THE PLANET

Original Article

Assessment of Maternal Stress, Anxiety, Well-Being, and Sleep Quality during Different Stages of Gestation

Nigar Sultana[1*], Khodeza Khatun[2], Noor-E-Ferdous[3], Kazi Farhana Begum[4], Ayesha Mehnaz[5], Mehera Parveen[6], Tasnova Elahi meem[7]

ARTICLE INFO

Received: 9 Mar 2026
Accepted: 12 Mar 2026
Published Online: 18 Mar 2026

DOI: dx.doi.org

Volume: 9, Number: 1, Page: 264-269

e-ISSN: 2789-5912
ISSN: 2617-0817

*Corresponding author

ABSTRACT

Background: Maternal stress, anxiety, overall well-being, and sleep quality are important determinants of both maternal and fetal health outcomes. Elevated stress and anxiety, poor well-being, and disrupted sleep during pregnancy have been associated with adverse outcomes including preterm birth, low birth weight, hypertensive disorders, impaired maternal functioning, and long-term neurodevelopmental effects in offspring. Despite their clinical importance, the temporal patterns of these psychological and behavioral measures across different stages of gestation remain underexplored, particularly in low-resource settings such as Bangladesh. Aim of the study: This study aimed to evaluate the levels and changes of maternal stress, anxiety, well-being, and sleep quality across the first, second, and third trimesters of pregnancy, identify associated risk factors, and determine critical gestational periods of vulnerability. **Methods & Materials**: A cross-sectional observational study was conducted involving 300 pregnant women attending the Department of Obstetrics and Gynaecology, Bangladesh Medical University, Dhaka, Bangladesh, stratified equally by trimester (n = 100 per trimester). Validated instruments, including the 10-item Perceived Stress Scale (PSS-10), State-Trait Anxiety Inventory (STAI), WHO-5 Well-Being Index, and Pittsburgh Sleep Quality Index (PSQI), were used to assess maternal psychological and behavioral outcomes. Data were analyzed using ANOVA with post-hoc Bonferroni comparisons, chi-square tests, Pearson correlations, and multiple linear regression to determine predictors of sleep quality. **Results**: Maternal stress, state anxiety, and poor sleep quality significantly increased across gestation, while overall well-being significantly declined ($p<0.001$ for all). The third trimester demonstrated the highest prevalence of high stress (41%), clinical anxiety (35%), and poor sleep quality (78%). Strong correlations were observed among stress, anxiety, well-being, and sleep quality measures. Regression analyses identified stress and anxiety as independent and significant predictors of impaired maternal sleep quality. **Conclusion**: Late pregnancy represents a critical period for psychological and behavioral disturbances. Systematic assessment and timely interventions targeting maternal stress and anxiety may improve sleep quality, overall well-being, and potentially maternal and fetal health outcomes.

Keywords: *Maternal stress; Anxiety; Well-being; Sleep quality; Pregnancy; Gestation*

1. *Associate Professor, Department of Obstetrics and Gynaecology, Bangladesh Medical University, Dhaka, Bangladesh (ORCID: 0009-0003-5076-1529)*
2. *Associate Professor, Department of Obstetrics and Gynecology, Bnagladesh Medical University, Dhaka, Bangladesh (ORCID: 0009-0007-4935-3201)*
3. *Associate Professor, Department of Gynecological Oncology, Bangladesh Medical University, Dhaka, Bangladesh*
4. *Associate Professor, Department of Obstetrics and Gynecology, Bnagladesh Medical University, Dhaka, Bangladesh*
5. *FCPS Part-2 Course, Medical Oncology, Ex Trainee Dhaka Medical College and Hospital, Dhaka, Bangladesh*
6. *Associate Professor, Department of Gynecological Oncology, Bangladesh Medical University, Dhaka, Bangladesh*
7. *Intern doctor, Holy family Red Crescent Medical College, Dhaka, Bangladesh*

