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Research Article

# Prevalence of altered sleep traits and female infertility: A case-control study in Indian population

**Neeta Singh [1], Nisha [1], Ashish Datt Upadhyay [2], Rekha Ramappa [1]***

[1]Department of Obstetrics and Gynaecology All India Institute of Medical Sciences, New Delhi, India.

[2]Department of Biostatistics All India Institute of Medical Sciences, New Delhi, India.

***Corresponding Author:** Rekha Ramappa, Department of Obstetrics and Gynaecology All India Institute of Medical Sciences, New Delhi, India.

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## Abstract:

**Aim:** To study the prevalence of altered sleep characteristics in female patients seeking treatment for infertility.

Materials and Methods: A case-control study conducted at tertiary centre from 2024 to 2025 after ethical approval (AIIMSA1273/03.05.2024). Women aged 20-40 years who are seeking treatment for infertility were included for cases and women aged 20-40 years who are fertile for control.

Women who declined consent for the study and those taking medication that can alter sleep-wake cycle were excluded. Patients' demographic parameters (age, smoking habits, gravida, parity, infertility length, type of infertility and BMI) will be gathered, as well as Pittsburgh Sleep Quality Index (PSQI) groups and scores. This index has 24 questions, 19 of which are filled by the individual and five by the individual's spouse or a person with whom they reside. There are seven modules to these 19 scored items A score of 0–3 is assigned to each module. These seven component ratings yield a total index score ranging from 0 to 21 Scores ≤ 5 were evaluated as good sleep quality, and scores >5 were set as poor sleep quality.

Primary outcome measure was global PSQI score while secondary outcome measures were subjective sleep quality,sleep duration, sleep efficiency and use of sleep medication.

Statistical analyses were performed using Stata-16 (TX, USA).

**Objective:**

To determine how common sleep disturbances are among infertile women receiving treatment for infertility and how these disturbances relate to demographic factors and various types of infertility.

**Methods:**

We conducted a case-control study with 145 infertile women and 96 age-matched controls. All participants completed structured questionnaire forms, including the Pittsburgh Sleep Quality Index (PSQI). The collected information on sleep patterns, types of infertility, and sociodemographic details was filled in excel and subjected to SPSS analysis. We analyzed the data to find any associations between sleep patterns, demographic variables, and types of infertility.

**Results:**

In the infertility group, the women were significantly older (mean 29.92 ± 3.86 years) and had been married longer (mean 6.64 ± 3.60 years) compared to controls (mean 26.32 ± 3.20 years; mean marriage duration 3.72 ± 2.30 years). Poor sleep quality, defined as a PSQI score above 5, was observed in 42.1% of infertile women. In contrast, only 3.1% of controls reported poor sleep ($p < 0.001$). In the infertility group, we found significant correlations among subjective sleep quality, sleep duration, sleep efficiency, and infertility-related variables. These correlations were not observed among the controls.

**Conclusion:**

Poor sleep quality is common among Indian women seeking infertility care. This indicates that including sleep assessment and counseling in infertility care may be beneficial.

**Keywords:** infertility; sleep quality; pittsburgh sleep quality index (psqi); female reproductive health; sleep disturbances

## 1.Introduction

The World Health Organization estimates that about 17.5% of people, roughly one in every six, suffer from infertility1. In India, the estimated prevalence of primary infertility ranges from 3.9% to 16.8%2. Despite improvements in reproductive technologies, infertility continues to cause significant psychological and social challenges, especially for women, primarily due to societal and cultural pressures3.

Sleep is necessary for vital functions, and sleep characteristics might affect fertility. As a result, there has been a new trend toward evaluating the relationship between sleep quality and fertility. The ideal duration of sleep is defined as 7–9h of sleep on a 24-h time span, but in real life, one-third of premenopausal women sleep less than 74. Environmental and lifestyle factors are also closely correlated with sleep and to the sleep-wake cycle, especially because of societal and work-related trends (e.g., late-night electronic device use, shift work, noise)5.

