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Original Research Article

Assessment of Nutritional Status and Sleep Quality and Its Association with Stress and Anxiety in Pregnant Women

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ABSTRACT

Aim: Assessment of Nutritional Status and Sleep Quality and its association with Stress and Anxiety in pregnant women.

Methodology: A cross-sectional study was conducted on 100 pregnant women attending antenatal clinics at selected hospitals in Mumbai. Data was collected using standardized tools: 24-hour dietary recall, a semi-quantitative food frequency questionnaire, Pittsburgh Sleep Quality Index (PSQI) for sleep assessment, Perceived Stress Scale (PSS), and the Pregnancy-Specific Anxiety Tool. Anthropometric and biochemical measurements (hemoglobin) were also recorded. Statistical analysis included One way ANOVA, Pearsons Correlation, and chi-square tests, where $p < 0.05$ is considered to be statistically significant.

Results: The majority of participants (61%) were in their third trimester. The mean hemoglobin level was 10.69 ± 1.43 g/dl, indicating prevalence of anemia among study participants. Dietary recall revealed suboptimal intakes for most nutrients: energy (1346 ± 317.5 kcal), protein (53.13 ± 11.7 g), iron (15.3 ± 3.4 mg), calcium (737.5 ± 169.1 mg), and zinc (7.24 ± 1.58 mg). Folate intake (580.2 ± 178.2 µg) was adequate. The diet pattern was primarily vegetarian, featuring homecooked foods such as roti, rice, dal, sabzi, fruits, khakhra, and tea, with minimal intake of animal protein or fortified products. Supplement usage among participants with consumption of various micronutrients like iron (38.4%), multivitamins (26%), and folate (20.5%) were the most common. Statistically significant associations were observed between trimester and folate ($p = 0.03$) and multivitamin supplementation ($p = 0.005$). Based on PSQI scores, 67% of participants had poor sleep quality. Sleep indicators such as subjective sleep quality ($p = 0.029$), sleep duration ($p = 0.005$), and sleep efficiency ($p = 0.01$) were significantly associated with trimester of participants. Moderate to high levels of stress and anxiety were observed in the majority of participants, with anxiety increasing in the third trimester. vi Significant positive correlations were observed between perceived stress and protein ($p = 0.03$), iron ($p = 0.007$), and zinc intake ($p = 0.01$). A negative correlation was observed between stress and sleep efficiency ($p = 0.005$). Higher animal protein intake was significantly associated with poorer sleep quality ($p = 0.002$).

Conclusion: The findings highlight a complex interplay between inadequate nutrient intake, elevated psychological stress, and poor sleep quality among pregnant women. These issues were most pronounced in the third trimester, likely due to cumulative physical discomfort, hormonal changes, and heightened anxiety regarding childbirth. Despite consumption of traditional home-cooked meals, key nutrient deficiencies were observed, reflecting a lack of dietary diversity. Poor sleep and high stress were closely linked, suggesting a bidirectional influence. These results emphasize the urgent need for integrated antenatal care that addresses nutritional adequacy, emotional wellbeing, and sleep health to promote optimal maternal and fetal outcomes.

Keywords: Pregnancy, Nutritional status, Sleep quality, Perceived stress, Anxiety, Pittsburgh Sleep Quality Index, Perceived Stress Scale, Pregnancy-Specific Anxiety Tool, 24-hour dietary recall, Micronutrient intake.

INTRODUCTION

Pregnancy is characterized by profound anatomical and physiological changes to support fetal growth, increasing maternal requirements for essential nutrients such as iron, vitamin B12, and folate (Soma-Pillay et al., 2016). Adequate preconception, antenatal, and obstetric care are critical for safe motherhood (Menon & Arora, 2021). Pregnant women are at increased risk of gestational diabetes, hypertensive disorders, pre-eclampsia, cesarean delivery, and long-term metabolic diseases (Poston et al., 2016; Vézina-Im et al., 2018). The World Health Organization (WHO) 2016 emphasizes healthy lifestyle practices—including balanced nutrition, weight management, regular physical activity, and psychosocial well-being—as essential for optimal maternal and fetal outcomes.

Nutritional status during pregnancy plays a pivotal role in placental function, fetal growth, and long-term health of the offspring. Inadequate or excessive nutrient intake can impair fetal development and increase the risk of low birth weight, preterm birth, and metabolic disorders later in life (Morrison et al., 2016). For a reference Indian woman, the Indian Council of Medical Research (ICMR) estimates an additional energy requirement of ~73,000 kcal over pregnancy, with increased needs for micronutrients such as iron, calcium, folate, vitamin D, and essential fatty acids (Maqbool et al., 2019).

Sleep disturbances are common in pregnancy due to hormonal fluctuations, physical discomfort, and anxiety. Poor sleep quality has been associated with gestational diabetes, hypertensive disorders, preterm birth, and adverse perinatal outcomes (Wang et al., 2022; Macdonald et al., 2025). Sleep quality often deteriorates in the later trimesters due to factors such as nocturnal urination, fetal movement, heartburn, and musculoskeletal discomfort (Alasmer et al., 2025).