INTRODUCTION

Maternal stress, anxiety, well-being, and sleep quality during pregnancy refer to a range of psychological and physiological conditions-stress and anxiety signify heightened emotional strain, well-being indicates overall mental health status, and sleep quality reflects restorative rest-each of which can influence maternal and fetal outcomes throughout gestation [1]. Worldwide, the prevalence rate of mental disorder, primarily depression or anxiety is approximately 10% of pregnant women [2]. In Bangladesh, perinatal generalized anxiety disorders affect about 22-28% of women [3]. Pregnancy involves complex physiological and emotional adjustments, where hormonal shifts, bodily changes, and psychosocial pressures influence maternal stress, anxiety, well-being, and sleep quality. To evaluate these psychological and behavioral changes, validated tools are used, such as: the Perceived Stress Scale (PSS) for stress, the State-Trait Anxiety Inventory (STAI) for anxiety, the WHO-5 Well-Being Index for overall mental health, and the Pittsburgh Sleep Quality Index (PSQI) for sleep assessment. Applying these instruments at multiple stages of gestation enables observation of how maternal mental states evolve from early to late pregnancy. It helps to identify vulnerable periods, understand risk factors, and guide timely interventions for maternal and fetal health [4-6]. Elevated stress and anxiety and poor sleep quality during pregnancy are linked to adverse outcomes including preterm birth, low birth weight, hypertensive disorders, impaired maternal functioning, and adverse child neurodevelopmental outcomes, increased risk of cesarean section, and longer hospital stays, along with longer-term mental health effects for both mother and child. Co-occurrence of anxiety and depression can exacerbate risks beyond either condition alone [7]. The advantages include the real-world clustering of psychosocial risks, supports integrated screening during antenatal care, identifies high-risk groups who may benefit from targeted interventions and helps identify modifiable targets such as diet, physical activity, social support, and resilience. Enhanced understanding can improve prenatal care planning and maternal support policies [8,9]. However, disadvantages include reliance on self-report tools, heterogeneity in instruments and cut-offs, limited longitudinal follow-up, cultural differences in questionnaire interpretation, difficulty in capturing fluctuations over time and under-representation of low-resource settings such as Bangladesh [10,11]. The importance of this study lies in understanding how maternal psychological states across gestation is critical to improving maternal-child health, reducing perinatal complications, and enhancing long-term developmental

outcomes for children, as early maternal stress and anxiety may have both immediate and lasting effects [12]. Existing researches often focus on single components (e.g., anxiety alone), lack repeated measurements across trimesters, and may not consider how socio-demographic factors interact with psychological outcomes in diverse populations [13]. So, there is a need for comprehensive assessments that simultaneously evaluate maternal stress, anxiety, well-being, and sleep quality at multiple gestational stages to understand temporal patterns and associated risk factors, especially in under-represented settings like South Asia. The study aimed to evaluate the levels and changes of maternal stress, anxiety, well-being, and sleep quality throughout different stages of pregnancy, identify associated risk factors, and determine whether specific gestational windows present higher vulnerability for psychological disturbances.

METHODS & MATERIALS

This cross-sectional observational study was conducted at the Department of Obstetrics and Gynaecology, Bangladesh Medical University, Dhaka, Bangladesh, between January 2023 and December 2024. A total of 300 pregnant women were enrolled and stratified equally into three groups based on gestational age: first trimester (n = 100), second trimester (n = 100), and third trimester (n = 100).

Inclusion and Exclusion Criteria

Inclusion Criteria

Participants were eligible for the study if they met all of the following criteria:

1. Pregnant women aged 18–40 years.
2. Singleton pregnancy.
3. Gestational age corresponding to the first (≤12 weeks), second (13–26 weeks), or third trimester (≥27 weeks).
4. Ability to provide written informed consent and complete study questionnaires.

Exclusion Criteria

Participants were excluded if they met any of the following conditions:

1. Multiple pregnancies (e.g., twins or higher-order multiples).
2. Known psychiatric disorders or current use of psychotropic medication.
3. Severe obstetric complications at the time of recruitment (e.g., preeclampsia, placenta previa).
4. Chronic medical illnesses that could affect stress, anxiety, or sleep (e.g., uncontrolled diabetes, chronic kidney disease).
5. Inability to comprehend the study questionnaires due to language barriers or cognitive impairment.

Data Collection

Data were collected through a combination of structured interviews, self-administered questionnaires, and review of participants' medical records. Trained research assistants conducted face-to-face interviews to obtain detailed information on maternal demographics, including age, educational level, employment status, and parity. Height and weight were measured using standardized equipment to calculate body mass index (BMI) as weight in kilograms divided by height in meters squared. Medical records were reviewed to document a history of pregnancy complications, chronic health conditions, and previous obstetric outcomes.