Research shows that sleep disturbances, inferior sleep quality and irregular sleep patterns, greatly impact female fertility. These issues are closely linked with infertility, suggesting that sleep plays a crucial role in reproductive health. Additionally, obesity combined with sleep problems can further increase the risk of infertility, as higher BMI and sleep disturbances relate to lower fertility rates. High stress levels and reduced quality of life also contribute to fertility issues, especially for women facing infertility. Lifestyle factors like diet and physical activity can worsen the negative effects of poor sleep and stress on fertility. While sleep disorders are a key factor, other lifestyle aspects, such as mental health and nutrition, also affect female fertility [6-10].

Recent studies reveal a strong connection between sleep deprivation, poor sleep quality, and disruptions in the hypothalamic-pituitary-gonadal (HPG) axis, which is a vital hormonal system for regulating reproduction. This can lead to menstrual irregularities and infertility. This is especially concerning in India, where research on this topic is limited. Sleep deprivation harms hormone secretion and reduces fertility in both men and women. It can cause issues such as anovulation, amenorrhea, and even early pregnancy loss by disrupting levels of gonadotropin and sex hormones. Disruptions in circadian rhythms, commonly seen in shift workers, have been linked to menstrual irregularities and decreased reproductive capacity. Furthermore, infertility itself is connected with increased psychological stress, which can further harm sleep quality. These findings underscore the need for more research to explore these connections and develop targeted treatments for women facing infertility and sleep issues [6-7, 11-12].

Sleep problems have been connected to reduced fertility since women struggling with infertility frequently report more sleep disturbances than fertile women. Poor sleep quality is also linked to negative reproductive outcomes, even in women undergoing assisted reproductive technologies [11-15].

In India, the most common causes of primary infertility are tubal factor infertility and male factor infertility. However, few studies have looked into how sleep problems might interact with these causes of infertility in the Indian population 16.

Despite global research, there is still a lack of studies focusing on Indian women, particularly regarding how sleep quality relates to different types of infertility and their underlying causes. This gap highlights the urgent need for in-depth research to inform specific interventions for Indian women experiencing infertility [17-19].

Additionally, poor sleep quality is linked to decreased ovarian reserve, suggesting a biological pathway through which sleep deprivation might affect fertility. Sleep therapy could potentially improve reproductive outcomes in women with poor baseline sleep quality. Emerging evidence indicates that sleep disturbances may trigger inflammation and hormone imbalances, reinforcing the idea that sleep quality is a modifiable risk factor for reproductive health [6,17,18-19].

Sleep is controlled by homeostatic regulation, which corresponds to the propensity to fall asleep, and by circadianregulation, which is under the control of the central clock located in the suprachiasmatic nuclei 5. The mechanism for infertility secondary to sleep disorders maybe the activation of the hypothalamic–pituitary–adrenal (HPA) axis 20. The activated HPA then affects sex hormones, such as LH, FSH, and progesterone, causing changes in menstruation, normal follicle development, and infertility. Moreover, HPA activation increases melatonin levels, which is associated with GnRH suppression and irregular ovulation 21. Sleep deprivation leads to high FSH, TSH, prolactin and estradiol and low progesterone, LH and melatonin. It also leads to increased oxidative stress and insulin resistance and glucose intolerance 22. a comprehensive study demonstrates that Clock gene is able to influence the activity of the estrogen receptor alpha, by regulating its transcriptional activity 23. Increase of glucocorticoid levels occurring due to stimulation of any cause could severely impair different organs including immune and reproductive system24.

The PSQI, which is frequently used to assess sleep quality, has been demonstrated to be beneficial in the study of sleep disorders25. It has 19 self-report items composed of seven categories. A score of 0–3 is assigned to each module. These seven component ratings yield a total index score ranging from 0 to 21. Scores ≤ 5are evaluated as good sleep quality, and scores >5 are set as poor sleep quality26.