Psychological stress and pregnancy-specific anxiety are prevalent during gestation, with global estimates suggesting 10–13% of pregnant women experience significant mental health issues (WHO, 2022; Dunkel Schetter, 2015). Elevated anxiety, particularly concerning fetal health and childbirth, has been linked to adverse maternal and neonatal outcomes, including low birth weight, preterm delivery, and developmental delays (Jalal et al., 2024).

In India, nutritional deficiencies, sleep disturbances, and high psychosocial stress are common among pregnant women, especially in socioeconomically disadvantaged groups. Understanding the interplay between these factors is crucial for designing culturally relevant antenatal interventions that optimize maternal and fetal health. This study aims to assess the nutritional status and sleep quality of pregnant women and explore their associations with stress and anxiety.

MATERIALS & METHODS

Study Design and Participants

A cross-sectional study was conducted among 100 pregnant women aged 18–40 years residing in Mumbai. Participants were recruited through purposive sampling from two nursing and one government hospital.

Inter System Biomedical Ethics Committee (ISBEC), an independent ethics committee approved the conduct of study and Participant Information sheet and written consent was obtained.

Inclusion and Exclusion Criteria

Inclusion criteria were pregnant women in any trimester aged 18–40 years. Exclusion criteria included pre-existing medical conditions affecting nutrient absorption or sleep (e.g., chronic kidney disease, severe cardiac conditions), diagnosed mental health or sleep disorders (e.g., obstructive sleep apnea, parasomnia), and those currently on related medications.

Data Collection Tools

Data were collected via interviewer-administered case record forms, comprising:

- **Socio-demographic details**: age, marital status, education, occupation, household income, and medical history.
- **Anthropometry**: height (cm) and weight (kg) measured using standard protocols; BMI calculated as kg/m².
- **Biochemical parameters**: hemoglobin (g/dl) and platelet count, recorded from recent laboratory reports.
- **Dietary assessment**: 24-hour dietary recall and semi-quantitative FFQ to estimate macro- and micronutrient intake and dietary patterns.
- **Sleep quality**: Pittsburgh Sleep Quality Index (PSQI), with a global score >5 indicating poor sleep quality.
- **Stress**: Perceived Stress Scale (PSS), scored 0–40 and categorized as low (0–13), moderate (14–26), and high (27–40) stress.
- **Anxiety**: Pregnancy-Specific Anxiety Tool (PSAT), with scores <10 indicating low anxiety and ≥10 indicating high/concerning anxiety.

STATISTICAL ANALYSIS

Data was analyzed using SPSS (version 21). Descriptive statistics summarized demographic, nutritional, psychological, and sleep-related variables. Associations between nutrient intake, sleep quality, stress, and anxiety were evaluated using independent t-tests, chi-square tests, and one-way ANOVA. Pearson's correlation coefficient assessed linear relationships. A p-value <0.05 was considered statistically significant.

RESULTS AND DISCUSSION

SOCIO DEMOGRAPHIC DETAILS OF THE PARTICIPANTS

The participants responded to sociodemographic details including the highest level of education, household income and primary residence location. Other details were also recorded including the current trimester, parity and existing medical conditions of the participant.

Table 1. Participant distribution of socio demographic characteristics

Socio- Demographic components	Number of participants distribution among socio demographic characteristics n (%) (n =100)
Highest level of education completed	
No formal education	1 (1)
Primary school	14 (14)
Secondary school	40 (40)
Tertiary education (College/University)	9 (9)
Graduate or Professional	36 (36)
Household income	
Less than 10,000	2(2)
10,000-20,000	49 (49)
20,000-30,000	18 (18)
More than 30,000	31 (31)
Primary residence location	

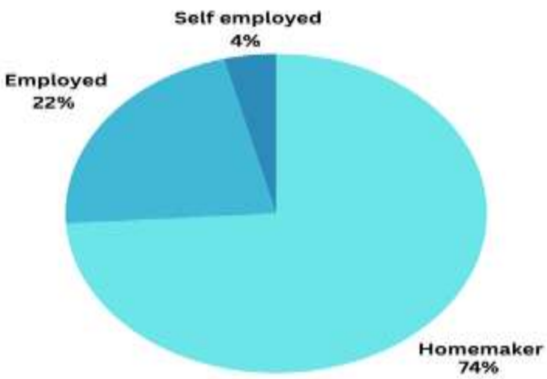
Urban	27 (27)
Suburban	50 (50)
Rural	23 (23)

Data represented as n (%)

As seen in the above table**,** majority of participants (49%) reported household incomes between ₹10,000 and ₹20,000. There are 31% who earn an income above ₹30,000, 18% of the participants who earn between ₹20,000 and ₹30,000, and only 2% whose income is than ₹10,000. In terms of primary residential location, the majority of participants (50%) live in suburban areas, followed by urban areas (27%), and rural areas (23%). This implies that the sample's population base is primarily suburban.

