model that simultaneously examines multiple growth trajectories. This approach is crucial for studying the co-development trajectories of closely related variables. While it is conceptually similar to the growth mixture model (GMM), the parallel process latent class growth modeling analysis does not account for changes in trajectories within the population. The significant differences in growth factors (intercept and slope) observed in this study suggested distinct subgroup characteristics of depression, anxiety, and sleep quality during pregnancy. To simplify the estimation process, four models containing two to five potential classes were subsequently estimated using Mplus 7.4, with the intragroup variance constrained to zero. To accurately determine the optimal number of trajectory categories, various fit indices, including the Akaike information criterion (AIC), Bayesian information criterion (BIC), and sample-size adjusted Bayesian information criterion (a-BIC), were considered. Generally, models with lower AIC, BIC, and a-BIC values are preferred. The Lo-Mendell-Ubin likelihood ratio test (LMR-LRT) was also employed to compare models with k trajectory classes against those with k-1 trajectory classes. A significant *p*-value from the LMR-LRT indicates that the model with k trajectory classes is superior to that with k 1 trajectory classes. Moreover, entropy is used to evaluate the accuracy of the classification. The entropy ranges from 0 to 1.0. The higher the value is, the more accurate the individual classification is. To enhance the universality of the study results, it is also necessary to consider whether each category size accounts for at least 5% of the total sample size. In addition to the above fitting index, the substantial interpretability of trajectory classes cannot be ignored. Thus, we used robust maximum likelihood estimation to process the missing data and complete the model estimation, mapping the covariant trajectories of depression, anxiety, and sleep quality during pregnancy.

The second purpose was analyzed using SPSS 24.0 software. First, we categorized the participants according to the optimal model group information of the covariant trajectories of depression, anxiety, and sleep quality during pregnancy obtained from the first objective. Next, we used a one-way chi-square test to determine whether the baseline variables of different groups were risk factors, setting the significance level at $P < 0.01$. Finally, we incorporated the statistically significant baseline variables into the independent variables for multiple logistic regression analysis. To explore the influencing factors of the common vulnerability trajectory categories of depression, anxiety, and sleep quality during pregnancy, the track grouping category was considered the dependent variable, and the good group category was considered the reference.

2.5. Common method bias test

The common method deviation of the data was tested by the Harman single-factor test. It was found that the first common factor explained 15.29% of the total variance, which was less than the critical value of 40%. Therefore, there is no common method bias problem in the data of this study. It was found that the first common factor explained 15.29% of the total variance, which was less than the critical value of 40%. Therefore, there is no common method bias problem in the data of this study.

3. Results

3.1. General trends in depression, anxiety, and sleep quality during pregnancy

The parallel process latent class growth modeling analysis revealed that the quadratic model fit better than the linear growth model, indicating that depression, anxiety, and sleep quality during pregnancy followed nonlinear growth trends at all four time points. Moreover, the intercepts of the tracks of depression, anxiety, and sleep quality during pregnancy showed significant differences; that is, the initial levels were significantly different ($P < 0.001$). Significant differences were detected only in the second slope of the depression trajectory during pregnancy ($P < 0.001$). However, there was no significant difference in the slopes of anxiety trajectories during pregnancy and sleep quality trajectories ($P = 0.113, 0.528$). These results suggested that parallel processing of LCGMs was necessary.

3.2. Results of parallel process latent class growth modeling analysis

One to six categories were analyzed via process parallel latent class growth modeling to determine the most appropriate number of trajectory categories. The process parallel latent class growth modeling method accounts for multiple growth tracks simultaneously. Parallel process LCGM is particularly useful when joint trajectory fitting is performed on closely related variables, and it has been used in several studies. Because AIC, BIC, and a-BIC gradually increase with the number of categories, selecting the best model according to the information index is challenging. The scree plot of the BIC index revealed that there was an inflection point in the second category, supporting the second category. The entropy value was always higher than 0.8 in classes 1 to 6, indicating high classification accuracy. Classes 2 and 5 were closest to 1, indicating that both categories had higher classification accuracy because the *P*-value of LMR-LRT was only significant in class 2. The scales of classes 5 and 6 were small (n < 5%). Thus, class 2 was supported, and the class 5 model was not selected. However, compared with the statistical index, interpretability and significance based on each category were more important. After carefully examining each class model, we determined that the new class found in the three-class model was more meaningful than the two-class models. The mean scores of depression, anxiety, and sleep quality during pregnancy in the new class were all higher than the clinical value of the scale, which is more meaningful from the perspective of explanation. The solution was also statistically acceptable. Furthermore, compared with the class 3 model, the class 4 model subdivided a class in the class 3 model into two similar subclasses. Therefore, based on the fit index of the trajectory class and its substantial interpretability, the present study determined the class 3 model as the final model. **Table 1** provides the fit indices of the six categories of models for the combined trajectory of depression, anxiety, and sleep quality during pregnancy.