Given these insights, this study aimed to explore the prevalence of sleep disturbances among Indian women seeking infertility treatment in comparison to fertile controls.

## 2. Materials and Methods

### *2.1 Study Design:*

This case-control study was conducted at the Department of Obstetrics and Gynaecology, AIIMS, New Delhi, between 15.7.2024 and 15.1.2025 after obtaining approval from the Institutional Ethics Committee (IEC No. AIIMSA1588) and written informed consent from all participants. This study was conducted as per Helsinki Declaration. Women aged 20-40 years who are seeking treatment for primary and secondary infertility were included for cases. The control group comprised age-matched fertile parous women with proven natural fertility with no history of infertility or assisted reproductive procedures. Exclusion criteria included known psychiatric disorders, diagnosed sleep disorders, chronic systemic diseases such as diabetes or thyroid dysfunction, use of medications that could impact sleep or hormonal status, and a history of substance abuse.

Data collection involved a structured questionnaire that included demographic details such as age, body mass index (BMI), duration of marriage, and infertility-related factors. Causes of infertility were categorized after thorough clinical evaluation, laboratory investigations, and imaging studies into tubal factor infertility, male factor infertility, polycystic ovary syndrome (PCOS), unexplained infertility, and other causes such as endometriosis or uterine abnormalities.

### *2.2 Questionnaire:*

In this study, the Pittsburg Sleep Quality Index (PSQI) was used to evaluate sleep quality and is mentioned in Table 8. It has 19 self-report items composed of seven categories: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, use of sleep medication and daytime dysfunction. The questions include sleep length, sleep latency, the regularity, and intensity of certain sleeping issues. This index has 24

questions, 19 of which are filled by the individual and five by the individual's spouse or a person with whom they reside. There are seven modules to these 19 scored items: Some are made up of only one object, while others are made up of a number of them. A score of 0–3 is assigned to each module. These seven component ratings yield a total index score ranging from 0 to 21. Scores ≤ 5 were evaluated as good sleep quality, and scores >5 were set as poor sleep quality

### *2.3 Outcomes:*

Primary outcome measure was global PSQI score while secondary outcome measures were subjective sleep quality, sleep duration, sleep efficiency and use of sleep medication.

## 3.Statistical analysis:

Statistical analysis was performed using SPSS Statistics (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD) and compared using the independent samples t-test. Categorical variables were presented as frequencies and percentages, with group differences analyzed using the chi-square test. Pearson's correlation coefficient was used to assess relationships between continuous variables. A p-value of less than 0.05 was considered statistically significant.

## 4.Results:

A total of 145 women with infertility and 96 healthy controls participated in this study. Figure 1shows flow diagram for study.