The largest percentage of participants (40%) finished secondary school in terms of educational attainment. A significant portion of the population (36%), have a graduate or professional degree, suggesting that many people are highly educated. Furthermore, 14% of participants have completed elementary school, and 9% went to college or university but did not pursue graduation. The percentage of participants who said they had no formal education was below 1%.

Figure 1. Employment status of study participants



***Data represented as %**

The occupational status of study participants has been depicted in the pie chart.74% of participants have been identified as homemakers. A lower percentage of participants, 22% are employed. Just 4% of participants indicated that they worked as entrepreneurs and had their business.

According to this distribution, the research sample is primarily made up of homemakers, with little representation from the working and self-employed women.

ANHTROPOMETRIC MEASUREMENTS OF THE PARTICIPANTS

To provide a foundational understanding of the study population, anthropometric measurements including age, height, and weight were recorded. These indicators offer insight into the general physical characteristics and nutritional status of the participants.

Table 2. Mean values of Anthropometric details of the participants

Anthropometric measurements	Mean and standard deviation (SD) (n=100)
Age (years)	28.83 ± 4.461
Height (cm)	152.43 ± 21.3
Weight (kg)	65.9 ± 11.95

***Data represented as Mean ± standard deviation**

Anthropometric measurements, including age, height and weight were recorded. The table depict the mean age of the pregnant participants, that is 28.83 ± 4.46 years, indicating that most of them are within the typical childbearing age group. The average height is 152.43 ± 21.3 cm, and the mean weight is 65.9 ± 11.95 kg. The weight is expected to vary during pregnancy, and the average suggests that participants are within a moderate weight range for pregnancy. The high standard deviations, especially for height and weight, suggest notable diversity in body size and nutritional status among the participants.

BIOCHEMICAL DATA OF THE PARTICIPANTS

Biochemical data was collected to assess internal health indicators such as hemoglobin levels and key micronutrient concentrations, which further contribute to understanding the nutritional and physiological status of the participants during pregnancy.

Table 3. Mean values of biochemical data of the participants

Biochemical Parameters	**Reference Values**	**Mean and standard deviation (SD) values of participants (n=100)**
Hemoglobin (g/dl)	11-14 g/dl	10.694 ± 1.43
Platelets (counts)	15,000-450,000 counts	325741.43 ± 335187.54

***Data represented as Mean ± standard deviation; Reference values as reported by World Health Organization 2024; The American College of Obstetricians and Gynecologists (2019)**

The average hemoglobin level is 10.694 ± 1.43 g/dl, which is less than the 11–14 g/dl range that is advised for expectant mothers. This highlights the significance of iron-rich foods or supplements and points to a predominance of anemia, a frequent illness during pregnancy that can impact the health of both the mother and the fetus.

The average platelet count for pregnant women is 325,741.43 ± 335,187.54, which is well within the physiological range of 150,000–450,000 counts. The high standard deviation, however, suggest substantial individual variance, which could be the result of underlying medical issues or changes in platelet levels brought on by pregnancy.

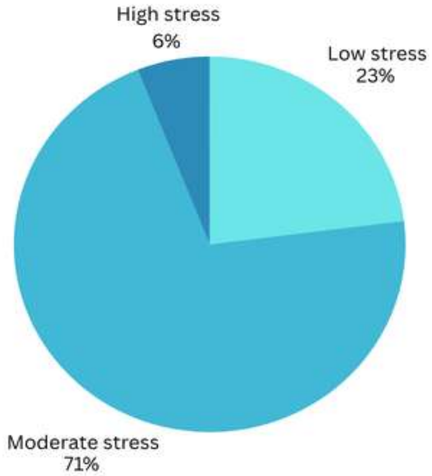
A study found that the platelets count is slightly lower in pregnant than in non-pregnant women (Abbassi- Ghanavati, M. et al., 2006). Most studies report an approximate 10% lower platelets level at the 37th to 42nd week of gestation compared to the platelets level at pre-pregnancy (Boehlen, F. et al.,2000; Jensen, J.D, et al., 2011).

According to the latest World Health Organization (WHO) guideline released in 2024, the threshold for defining anaemia in pregnancy varies by trimester: 11.0 g/dL in the first and third trimesters, and 10.5 g/dL in the second trimester, reflecting the physiological haemodilution during mid-pregnancy. These trimester-specific cut-offs are based on population-level reference data and represent the 5th percentile for healthy women at sea level (WHO, 2024).

STRESS PERCEIVED BY THE PARTICIPANTS

Perceived Stress Scale designed by Sheldon Cohen in the year 1983, has been used to measure the level of stress of the participants. Stress, anxiety, and depression during pregnancy are strongly associated with increased risk of adverse outcomes for the mother and the fetus. Prenatal anxiety is a significant psychosocial factor that has been linked to reduced gestational duration, often resulting in preterm birth. This shortened intrauterine period may compromise fetal neurodevelopment and contribute to poorer health outcomes in the newborn. (Dunkel Schetter C et al,2015).