Table 1. Fit statistics for the parallel process latent class growth modeling analysis

	AIC	BIC	a-BIC	Entropy	LMR-LRT (*p*)	Class Proportions
Class 1	10902.134	10955.839	10898.879	-	-	1.000
Class 2	10405.899	10480.490	10401.378	0.913	0.0005	0.38/0.62
Class 3	10255.892	10351.367	10250.105	0.892	0.0996	0.23/0.34/0.43
Class 4	10195.548	10311.909	10188.495	0.888	0.5629	0.49/0.25/0.18/0.08
Class 5	10147.596	10284.842	10139.277	0.910	0.7091	0.20/0.02/0.05/0.49/0.24
Class 6	10110.364	10268.477	10100.761	0.889	0.6524	0.19/0.34/0.12/0.02/0.05/0.29

Note: Boldface indicates the selected model. AIC: Akaike information criterion; BIC: Bayesian information criterion; a-BIC: sample-

size-adjusted Bayesian information criterion; LMR-LRT: Lo–Mendell–Rubin adjusted likelihood ratio test. The bold category is the final selection category.

The mean values of the joint trajectory classes (three classes) of depression, anxiety, and sleep quality during pregnancy are shown in **Figure 1**. The first category accounted for 34.2% of the sample (n = 50). For pregnant women in this class, the scores of the depression, anxiety, and sleep quality scales were lower than the prescribed thresholds at the beginning of pregnancy and remained stable throughout pregnancy. These findings indicated that the pregnant woman did not have depression or anxiety throughout pregnancy and that the quality of sleep remained good; this group was called the stable asymptomatic group. The second class comprised 43.8% of the total sample (n = 64). Women in this class were characterized by relatively high depression, anxiety, and sleep quality scales in early pregnancy, with scores close to the critical value, but the scores remained stable later in pregnancy, with a slight improvement in depression; this group was called the general health group. Class 3 accounted for 21.9% of the total sample (n = 32). Compared with women in the first two classes, women in this category had scores above the threshold on the depression, anxiety and sleep quality scales from early cognition, and these scores continued to be above the threshold throughout pregnancy. Considering that depression, anxiety, and sleep quality concurrently affected women in this group throughout pregnancy, this class was named the joint symptoms group.

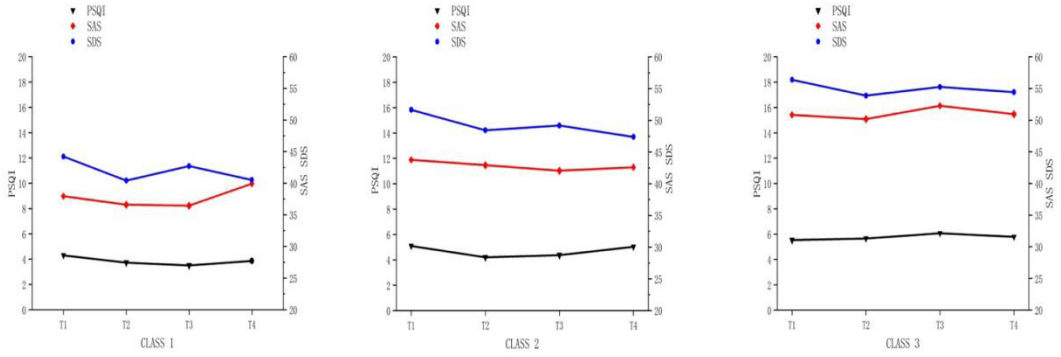

Figure 1. Mean values of the combined trajectories of depression, anxiety, and sleep quality during pregnancy (3 classes).Note: The three figures represent class 1 “stable asymptomatic group”, class 2 “general health group”, and class 3 “joint symptoms group”. The X-axis represents the following four measurement times: T1, 11-13 weeks; T2, 20-22 weeks; T3, 30-32 weeks; and T4, 36-38 weeks. The left Y-axis represents the Pittsburgh Sleep Quality Index Scale (PSQI) score, and the right Y-axis represents the Self-rating Anxiety Scale (SAS) and Self-rating Depression Scale (SDS) scores.