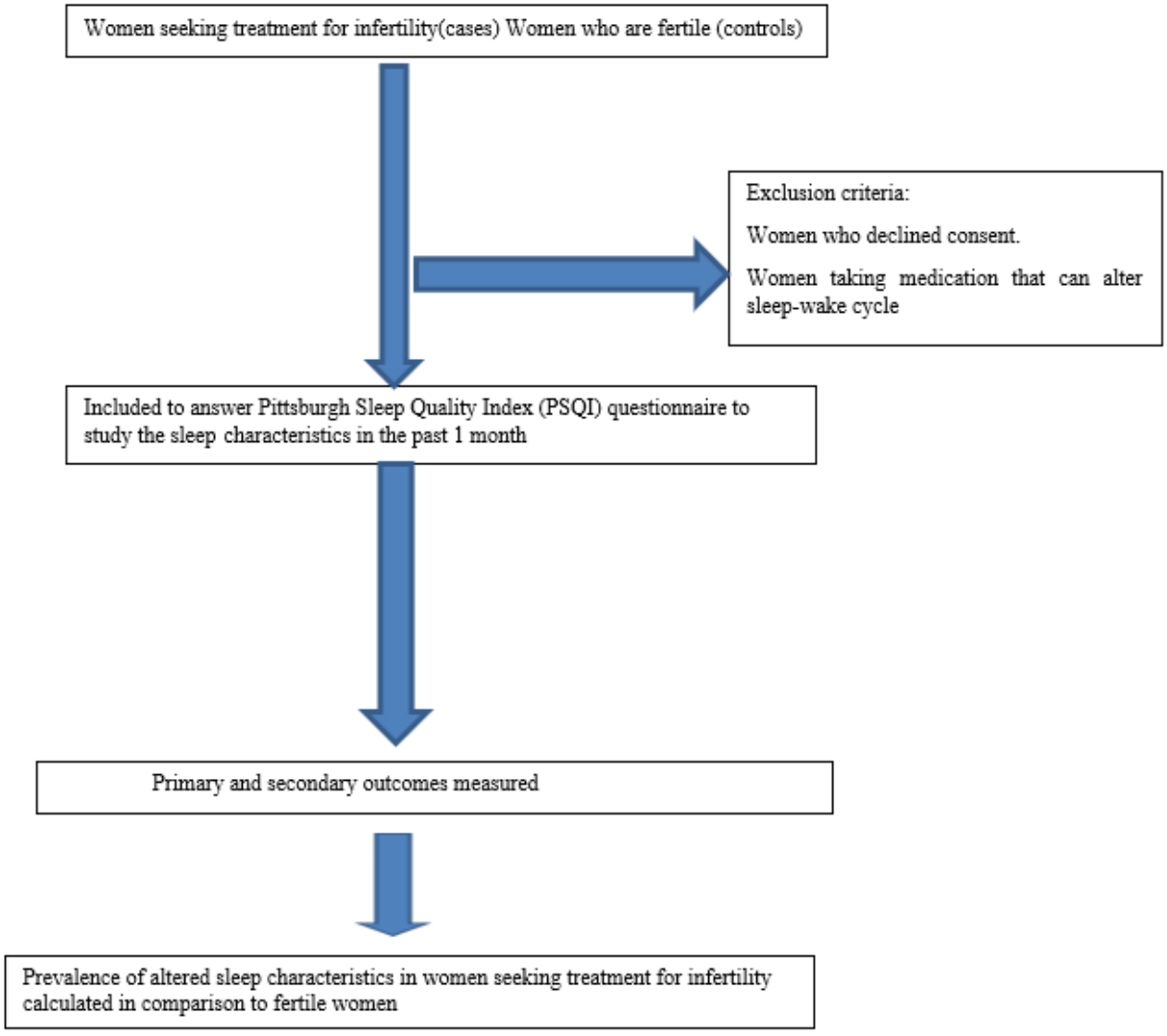


**Figure 1:** Flow diagram of stud

### *4.1 Demography of Study Participants:*

The demographic comparison in Table 1 showed that infertile women were significantly older and had been married longer than the control group. Both groups had similar BMI values, but the infertility group had a much higher global PSQI score, indicating poorer sleep quality among these women.

In our study, primary infertility was the most common diagnosis, making up 83.4% of the infertility cases. As shown in Table 2, there was a significant link between the type of infertility and its causes. Tubal factor and male factor infertility were most often connected to primary infertility. This likely occurs because these issues interfere with natural conception. On the other hand, unexplained infertility was more frequently observed in women with secondary infertility, possibly due to more subtle, acquired, or combined causes that develop after a previous pregnancy. These findings emphasize the need for tailored diagnostic strategies based on the specific type of infertility.

The demographic analysis revealed significant differences in age, BMI, and duration of marriage between women with infertility and healthy controls, as shown in Table 3. In terms of age distribution, most infertility cases were in the 26–30 and 31–35 year age groups. The control group was mostly younger, with many in the 20–25 and 26–30 year categories. Notably, none of the controls were older than 35, while about 33% of infertility cases were aged 31 or older, suggesting a trend toward older age among infertile women.