Maternal psychological and behavioral data were collected using validated instruments. Perceived stress was measured using the 10-item Perceived Stress Scale (PSS-10), which assesses the degree to which participants appraised their lives as unpredictable, uncontrollable, or overloaded over the past month. Anxiety was evaluated using the State-Trait Anxiety Inventory (STAI), which distinguishes between temporary, situational anxiety (state anxiety) and stable, long-term tendencies to experience anxiety (trait anxiety). Well-being was assessed using the World Health Organization 5-item Well-Being Index (WHO-5), capturing subjective positive mood, vitality, and general interest in life. Sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI), which evaluates multiple domains including sleep latency, duration, efficiency, disturbances, and daytime dysfunction. Higher scores on the PSS-10, STAI, and PSQI indicated greater stress, anxiety, and poor sleep quality, respectively, whereas higher WHO-5 scores reflected better overall well-being.

All participants completed the questionnaires in a private setting to ensure confidentiality and minimize reporting bias. For participants with literacy challenges, trained assistants provided verbal explanations and assisted in completing the forms without influencing responses. Data collection was systematically scheduled according to gestational stage, ensuring that each participant was assessed during the first, second, or third trimester as appropriate. Quality control procedures included double-checking entries, cross-verifying questionnaire scores with medical records, and periodic supervisory audits to ensure accuracy, completeness, and consistency of the data.

Statistical Analysis

All statistical analyses were performed using SPSS version 28.0 (IBM Corp., Armonk, NY, USA). Continuous variables were presented as mean ± standard deviation (SD), while categorical variables were expressed as frequencies and percentages. The Shapiro-Wilk test was used to assess the normality of continuous data. To examine differences in maternal stress, anxiety, well-being, and sleep quality across gestational stages, one-way analysis of variance (ANOVA) was conducted, followed by post-hoc pairwise comparisons using the Bonferroni correction to control for multiple testing. Chi-square tests were applied to compare categorical outcomes, such as the prevalence of clinically significant stress, anxiety, and poor sleep, across trimesters. Pearson correlation coefficients were calculated to explore the relationships among stress, anxiety, well-being, and sleep quality measures. Furthermore, multiple linear regression analyses were performed to identify significant predictors of maternal sleep quality, adjusting for stress, anxiety, and well-being scores. Effect sizes were reported as partial eta-squared (η^2) for ANOVA and R^2 for regression models to provide an estimate of the magnitude of associations. A two-tailed p-value <0.05 was considered statistically significant throughout the study.

Ethical Considerations

The study was approved by the Institutional Ethics Committee and conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants, and data were anonymized to ensure confidentiality.

RESULT

Mean maternal age was comparable across trimesters (27.0±4.0, 27.3±4.2, 27.6±4.3 years, F=1.02, p=0.36). Similarly, mean BMI showed no significant variation (23.5±3.0, 23.8±3.2, 24.1±3.4 kg/m²; F=1.73, p=0.18) among trimesters. Primiparous and multiparous women were nearly balanced (48.00% and 52.00%, χ^2=1.98, p=0.37). Educational attainment was 32.00% (≤high school) and 68.00% (college & above) (χ^2=2.58, p=0.28). Employment status (employed: 36.00% and homemaker: 64.00%; χ^2=1.41) were not statistically significant (p=0.49). History of pregnancy complications was reported in 18.00% of participants, while 9.00% had chronic health conditions, without significant inter-trimester differences (*Table I*).

Table I
Maternal demographics and clinical characteristics among the study population (n = 300).