3.4. Predictors of trajectory classes membership

The single-factor test based on demographic factors, sociological factors, obstetrical factors, personal habit factors, interpersonal factors, family factors, and physical and psychological changes after pregnancy is shown in **Table 2**. The trajectory classes were considered as the dependent variables, while demographic and psychosocial factors were considered as the independent variables. χ^2 test analysis was performed, and $P < 0.01$ was considered as the test level. The results revealed statistically significant differences in terms of abortion experience, disturbance of sleep by family members, impact of pregnancy on daily life, and symptoms of low back pain.

Table 2. Univariate analysis of indicators related to depression, anxiety and sleep quality during pregnancy on the basis of joint trajectory categories

Item	Joint trajectories classes			χ^2	*P*
	Stable asymptomatic group (n = 50)	General health group (n = 64)	Joint symptoms group (n = 32)		
Obstetric factor					
Abortion experience				17.221	0.002
No miscarriage	8	42	31		
One miscarriage	14	13	14		
Two or more miscarriages	10	9	5		
Family-related factors					
Family members interfere with sleep					
Yes	15	14	8	9.847	0.007
No	17	50	42		
Some changes after pregnancy					
The impact of pregnancy on daily life				15.485	0.004
Tremendous	6	9	4		
Normal	24	41	25		
Small	2	14	21		
Lower back pain after pregnancy				10.561	0.005
Present	9	27	31		
Not present	23	37	18		

Note: Given the space constraints, only variables that exhibited statistical significance were included. The threshold for statistical significance was set at $P < 0.01$.

With the above statistically significant single-factor test results as independent variables, the trajectory classes were considered as dependent variables, and the multivariate logistic regression was performed for analysis. In this process, the trajectory order was adjusted to the stable asymptomatic group for reference, and the order of the independent variables was also adjusted according to the same hierarchical law. A likelihood ratio test of $P < 0.001$ indicated that the model was valid. The multivariate logistic regression model results revealed that the three independent risk predictors of the joint symptoms group compared with the stable asymptomatic group were abortion experience (OR = 2.366, 95% CI [1.153;4.856]), the impact of pregnancy on daily life (OR = 3.286, 95% CI [1.296;8.331]), and signs of low back pain after pregnancy (OR = 5.619, 95% CI [1.843;17.128]). Compared with the stable asymptomatic group, two independent risk predictors of the general health group were t the impact of pregnancy on daily life (OR = 2.712, 95% CI [1.296;5.674]) and signs of low back pain (OR = 3.183, 95% CI [1.343;7.543]). The detailed statistical results are shown in **Table 3**. This result remained unchanged after removing the single variable, indicating that the regression result was stable.

Table 3. Logistics regression analysis of indicators related to depression, anxiety and sleep quality during pregnancy on the basis of joint trajectory categories

Item	Joint symptoms group			General health group		
	OR	95%CI	*P*	OR	95%CI	*P*
Abortion experience	2.366	1.153-4.856	0.019	1.080	0.578-2.020	0.809
The impact of pregnancy on daily life	3.286	1.296-8.331	0.012	2.712	1.296-5.674	0.008
Lower back pain after pregnancy	5.619	1.843-17.128	0.002	3.183	1.343-7.543	0.009
Family members interfere with sleep	3.363	0.995-11.369	0.051	1.309	0.444-3.856	0.625

Note: The threshold for statistical significance was set at $P < 0.05$.

4. Discussion

4.1. The joint trajectory of depression, anxiety, and sleep quality remains stable during pregnancy

The trajectories of depression, anxiety, and sleep quality during pregnancy were heterogeneous and were categorized into the following three distinct classes: the stable asymptomatic group, the general health group, and the joint symptoms group.