Figure 2 Distribution of participants with relation to stress scores from Perceived stress scale



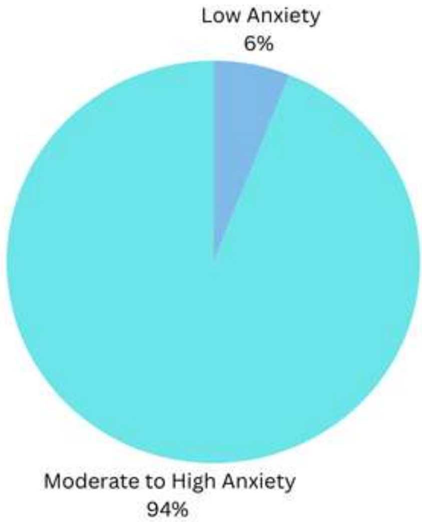
Data represented as %

The pie chart above illustrate that a majority of pregnant women participants (71%) experienced moderate stress, while 23% reported low stress and 6% experienced high stress. Moderate stress, if persistent and unaddressed, can still have adverse effects on both maternal health and fetal development, including risks such as preterm labor, low birth weight, and elevated maternal blood pressure. These findings highlight the importance of routine screening for stress levels during antenatal visits and the implementation of early interventions such as counseling, relaxation techniques, and social support systems to promote emotional well-being.

Level of anxiety experienced by the participants

The anxiety levels were measured using the Pregnancy Specific Anxiety Tool designed by Brunton et al (2011) which include questions related to Health and Wellbeing of the baby, labor and pregnant women's wellbeing, postpartum and career & finance, support provided and severity of the issues. The levels of the anxiety are classified as total scores below 10 as low anxiety and above 10 as high and concerning level of anxiety.

Figure 3 Level of anxiety experienced by the participants



Data represented as %

The pie chart illustrate that a small proportion of participants (6%) reported experiencing low levels of pregnancy-specific anxiety, indicating they rarely faced significant worry or distress related to their pregnancy. In contrast, the vast majority of participants (94%) experienced moderate to high levels of anxiety, with many frequently endorsing concerns such as persistent worry, panic attacks, emotional distress, financial or partner-related worries, and fears about their baby's health and development. These findings highlight that while a few participants were able to manage their anxiety effectively, most participants faced notable challenges with emotional regulation and required adequate support and reassurance during their pregnancy.

SLEEP QUALITY OF THE PARTICIPANTS

Sleep quality plays a vital role in maintaining physical and psychological health during pregnancy. The profound physiological, hormonal, and emotional changes experienced throughout gestation often contribute to sleep disturbances, making pregnant women particularly vulnerable to poor sleep. Recognizing the importance of sleep in maternal and fetal well-being, this study assessed the sleep quality of participants using the Pittsburgh Sleep Quality Index (PSQI), a standardized and widely validated tool designed by Dr. Daniel Buysse in 1989 for evaluating sleep patterns and disturbances over a one-month period. The PSQI provides a comprehensive assessment across multiple components, including sleep duration, latency, disturbances, and daytime dysfunction. Understanding the sleep quality of pregnant women is essential, as poor sleep has been linked to increased risk of preterm birth, gestational hypertension, and postpartum depression. This section presents the findings on sleep quality among the study participants based on their PSQI scores.

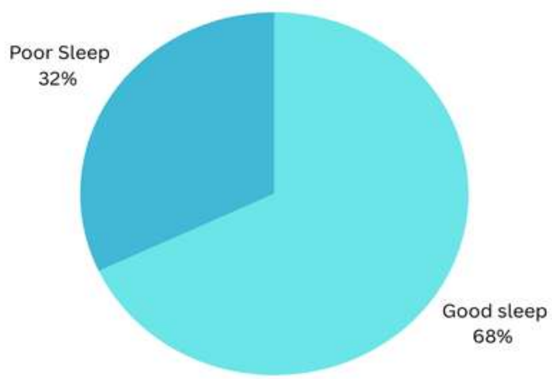
Table 4. Distribution of participants for components of Sleep scores as measured by the Pittsburgh Sleep Quality Index

	Distribution of percentage of responses by the participants of the various PSQI component scores (n=100)						
PSQI SCORES	**Subjective Sleep Quality (n %)**	**Sleep Latency (n %)**	**Sleep Duration (n %)**	**Sleep Efficiency (n %)**	**Sleep Disturbance (n %)**	**Use of Sleep Medications (n %)**	**Daytime Dysfunction (n %)**
0	9 (9)	15 (15)	21 (21)	64 (64)	6 (6)	91 (91)	23 (23)
1	47 (47)	29 (29)	37 (37)	13 (13)	48 (48)	5 (5)	48 (48)
2	27 (27)	26 (26)	26 (26)	4 (4)	46 (46)	2 (2)	24 (24)
3	17 (17)	30 (30)	16 (16)	19 (19)	0	2 (2)	5 (5)

Data represented as n (%)

Analysis of PSQI components among 100 pregnant women revealed that 47% reported slight difficulty with subjective sleep quality, while 9% reported no issues. Delayed sleep onset was common, with 30% scoring high for sleep latency and 29% reporting moderate difficulty. Sleep duration was mildly reduced in 37% and moderately reduced in 26% of participants. Sleep efficiency was generally preserved, with 64% reporting minimal problems. Moderate sleep disturbances were reported by 48%, and frequent disturbances by 46%. Use of sleep medications was rare (91% scoring zero). Daytime dysfunction was moderate in 48% and greater in 24%, with 5% reporting severe impairment. These findings suggest that while sleep efficiency and medication use were largely unaffected, latency, duration, and daytime functioning were notably compromised.