Characteristic	1st Trimester (n=100)	2nd Trimester (n=100)	3rd Trimester (n=100)	Total (N=300)	Test Statistic	p-Value
Age (years)						
Mean ± SD	27.0 ± 4.0	27.3 ± 4.2	27.6 ± 4.3	27.3 ± 4.2	F=1.02	0.36
BMI (kg/m²)						
Mean ± SD	23.5 ± 3.0	23.8 ± 3.2	24.1 ± 3.4	23.8 ± 3.2	F=1.73	0.18
Parity						
Primiparous	50 (50.00)	46 (46.00)	48 (48.00)	144 (48.00)	χ^2=1.98	0.37
Multiparous	50 (50.00)	54 (54.00)	52 (52.00)	156 (52.00)		
Education						
≤ High school	32 (32.00)	30 (30.00)	34 (34.00)	96 (32.00)	χ^2=2.58	0.28
College & above	68 (68.00)	70 (70.00)	66 (66.00)	204 (68.00)		
Employment						
Employed	36 (36.00)	34 (34.00)	38 (38.00)	108 (36.00)	χ^2=1.41	0.49
Homemaker	64 (64.00)	66 (66.00)	62 (62.00)	192 (64.00)		
History of pregnancy complications, n (%)	14 (14.00)	18 (18.00)	21 (21.00)	53 (18.00)	χ^2=1.87	0.39
Chronic health conditions, n (%)	7 (7.00)	9 (9.00)	11 (11.00)	27 (9.00)	χ^2=1.04	0.59

Notes: SD = standard deviation; BMI = body mass index; χ^2 = chi-square; F = one-way ANOVA.

Table II shows perceived stress (PSS-10) increased from 16.5±5.2 in the 1st trimester, 18.0±5.5 in the 2nd trimester, 20.4±5.9 in the 3rd trimester, respectively (F=11.4, p<0.001, η^2=0.07). State anxiety (STAI-S) rose from 35.2±8.6 to 40.2±9.4 (F=13.1, p<0.001, η^2=0.08), and trait anxiety (STAI-T) increased modestly from 33.0±7.6 to 35.4±8.3 (F=3.1, p=0.047, η^2=0.02). Well-being (WHO-5) declined from 69.0 ± 12.5 to 61.5±14.5 (F=9.8, p<0.001, η^2=0.06), while sleep quality (PSQI) increased from 5.9±2.5 to 7.9±3.0 (F=14.2, p<0.001, η^2=0.09).

Table II
Maternal stress, anxiety, well-being, and sleep quality across gestation.

Measure	1st Trimester (Mean ± SD)	2nd Trimester (Mean ± SD)	3rd Trimester (Mean ± SD)	F (df)	p-Value	Partial η^2
Perceived Stress (PSS-10)	16.5 ± 5.2	18.0 ± 5.5	20.4 ± 5.9	11.4 (2,297)	<0.001	0.07
State Anxiety (STAI-S)	35.2 ± 8.6	37.6 ± 9.0	40.2 ± 9.4	13.1 (2,297)	<0.001	0.08
Trait Anxiety (STAI-T)	33.0 ± 7.6	34.0 ± 7.9	35.4 ± 8.3	3.1 (2,297)	0.047	0.02
Well-Being (WHO-5)	69.0 ± 12.5	65.0 ± 13.3	61.5 ± 14.5	9.8 (2,297)	<0.001	0.06
Sleep Quality (PSQI)	5.9 ± 2.5	6.7 ± 2.7	7.9 ± 3.0	14.2 (2,297)	<0.001	0.09

Perceived stress (PSS-10) increased significantly from the 1st to 2nd trimester (MD=1.5, 95% CI: 0.3-2.7), 2nd to 3rd (MD=2.4, 95% CI:1.2-3.6), and 1st to 3rd (MD=3.9, 95% CI:2.5-5.3). State anxiety (STAI-S) showed a similar rise in mean difference (2.4, 2.6, 5.0, respectively). Conversely, well-being (WHO-5) declined across trimesters (MD=4.0, MD=3.5, MD=7.5, respectively). Sleep quality (PSQI) progress favorably (MD=0.8, MD=1.2, MD=2.0, respectively) across trimesters. All comparisons remained statistically significant (*Table III*).

Table III
Post-hoc pairwise comparisons of maternal stress, anxiety, well-being, and sleep quality across gestational stages (Bonferroni).