Although scores for the depression, anxiety, and sleep quality scales varied with gestational week across classes, the trajectory of each symptom change was relatively stable over time. A previous study [21]11 has used the LCGA model to analyze the trajectories of depression and anxiety throughout pregnancy, revealing that these trajectories remain stable throughout gestation. The present study confirmed this finding using the PP-LCGM method, and the present results suggested that sleep quality during pregnancy was generally stable, which was consistent with the trajectories of depression and anxiety. However, longitudinal studies have revealed several trajectory groups of sleep quality during pregnancy, including high sleep quality throughout pregnancy (21.5%), low sleep quality during pregnancy (59.5%), significantly lower sleep quality during pregnancy (12.3%), and low sleep quality throughout pregnancy (6.7%) [15]. The present study adopted a joint trajectory model of sleep, depression, and anxiety, revealing that on the basis of an average sleep value, the sleep quality changed for each class. Sleep quality tended to deteriorate in the third trimester of pregnancy; however, the change in the slope of sleep quality was not statistically significant, indicating that the change trend was not obvious. The group with a significant decline in sleep quality was not fitted. This inconsistency may be due to different statistical models having different assumptions regarding changes in the growth trajectory of the individuals identified in each group, and it may also be due to stable depression and anxiety trajectories during pregnancy, as well as stable sleep quality. Previous studies have shown that poor sleep quality during pregnancy is associated with depressive symptoms [21. Regardless of the cause, the present study revealed that the joint trajectory of depression, anxiety, and sleep quality during pregnancy remained stable throughout pregnancy. These findings suggested that screening for depression, anxiety, and sleep quality in pregnant women and early intervention could theoretically yield better intervention effects, supporting early psychological screening in pregnancy care.

4.2. Comorbidities with depression, anxiety, and sleep quality during pregnancy exist

The joint trajectory results obtained in the present study did not fit the single vulnerable trajectory,

confirming that gestational anxiety, depression, and sleep trajectories are simultaneously correlated and are universal throughout pregnancy [23]. This result was in line with our expectations, as previous studies have reported associations between depression and anxiety during pregnancy [21,23,24]. The present study is the first to analyze the common trajectory changes of depression, anxiety, and sleep quality from the perspective of a joint trajectory. In particular, the joint symptoms group class of pregnant women identified in this study had depression, anxiety, and sleep quality scores above the scale threshold throughout pregnancy, indicating that these pregnant women were affected by multiple symptoms from early pregnancy until delivery. As this group accounts for 21.9%, these results cannot be ignored. In mental health care during pregnancy, the depression, anxiety, and sleep quality of pregnant women should receive equal attention; after all, mental health during pregnancy is closely related to postpartum depression, and multiple symptoms may significantly increase the likelihood of postpartum depression [28].

4.3. Factors influencing the joint trajectory of depression, anxiety, and sleep quality during pregnancy

Through multivariate logistic regression analysis, the present study revealed that the joint trajectory of depression, anxiety, and sleep quality during pregnancy had several significant characteristics. The predictors of the joint symptoms group included previous miscarriage experience and changes in physiological and life factors after pregnancy, such as low back pain symptoms and the impact of pregnancy on life. These results were inconsistent with previous results of separate regression analyses of depression and anxiety trajectories [13], which identified nation, maternal age, and relationship satisfaction as risk factors for the perinatal depression trajectory, as well as past depression, stress level, and income level as significant risk factors for the anxiety trajectory. However, the present study did not identify maternal age, income, and relationship satisfaction as factors influencing the combined trajectory of depression, anxiety, and sleep quality during pregnancy. The differences may be due to a smaller range of regression results in the vulnerable group of the joint trajectories in our study. It is also possible that the influencing factors differ after adding sleep variables to the measurement.

Women with a history of miscarriage may have worse depression, anxiety, and sleep during pregnancy [29]. In the present study, we focused on factors that might be modifiable. Women whose self-reported pregnancies had a more significant impact on daily life were more likely to experience more depression symptoms, more anxiety symptoms and poorer sleep quality throughout pregnancy, suggesting the need to focus on postpregnancy life changes in early pregnancy. The impact of pregnancy on daily life may be multifaceted and may have individual differences. Unfortunately, the present study was unable to explore this in depth. In practical work, however, taking this factor into account and conducting targeted analysis and intervention for individuals may improve the symptoms of depression, anxiety, and poor sleep quality during pregnancy.

In addition, we found that physiologic low back pain symptoms were risk factors for the joint symptoms group trajectory of depression, anxiety, and sleep quality during pregnancy. Low back pain is common during pregnancy and has been reported to be associated with depression, anxiety, and sleep quality. A retrospective case–control study has revealed that women who report low back pain have an increased risk of perinatal depression, with differences in the prevalence of depressive symptoms among prenatal, postnatal, and perinatal women with different types of low back pain [30].