Figure 4 Sleep quality of the participants



The pie chart indicated that 68% of pregnant women reported good sleep quality, while 32% experienced poor sleep. This indicates that nearly one-third of participants had compromised sleep, highlighting a substantial proportion at risk for sleep-related issues during pregnancy.

NUTRIENT CONSUMPTION OF THE STUDY PARTICIPANTS

An adequate intake of both macro- and micronutrients is essential during pregnancy to support maternal health and fetal development. This section presents a detailed analysis of the dietary intake patterns of the study participants, highlighting their consumption levels of key nutrients in comparison to the recommended dietary allowances (RDAs). The data offered insight into potential nutritional gaps or excesses, thereby helping to identify areas that may require dietary interventions or nutritional counseling. Understanding these patterns is crucial in evaluating the overall nutritional status of the pregnant women in the study and their potential impact on pregnancy outcomes.

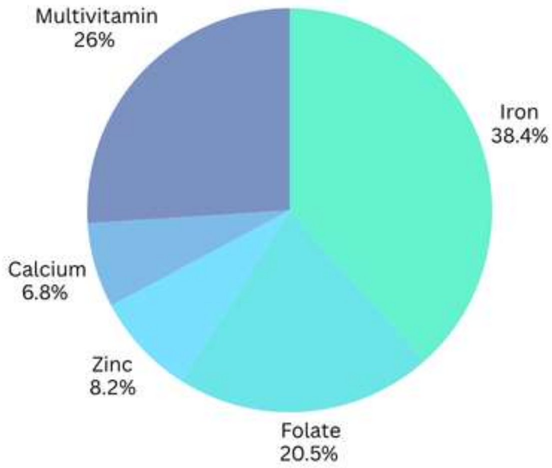
Table 5. Mean distribution of macronutrient and micronutrient consumption among study participants from 24hour recall

NUTRIENTS	MEAN (SD) values of study participants (n-100)	Reference values (RDA 2023)
ENERGY (kcal)	1346 ± 317.5	30 kcal per kg body weight
PROTEIN (g)	53.13 ± 11.7	First trimester- 0.83g/kg Second trimester-(0.83g/kg) +10.33 Third trimester- (0.83g/kg) +22.83
CHO (g)	181.32 ± 47.8	-
FAT (g)	44.9 ± 16.57	-
FIBER (g)	30 ± 11.8	40g as per moderate women
IRON (mg)	15.3 ± 3.4	27mg
FOLATE (ug)	580.2 ± 178.2	570 ug
ZINC (mg)	7.24 ± 1.58	14.5
SODIUM (mg)	475.8 ± 215.9	- (2000mg upper limit was considered)
POTASSIUM (mg)	2213.29 ± 840.6	- (3000 upper limit was considered)
CALCIUM (mg)	737.5 ± 169.1	1000mg

***Data represented as Mean (SD); Reference for RDA- RDA 2023 by ICMR NIN**

The 24-hour dietary recall revealed a pattern dominated by traditional Indian vegetarian foods such as tea, khakhra, fruits (apple, banana), makhana, roti, rice, pulses, vegetables, and occasional dairy products. While these foods contribute to basic nutrition, mean energy intake (1346 ± 317.5 kcal) was well below recommendations, reflecting inadequate caloric intake, possibly due to reliance on light, low-calorie snacks. Protein intake (53.13 ± 11.7 g) was also below RDA, likely from low consumption of high-protein sources. Fiber intake (30 ± 11.8 g) fell short of the 40 g/day target due to limited whole grains, legumes, and raw vegetables. Iron (15.3 ± 3.4 mg), zinc (7.24 ± 1.58 mg), and calcium (737.5 ± 169.1 mg) intakes were inadequate, reflecting low intake of animal foods and dairy, while folate (580.2 ± 178.2 µg) met RDA, possibly due to supplementation or leafy vegetables. Sodium (475.8 ± 215.9 mg) and potassium (2213.29 ± 840.6 mg) were within safe limits. Overall, the diet lacked adequate energy, protein, iron, calcium, zinc, and fiber, underscoring the need for more nutrient-dense, diverse foods during pregnancy.

Figure 5 Consumption of various supplements by the study participants



A few participants have reported to consume various Iron, Folate, Calcium, Zinc and Multivitamin supplements like Fefol-Z, Neurobion Forte, Shelcal twice daily.