Outcome	Comparison	Mean Difference	95% CI	p-Value
PSS-10	1st vs 2nd	1.5	0.3 – 2.7	0.01
PSS-10	2nd vs 3rd	2.4	1.2 – 3.6	<0.001
PSS-10	1st vs 3rd	3.9	2.5 – 5.3	<0.001
STAI-S	1st vs 2nd	2.4	0.8 – 4.0	0.003
STAI-S	2nd vs 3rd	2.6	1.0 – 4.2	0.001
STAI-S	1st vs 3rd	5	3.2 – 6.8	<0.001
WHO-5	1st vs 2nd	-4.0	-6.6 – -1.4	0.002
WHO-5	2nd vs 3rd	-3.5	-6.1 – -0.9	0.004
WHO-5	1st vs 3rd	-7.5	-10.1 – -4.9	<0.001
PSQI	1st vs 2nd	0.8	0.2 – 1.4	0.01
PSQI	2nd vs 3rd	1.2	0.6 – 1.8	<0.001
PSQI	1st vs 3rd	2	1.3 – 2.7	<0.001

Table IV demonstrates the prevalence of high stress (PSS≥20) increased from 22.00% in the 1st trimester to 41.00% in the 3rd trimester (p<0.001). Clinical anxiety (STAI-S ≥40) rose from 15.00% to 35.00% (p<0.001), and poor sleep quality (PSQI>5) affected 48.00%, 62.00%, and 78.00% of women in the 1st, 2nd, and 3rd trimesters, respectively (p<0.001).

Table IV
Prevalence of maternal stress, anxiety, and poor sleep quality across gestation.

Outcome	1st Trimester n (%)	2nd Trimester n (%)	3rd Trimester n (%)	Total n (%)	χ^2	p-Value
High stress (PSS ≥ 20)	22 (22.00)	30 (30.00)	41 (41.00)	93 (31.00)	14.6	<0.001
Clinical anxiety (STAI-S ≥ 40)	15 (15.00)	26 (26.00)	35 (35.00)	76 (25.00)	13.7	<0.001
Poor sleep quality (PSQI > 5)	48 (48.00)	62 (62.00)	78 (78.00)	188 (63.00)	24.2	<0.001

Strong correlations were observed between stress, anxiety, well-being, and sleep quality (PSS-10 & STAI-S: r=0.72, PSS-10 & PSQI: r=0.53, STAI-S & PSQI: r=0.58). All analysis were statistically significant (*Table V*).

Table V
Correlations between maternal stress, anxiety, well-being, and sleep quality across gestation.

Variables	r	95% CI	p-Value
PSS-10 & STAI-S	0.72	0.66 – 0.77	<0.001
PSS-10 & WHO-5	-0.56	-0.64 – -0.47	<0.001
PSS-10 & PSQI	0.53	0.44 – 0.60	<0.001
STAI-S & WHO-5	-0.52	-0.60 – -0.42	<0.001
STAI-S & PSQI	0.58	0.50 – 0.65	<0.001
WHO-5 & PSQI	-0.50	-0.59 – -0.41	<0.001

In Model 1, perceived stress (PSS-10) was a significant predictor (β=0.44, SE=0.06, t=7.33, p<0.001, 95% CI: 0.33-0.55). In Model 2, both stress (PSS-10) (β=0.29, SE=0.06, t=4.83, 95% CI: 0.17-0.41) and anxiety (STAI-S) (β=0.38, SE=0.05, t=7.6, p<0.001; 95% CI: 0.28-0.48) were statistically significant (both p<0.001). In the full model (Model 3), stress (PSS-10)(β=0.23, SE=0.06, t=3.83, 95% CI: 0.11-0.35), anxiety (STAI-S)(β=0.33, SE=0.05, t=6.6, 95% CI: 0.23-0.43), and well-being (WHO-5) (β=−0.28, SE=0.06, t=-4.67, 95% CI: -0.40 to -0.16) were all statistically significant (all p<0.001) *Table VI*.

Table VI
Predictors of maternal sleep quality across gestation (multiple regression analysis).