The specific mechanism underlying the relationship between low back pain symptoms and a persistent poor combination of depression, anxiety, and sleep quality during pregnancy is unclear. Studies have shown

that chronic pain can directly affect sleep and anxiety [31]. Chronic pain has also been reported to correlate with depression [32]. A recent study on adolescents has also revealed that social anxiety and depressive symptoms are associated with back pain [33]. Thus, low back pain is closely related to depression and anxiety. In terms of interventions, recent studies [34] have shown that yoga training can change the lower back pain symptoms, depression, anxiety, and sleep quality of IT practitioners, but further verification is needed to determine if yoga training is effective for pregnant women.

4.4. Limitations and strengths

The present findings should be interpreted with caution, considering multiple limitations. The study samples were obtained from relatively healthy women during pregnancy in urban areas, and they were not collected in rural or low-income areas. Thus, the samples were not representative of pregnant women in rural or low-income areas. Moreover, individuals excluded from the present study may not follow the same depressive symptom trends as those in the present study. According to the regression results of the present study, women who felt that their pregnancy had a significant impact on their lives were more likely to enter the trajectory of depression, anxiety, and a shared vulnerability to sleep quality, which may be caused by higher stress levels resulting from this stressor. Previous studies have reported that a high stress level is a significant risk factor for high depression and anxiety [13]. Although the present study failed to measure and analyze the stress level, self-assessment of the impact of pregnancy on life early in pregnancy may be simpler than measuring stress scales.

Because few studies have been conducted on sleep quality during pregnancy and during the perinatal period, the present study could not explore risk factors in depth. However, similar studies are expected in the future, which will contribute to the identification and prevention of depression, anxiety, and sleep quality during pregnancy.

The present study also had several advantages. Depression, anxiety, and sleep quality during pregnancy have received extensive attention in the fields of perinatal health care and psychology. However, the process by which they all develop together is unclear. The present study used the parallel process LCGA approach to better describe the developmental relationships among the three factors. In a longitudinal study involving four waves of data, the three co-developmental trajectories of depression, anxiety, and sleep quality presented different degrees of co-development but similar patterns. These findings shed new light on how all three factors develop. In addition, the present study analyzed risk factors for trajectories. Among those with persistent depression, anxiety, and poor sleep quality during pregnancy, the risk factors included a history of prior miscarriage, lower back pain during pregnancy, and a greater impact of pregnancy on daily life. These risk factors, especially the physiological symptoms of low back pain, have guiding significance for mental health care during pregnancy.

4.5. Implications

Perinatal professionals need to identify depression, anxiety, and sleep quality early in pregnancy to allow adequate opportunities for ongoing monitoring and early intervention, and they need to focus on physiological and life changes in early pregnancy, especially symptoms of low back pain and the extent to which pregnancy affects daily life.

5. Conclusion

This prospective longitudinal study used parallel process latent class growth analysis (PP-LCGA) to identify three heterogeneous joint developmental trajectories of depression, anxiety, and sleep quality during pregnancy. It confirmed that the three psychosomatic symptoms showed non-linear stable changes and significant comorbidity during pregnancy, and 21.9% of pregnant women remained in a high-risk state comorbid with depression, anxiety, and sleep disturbance from early pregnancy. Multivariate logistic regression analysis identified abortion experience, low back pain during pregnancy , and the significant impact of pregnancy on daily life as independent predictive factors for pregnant women to enter the high-risk trajectory of joint symptoms. From the perspective of multi-dimensional joint trajectory, this study fills the research gap of the covariate pattern of psychosomatic symptoms during pregnancy, and provides evidence-based support for precise screening and stratified intervention of perinatal mental health. Limited by the sample from the urban community pregnant women in western China, the generalizability of the results is restricted. Future research can expand to rural and low-income populations, further analyze the mechanism of symptom comorbidity and verify early intervention programs . In clinical practice, combined screening of depression, anxiety and sleep quality should be carried out in early pregnancy, with focus on pregnant women with abortion history, low back pain symptoms and strong perception of pregnancy impact on daily life. Early identification and continuous intervention should be adopted to reduce the risk of multiple psychosomatic symptom comorbidity during pregnancy and optimize maternal and fetal health outcomes.

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Disclosure statement

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