Iron supplements were the most widely consumed, with 38.4% of participants reporting their use, followed by multivitamins (26%), folate (20.5%), zinc (8.2%), and calcium (6.9%). This has highlighted the prioritization of iron supplementation during pregnancy, in line with national guidelines aimed at preventing maternal anemia. However, despite this, the 24-hour recall data revealed a mean iron intake of only 15.3 ± 3.4 mg, which is still below the recommended 27 mg/day, suggesting that dietary sources of iron remain inadequate and supplementation is essential to meet requirements. Similarly, folate intake was found to be adequate (580.2 ± 178.2 µg), which may be attributed to both supplementation and intake of green leafy vegetables and pulses. In contrast, calcium intake (737.5 ± 169.1 mg) and zinc intake (7.24 ± 1.58 mg) were also below recommended levels, despite some participants consuming supplements. The relatively low usage rates of calcium and zinc supplements (6.9% and 8.2% respectively) may partly explain these deficits.

Supplementation, especially for iron and folate, plays a critical role in addressing key deficiencies, reliance solely on food intake is insufficient, and broader supplementation or dietary diversification may be necessary to meet the nutritional requirements during pregnancy.

Table 6. Association of PSQI (Pittsburgh Sleep Quality Index) scores with the trimesters

Subjective Sleep Quality	**Trimester 1**	**Trimester 2**	**Trimester 3**	**x2 value**	**p value**
Very good	3	1	5	14.036	0.02
Fairly good	3	19	25		
Fairly bad	2	8	17		
Very bad	0	3	14		
Sleep latency	**Trimester 1**	**Trimester 2**	**Trimester 3**	**x2 value**	**p value**
≤ 15 minutes	2	3	10	7.979	0.24
16-30 minutes	2	12	15		
31-60 minutes	4	8	14		
> 60 minutes	0	8	22		
Sleep duration	**Trimester 1**	**Trimester 2**	**Trimester 3**	**x2 value**	**p value**
> 7 hours	1	2	18	25.256	0.005
6-7 hours	7	16	14		
5-6 hours	0	10	16		
< 5 hours	0	3	13		

Sleep efficiency	Trimester 1	Trimester 2	Trimester 3	x2 value	p value
> 85 %	8	23	33	15.184	0.01
75-84 %	0	3	10		
65- 74 %	0	3	1		
< 65 %	0	2	17		
Sleep disturbance	**Trimester 1**	**Trimester 2**	**Trimester 3**	**x2 value**	**p value**
Not during the past month	0	1	5	5.868	0.20
Less than once a week	6	18	24		
Once or twice a week	2	12	32		
Use of sleep medication	**Trimester 1**	**Trimester 2**	**Trimester 3**	**x2 value**	**p value**
Not during the past month	8	29	54	3.223	0.78
Less than once a week	0	2	3		
Once or twice a week	0	0	2		
Three or more times a week	0	0	2		
Daytime dysfunction	**Trimester 1**	**Trimester 2**	**Trimester 3**	**x2 value**	**p value**
Not during the past month	5	6	12	11.727	0.06
Less than once a week	3	17	28		
Once or twice a week	0	8	16		
Three or more times a week	0	0	5		

***Data represented as n; p-Value ≤ 0.05 is considered statistically significant**

The table above has reported the results of Chi-square tests assessing the relationship between trimesters of pregnancy and various PSQI component scores. Among pregnant women, subjective sleep quality (p = 0.029), sleep duration (p = 0.005), and sleep efficiency (p = 0.019) showed significant deterioration with advancing trimester, particularly in the third trimester. Sleep latency, disturbance, medication use, and daytime dysfunction worsened with gestation but were not statistically significant. Overall, later pregnancy was associated with marked declines in sleep quantity and efficiency, contributing to greater discomfort and sleep challenges.

Table 7. Association of trimesters with anxiety

STATEMENTS	Trimester 1	Trimester 2	Trimester 3	x 2 value	p value
I am worried how my pregnancy and raising the baby will impact the baby's career					
Never	5	23	47	24.240	0.000
Sometimes	1	6	9		
Most times	0	2	5		
Always	2	0	0		
I am worried that my health care provider won't support my decisions about my pregnancy	**Trimester 1**	**Trimester 2**	**Trimester 3**	**x 2 value**	**p value**
Never	6	29	51	12.280	0.015
Sometimes	2	0	2		
Most times	0	0	0		
Always	0	0	0		

***p-Value ≤ 0.05 is considered statistically significant**

The chi-square test results reveal how anxiety-related concerns vary across the different trimesters of pregnancy. Although many of the observed differences in responses were not statistically significant, a few anxiety domains demonstrated notable patterns. One of the most significant findings was that worry about the pregnancy impacting the family's career showed a highly significant difference across trimesters (p = 0.000). This suggest that as pregnancy progresses, concerns about the broader impact on family life and career responsibilities become more prominent. Additionally, anxiety related to insufficient support from healthcare providers also varied significantly across trimesters (p = 0.015), indicating that women may feel increasingly vulnerable and in need of reassurance and consistent communication from medical professionals in the later stages of pregnancy. In a recent study, lower socioeconomic status, low social support and depression emerged as significant determinants of anxiety. (Nath A et al,2019)