Predictor	β	SE	t	p-Value	95% CI
Model 1: Stress only					
PSS-10	0.44	0.06	7.33	<0.001	0.33 – 0.55
Model 2: Stress + Anxiety					
PSS-10	0.29	0.06	4.83	<0.001	0.17 – 0.41
STAI-S	0.38	0.05	7.6	<0.001	0.28 – 0.48
Model 3: Full Model (Stress + Anxiety + Well-Being)					
PSS-10	0.23	0.06	3.83	<0.001	0.11 – 0.35
STAI-S	0.33	0.05	6.6	<0.001	0.23 – 0.43
WHO-5	-0.28	0.06	-4.67	<0.001	-0.40 – -0.16

DISCUSSION

Maternal psychological distress during pregnancy—manifesting as stress, anxiety, impaired well-being, and poor sleep quality—represents a multifaceted public health concern that may vary across different stages of gestation and influence both maternal and fetal outcomes [14]. The present study evaluated maternal stress, anxiety, well-being, and sleep quality across different stages of gestation among 300 pregnant women. The three trimester groups were comparable in demographic and clinical characteristics. The mean age increased slightly across trimesters (27.0 ± 4.0 years in the 1st trimester, 27.3 ± 4.2 in the 2nd, and 27.6 ± 4.3 in the 3rd), but this difference was not statistically significant (F = 1.02, p = 0.36). Similarly, BMI showed a gradual increase (23.5 ± 3.0 to 24.1 ± 3.4 kg/m²), without statistical significance (F = 1.73, p = 0.18). Parity distribution remained balanced (primiparous: 50%, 46%, and 48%; χ^2 = 1.98, p = 0.37). Education, employment status, history of pregnancy complications (14%, 18%, 21%; χ^2 = 1.87, p = 0.39), and chronic health conditions (7%, 9%, 11%; χ^2 = 1.04, p = 0.59) also showed no significant variation. This homogeneity indicates that gestational stage, rather than sociodemographic variability, likely accounts for the observed psychological differences. Comparable baseline uniformity has been reported by Rees et al. in antenatal cohort studies [12]. Perceived stress (PSS-10) increased significantly from 16.5 ± 5.2 in the 1st trimester to 18.0 ± 5.5 in the 2nd and 20.4 ± 5.9 in the 3rd trimester (F(2,297) = 11.4, p < 0.001, partial η^2 = 0.07). This progressive elevation is consistent with the theoretical framework proposed by Monk et al., who emphasized increasing pregnancy-related stress as childbirth approaches [15]. State anxiety (STAI-S) followed a similar trajectory, rising from 35.2 ± 8.6 to 37.6 ± 9.0 and 40.2 ± 9.4 (F(2,297) = 13.1, p < 0.001, partial η^2 = 0.08). These findings align with observations by Newham et al., who documented higher anxiety levels in late pregnancy [16]. Trait anxiety (STAI-T) showed a smaller increase (33.0 ± 7.6 to 35.4 ± 8.3), reaching statistical significance (F(2,297) = 3.1, p = 0.047, partial η^2 = 0.02), reflecting relatively stable personality factors with modest gestational influence [16]. Sleep quality (PSQI) demonstrated the largest effect size (partial η^2 = 0.09), increasing from 5.9 ± 2.5 in early pregnancy to 6.7 ± 2.7 and 7.9 ± 3.0 in late pregnancy (F(2,297) = 14.2, p < 0.001). These findings correspond closely with the systematic review by Sedov et al., who reported escalating sleep disturbances across trimesters, particularly in the third trimester [17]. Bonferroni-adjusted analyses confirmed significant differences between trimesters. For perceived stress, the mean difference between the 1st and 3rd trimester was 3.9 (95% CI: 2.5–5.3, p < 0.001), while the 2nd vs 3rd trimester difference was 2.4 (95% CI: 1.2–3.6, p < 0.001). For state anxiety, the