Table 8. Association between the current trimester and the type of protein

Trimester	Plant protein	Animal protein	F value	p value
First	38.8 ± 20.1	10 ± 19.2	2.390	0.09
Second	35.1 ± 9.7	11.1 ± 17.2	1.099	0.33
Third	42 ± 15.3	6.28 ± 14	4.279	0.01

***Data represented as Mean (SD); p-Value ≤ 0.05 is considered statistically significant**

The protein consumption for each trimester is examined in this table. 68 participants were vegetarians and 32 participants were non vegetarians. The third trimester had a larger plant protein intake (42 ± 15.3 g) than the first (38.8 ± 20.1 g) and second (35.1 ± 9.7 g), indicating a significant variation in total protein intake. According to research on whole-body protein turnover, pregnant and non-pregnant women have comparable protein turnover in the first trimester of pregnancy, while the second and third trimesters have a 15% and 25% absolute increase in protein synthesis, respectively. Early in pregnancy, there are concurrent declines in maternal amino acid concentrations, urea synthesis, and urine urea excretion, which continue to be low throughout the pregnancy (Mousa A et al, 2019).

Table 9. Correlation of perceived stress with nutrients and sleep efficiency

NUTRIENTS			PERCEIVED STRESS	
	Reference values (RDA 2023 ICMR NIN)	**Mean (SD) of study participants**	**r value**	**p value**
ENERGY (kcal)	30 kcal per kg body weight	1346 ± 317.5	0.141	0.16
PROTEIN (g)	First trimester- 0.83g/kg Second trimester- (0.83g/kg) +10.33 Third trimester- (0.83g/kg) +22.83	53.13 ± 11.7	0.209*	0.03
CHO (g)	-	181.32 ± 47.8	0.185	0.06
FAT (g)	-	44.9 ± 16.57	0.004	0.97
FIBER (g)	40g as per moderate women	30 ± 11.8	0.143	0.15
IRON (mg)	27mg	15.3 ± 3.4	0.267*	0.007
FOLATE (ug)	570 ug	580.2 ± 178.2	0.066	0.51
ZINC (mg)	14.5	7.24 ± 1.58	0.254*	0.01
SODIUM (mg)	- (2000mg upper limit was considered)	475.8 ± 215.9	0.049	0.63
POTASSIUM (mg)	- (3000 upper limit was considered)	2213.29 ± 840.6	0.076	0.45
CALCIUM (mg)	1000mg	737.5 ± 169.1	0.153	0.13
SLEEP EFFICIENCY	-	81.83 ± 0.08	-0.279**	0.005

***Data represented as Mean (SD); p-Value ≤ 0.05 is considered statistically significant**

The table presented the correlation between perceived stress levels and various nutrient intakes, as well as sleep efficiency, among pregnant women. Although a statistically significant positive correlation was observed between perceived stress levels and the intake of protein (r = 0.209, *p* = 0.03), iron (r = 0.267, *p* = 0.007), and zinc (r = 0.254, *p* = 0.01), it is possible that elevated stress levels might have led to physiological changes that affect nutrient metabolism or requirements, prompting increased dietary intake either voluntarily or as a result of appetite changes. Additionally, stress could alter gastrointestinal function and absorption, which may influence nutrient status and thereby affect intake patterns indirectly. These findings suggest a complex bidirectional relationship between nutrition and psychological stress that warrants further exploration, particularly in vulnerable populations such as pregnant women.

On the other hand, sleep efficiency showed a significant negative correlation with perceived stress (r = -0.279, p = 0.005), indicating that better sleep efficiency is linked to lower levels of perceived stress.

Table 10. Correlation of sleep efficiency with nutrients

NUTRIENTS			SLEEP EFFICIENCY	
	Reference values (RDA 2023 ICMR NIN)	**Mean (SD)**	**r value**	**p value**
ENERGY (kcal)	30 kcal per kg body weight	1346 ± 317.5	-0.12	0.23
PROTEIN (g)	First trimester- 0.83g/kg Second trimester- (0.83g/kg) +10.33 Third trimester- (0.83g/kg) +22.83	53.13 ± 11.7	-0.15	0.13
CHO (g)	-	181.32 ± 47.8	-0.077	0.44
FAT (g)	-	44.9 ± 16.57	-0.099	0.32
FIBER (g)	40g as per moderate women	30 ± 11.8	-0.027	0.09
IRON (mg)	27mg	15.3 ± 3.4	-0.149	0.13
FOLATE (ug)	570 ug	580.2 ± 178.2	-0.082	0.41
ZINC (mg)	14.5	7.24 ± 1.58	-0.151	0.13
SODIUM (mg)	- (2000mg upper limit was considered)	475.8 ± 215.9	-.205*	0.04
POTASSIUM (mg)	- (3000 upper limit was considered)	2213.29 ± 840.6	-0.135	0.17
CALCIUM (mg)	1000mg	737.5 ± 169.1	-0.09	0.37

***Data represented as Mean (SD); p-Value ≤ 0.05 is considered statistically significant**

The table has presented the correlation between sleep efficiency and various macronutrient and micronutrient intakes. Sodium intake has demonstrated a weak negative correlation with sleep efficiency (r = -0.205, p = 0.041), suggesting that higher sodium consumption is associated with lower sleep efficiency. This is the only relationship in the table that reaches statistical significance (p < 0.05).