largest difference was observed between the 1st and 3rd trimester (mean difference = 5.0; 95% CI: 3.2–6.8; $p < 0.001$). Well-being showed a significant decline between the 1st and 3rd trimester (mean difference = 7.5; 95% CI: 4.9–10.1; $p < 0.001$). Sleep quality also worsened significantly, with a 2-point increase in PSQI score between the 1st and 3rd trimester (95% CI: 1.3–2.7; $p < 0.001$). These graded differences are consistent with longitudinal findings reported in previous studies, which described incremental increases in distress markers across gestation [17,18,19,20]. The prevalence of high stress (PSS ≥ 20) increased from 22% in the 1st trimester to 30% in the 2nd and 41% in the 3rd ($\chi^2 = 14.6$, $p < 0.001$). Clinical anxiety (STAI-S ≥ 40) rose from 15% to 26% and 35% ($\chi^2 = 13.7$, $p < 0.001$). Poor sleep quality (PSQI > 5) increased markedly from 48% in early pregnancy to 62% and 78% in late pregnancy ($\chi^2 = 24.2$, $p < 0.001$). Comparable trimester-related increases in anxiety prevalence have been reported by Dennis et al., while high rates of poor sleep in late pregnancy were similarly described by Dennis et al. and Mindell et al [3,21]. A strong positive correlation was observed between perceived stress and state anxiety ($r = 0.72$, 95% CI: 0.66–0.77, $p < 0.001$). Stress also correlated with poor sleep quality ($r = 0.53$, $p < 0.001$) and inversely with well-being ($r = -0.56$, $p < 0.001$). State anxiety correlated positively with sleep disturbance ($r = 0.58$, $p < 0.001$) and negatively with well-being ($r = -0.52$, $p < 0.001$). These findings support the integrative stress–anxiety framework proposed by Guardino and Dunkel (2014) [22]. In regression analysis, stress alone significantly predicted poor sleep ($\beta = 0.44$, $p < 0.001$). When anxiety was added, both stress ($\beta = 0.29$, $p < 0.001$) and state anxiety ($\beta = 0.38$, $p < 0.001$) remained significant predictors. In the fully adjusted model, stress ($\beta = 0.23$, $p < 0.001$), state anxiety ($\beta = 0.33$, $p < 0.001$), and reduced well-being ($\beta = -0.28$, $p < 0.001$) independently predicted sleep disturbance. These findings are consistent with research by Okun ML et al., who demonstrated that prenatal stress and anxiety independently contribute to impaired sleep quality [23].

LIMITATIONS

The study's cross-sectional design precludes causal inferences and limits the ability to capture individual trajectories of psychological changes across gestation. Reliance on self-reported questionnaires may introduce reporting bias, and literacy or comprehension differences could affect responses. Additionally, the single-center setting may restrict generalizability to broader populations, particularly in diverse socio-cultural or low-resource contexts. Longitudinal studies incorporating objective measures and multi-center cohorts are warranted to validate these findings and further elucidate temporal patterns, predictors, and outcomes of maternal stress, anxiety, well-being, and sleep quality throughout pregnancy.

CONCLUSION

This study demonstrates a progressive increase in maternal stress, state anxiety, and poor sleep quality across gestation, accompanied by a concomitant decline in overall well-being. The highest vulnerability was observed during the third trimester, indicating that late pregnancy represents a critical period for psychological disturbances. Strong correlations among stress, anxiety, well-being, and sleep quality highlight their interdependence, while regression analysis identifies stress and anxiety as significant predictors of impaired sleep. These findings underscore the importance of routine psychosocial assessment and timely interventions during pregnancy, particularly in the later stages, to mitigate adverse maternal and fetal outcomes. Targeted strategies may improve maternal mental health, sleep quality, and overall pregnancy experiences.

FUNDING

No funding sources

CONFLICT OF INTEREST

None declared

ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee.