In a study, increased sodium intake had a significant association with poor sleep quality and nocturnal urination in women (Jung JY et al,2017).

Table 11. Comparison between the trimesters with various nutrients, sleep and hemoglobin levels

Parameters	Trimester comparison	Mean difference	p value
Hemoglobin (Reference value 11-14 g/dl)	1 and 3	1.8611*	0.03
Global PSQI score	1 and 3	1.605	0.029
Protein %	1 and 3	29.920 *	0.001
	2 and 3	21.553*	0.000
Folate (ug) (RDA-570ug)	1 and 3	-178.83939*	0.019
	2 and 3	-91.99979*	0.048
Potassium (ref value- <3000mg)	2 and 3	517.86967*	0.013
Calcium (mg) (RDA 1000mg)	1 and 2	-206.19226	0.005
	1 and 3	-202.19226*	0.004

***p-Value ≤ 0.05 is considered statistically significant; Reference for RDA- RDA 2023 by ICMR NIN**

The table shows significant trimester-wise changes in physiological and nutritional parameters. Hemoglobin declined from the first to third trimester (−1.86, p = 0.033), indicating higher anemia risk. Global PSQI scores worsened (−1.605, p = 0.029), reflecting reduced sleep quality. Protein percentage fell sharply from the first to third (−29.92, p = 0.001) and second to third trimesters (−21.55, p = 0.000), consistent with increased late-pregnancy protein demands. Folate decreased from the first to third (−178.84, p = 0.019) and second to third trimesters (−91.99, p = 0.048), underscoring the need for continued supplementation. Calcium dropped from the first trimester to both the second (−206.19, p = 0.005) and third (−202.19, p = 0.004), increasing the risk of bone demineralization, while potassium rose between the second and third trimesters (517.87, p = 0.013). Overall, late pregnancy showed declines in hemoglobin, folate, protein, and calcium alongside poorer sleep, highlighting the importance of ongoing nutritional monitoring, supplementation, and stress management.

SUMMARY

Pregnancy is a physiologically and emotionally sensitive phase influencing nutritional needs, mental wellbeing, and sleep. Nutritional status and sleep quality are crucial for maternal and fetal health, yet hormonal changes, increased physical demands, and psychological stress can impair both, contributing to higher stress and anxiety levels linked to adverse outcomes.

This cross-sectional study assessed the nutritional status, sleep quality, and their association with stress and anxiety among 100 pregnant women aged 18–40 years, excluding those with chronic medical conditions or diagnosed sleep disorders. Data were collected using a questionnaire covering socio demo graphics, anthropometry, dietary intake (24-hour recall and food frequency questionnaire), sleep quality (Pittsburgh Sleep Quality Index), and psychological assessments (Perceived Stress Scale and Pregnancy Specific Anxiety Tool). Findings showed inadequate intakes of protein, fiber, calcium, potassium, and iron, with excess carbohydrates and fats. Poor sleep quality was common, especially in the third trimester, aligning with increased discomfort. Moderate to high stress and anxiety were prevalent, often linked to low micronutrient intake (iron, magnesium), inadequate fiber, and poor sleep. Sleep quality deterioration and rising anxiety were observed with advancing pregnancy, though BMI showed no significant association with stress, highlighting the stronger role of psychosocial and lifestyle factors.

CONCLUSION

The study concludes that a majority of pregnant women demonstrated poor nutritional intake, inadequate sleep quality, and elevated levels of stress and anxiety. The mean sleep quality score indicated poor sleep in more than half of the sample, while psychological assessments reflected moderate to high stress and anxiety levels. Poor nutrient intake—especially deficiencies in fiber, iron, calcium, and potassium—was positively associated with elevated stress and anxiety. Sleep quality, particularly in the later stages of pregnancy, also exhibited a strong and significant association with maternal stress and anxiety levels.

Thus, maternal health during pregnancy must be approached holistically by integrating nutritional counseling, psychological support, and sleep hygiene education into routine antenatal care. The findings emphasize the need for early identification and intervention strategies that target nutrition and sleep to mitigate stress and anxiety, ultimately promoting better maternal and fetal outcomes.

Declaration by Authors

Ethical Approval: Approved the Inter System Biomedica Ethics Committee, and informed written consent was collected from all participants prior to data collection.

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