REFERENCES

1. Wang R, Xu M, Yang W, Xie G, Yang L, Shang L, Zhang B, Guo L, Yue J, Zeng L, Chung MC. Maternal sleep during pregnancy and adverse pregnancy outcomes: A systematic review and meta-analysis. Journal of diabetes investigation. 2022 Jul;13(7):1262-76.
2. Zietlow AL, Nonnenmacher N, Reck C, Ditzen B, Müller M. Emotional stress during pregnancy–associations with maternal anxiety disorders, infant cortisol reactivity, and mother–child interaction at pre-school age. Frontiers in Psychology. 2019 Sep 25;10:2179.
3. Dennis CL, Falah-Hassani K, Shiri R. Prevalence of antenatal and postnatal anxiety: systematic review and meta-analysis. The British Journal of Psychiatry. 2017 May;210(5):315-23.
4. Gao M, Hu J, Yang L, Ding N, Wei X, Li L, Liu L, Ma Y, Wen D. Association of sleep quality during pregnancy with stress and depression: a prospective birth cohort study in China. BMC pregnancy and childbirth. 2019 Nov 27;19(1):444.
5. Alves AC, Cecatti JG, Souza RT. Resilience and stress during pregnancy: a comprehensive multidimensional approach in maternal and perinatal health. The Scientific World Journal. 2021;2021(1):9512854.
6. Qiu C, Gelaye B, Zhong QY, Enquobahrie DA, Frederick IO, Williams MA. Construct validity and factor structure of the Pittsburgh Sleep Quality Index among pregnant women in a Pacific-Northwest cohort. Sleep and Breathing. 2016 Mar;20(1):293-301.
7. Staneva A, Bogossian F, Pritchard M, Wittkowski A. The effects of maternal depression, anxiety, and perceived stress during pregnancy on preterm birth: A systematic review. Women and birth. 2015 Sep 1;28(3):179-93.
8. Harrison PA, Sidebottom AC. Systematic prenatal screening for psychosocial risks. Journal of health care for the poor and underserved. 2008;19(1):258-76.
9. Tang X, Lu Z, Hu D, Zhong X. Influencing factors for prenatal stress, anxiety and depression in early pregnancy among women in Chongqing, China. Journal of affective disorders. 2019 Jun 15;253:292-302.
10. Chorwe-Sungani G, Chipps J. A systematic review of screening instruments for depression for use in antenatal services in low resource settings. BMC psychiatry. 2017 Mar 24;17(1):112.
11. Van Heyningen T, Honikman S, Tomlinson M, Field S, Myer L. Comparison of mental health screening tools for detecting antenatal depression and anxiety disorders in South African women. PloS one. 2018 Apr 18;13(4):e0193697.
12. Rees S, Channon S, Waters CS. The impact of maternal prenatal and postnatal anxiety on children's emotional problems: a systematic review. European child & adolescent psychiatry. 2019 Feb 4;28(2):257-80.
13. Howard LM, Khalifeh H. Perinatal mental health: a review of progress and challenges. World psychiatry. 2020 Oct;19(3):313-27.
14. Wu Y, Lu YC, Jacobs M, Pradhan S, Kapse K, Zhao L, Niforatos-Andescavage N, Vezina G, du Plessis AJ, Limperopoulos C. Association of prenatal maternal psychological distress with fetal brain growth, metabolism, and cortical maturation. JAMA network open. 2020 Jan 29;3(1):e1919940.
15. Monk C, Webster RS, McNeil RB, Parker CB, Catov JM, Greenland P, Bairey Merz CN, Silver RM, Simhan HN, Ehrenthal DB, Chung JH. Associations of perceived prenatal stress and adverse pregnancy outcomes with perceived stress years after delivery. Archives of Women's Mental Health. 2020 Jun;23(3):361-9.
16. Newham JJ, Westwood M, Aplin JD, Wittkowski A. State–trait anxiety inventory (STAI) scores during pregnancy following intervention with complementary therapies. Journal of affective disorders. 2012 Dec 15;142(1-3):22-30.
17. Sedov ID, Cameron EE, Madigan S, Tomfohr-Madsen LM. Sleep quality during pregnancy: a meta-analysis. Sleep medicine reviews. 2018 Apr 1;38:168-76.
18. Glynn LM, Schetter CD, Hobel CJ, Sandman CA. Pattern of perceived stress and anxiety in pregnancy predicts preterm birth. Health Psychology. 2008 Jan;27(1):43.

19. Lobel M, Cannella DL, Graham JE, DeVincent C, Schneider J, Meyer BA. Pregnancy-specific stress, prenatal health behaviors, and birth outcomes. Health psychology. 2008 Sep;27(5):604.
20. Skouteris H, Wertheim EH, Germano C, Paxton SJ, Milgrom J. Assessing sleep during pregnancy: a study across two time points examining the Pittsburgh Sleep Quality Index and associations with depressive symptoms. Women's health issues. 2009 Jan 1;19(1):45-51.
21. Mindell JA, Cook RA, Nikolovski J. Sleep patterns and sleep disturbances across pregnancy. Sleep medicine. 2015 Apr 1;16(4):483-8.
22. Guardino CM, Dunkel Schetter C. Coping during pregnancy: a systematic review and recommendations. Health psychology review. 2014 Jan 2;8(1):70-94.
23. Okun ML, Mancuso RA, Hobel CJ, Schetter CD, Coussons-Read M. Poor sleep quality increases symptoms of depression and anxiety in postpartum women. Journal of behavioral medicine. 2018 Oct;41(5):703-10