The BMI distribution also showed clear differences. Obesity was common in both groups, but it was slightly more prevalent among the controls. Underweight women were found only in the infertility group (6.9%), indicating that low body weight might affect fertility in women experiencing infertility.

A significant difference also appeared in the duration of marriage between the two groups. Most healthy controls had been married for less than five years, while more than half (56.6%) of the infertility cases had been married for over five years. Notably, 11% of the infertile women had been married for over ten years, a category not seen in the controls. This trend suggests that infertile women tended to have a longer marriage duration, likely due to ongoing efforts to conceive.

Overall, these findings indicate that older age, longer marriage duration, and extremes in BMI (both obesity and underweight) are more common among women with infertility. This supports the idea that these factors might be important demographic risk factors for infertility.

| Demographic Variables | Cases (Mean ± SD) | Controls (Mean ± SD) |
|---|---|---|
| Age (years) | 29.92 ± 3.86 | 26.32 ± 3.20 |
| BMI (Kg/m²) | 25.9 ± 3.26 | 25.7 ± 3.04 |
| Married life (years) | 6.64 ± 3.60 | 3.72 ± 2.30 |

**Table 1:** Comparison of Demographic Variables between Infertility Cases and Controls

| Factor | Primary (n, %) | Secondary (n, %) | Total (n, %) | $\chi^2$ (*p*-value) |
|---|---|---|---|---|
| Unexplained Infertility | 19 (13) | 13 (9) | 32 (22.1) | 21.53 (<0.001)* |
| Tubal | 30 (20.7) | 2 (1.4) | 32 (22.1) | |
| Male Factor | 30 (20.7) | 1 (0.7) | 31 (21.4) | |
| PCOS | 21 (14.5) | 6 (4.1) | 27 (18.6) | |
| Others | 21 (14.5) | 2 (1.4) | 23 (15.9) | |
| **Total** | **121 (83.4)** | **24 (16.6)** | **145 (100)** | |

**Table 2:** Association between Infertility Type and Contributing Factors (Cases Only, n = 145)

*Significant at p < 0.001

| Variable | Cases (n, %) | Controls (n, %) | $\chi^2$ (*p*-value) |
|---|---|---|---|
| **Age group (years)** | | | 38.98 (<0.001)* |
| 20–25 | 21 (14.5) | 39 (40.6) | |
| 26–30 | 60 (41.4) | 47 (49.0) | |
| 31–35 | 53 (36.6) | 10 (10.4) | |
| 36–40 | 11 (7.6) | 0 (0) | |
| **BMI** | | | 8.64 (0.035)* |
| Underweight | 10 (6.9) | 0 (0) | |
| Normal | 25 (17.2) | 13 (13.5) | |
| Overweight | 38 (26.2) | 24 (25) | |
| Obese | 72 (49.7) | 59 (61.5) | |
| **Married Life (years)** | | | 30.17 (<0.001)* |
| Less than 5 | 63 (43.4) | 74 (77.1) | |
| 5–10 | 66 (45.5) | 22 (22.9) | |
| 10–15 | 16 (11) | 0 (0) | |

**Table 3:** Distribution of Age, BMI, and Married Life in Infertility Cases and Controls

*Statistically significant

### *4.2 PSQI score and study participants*

The comparison of PSQI components in Table 4 revealed that women with infertility reported significantly worse subjective sleep quality and shorter sleep durations compared to healthy controls. Although there was no major difference in sleep efficiency between the groups, the prevalence of poor sleep quality (defined as PSQI >5) was much higher among infertility cases. These results suggest that infertile women not only view their sleep quality as worse but also report shorter sleep durations and higher PSQI scores, indicating that sleep disturbances may be linked to infertility.

The correlation analysis within the infertility group in Table 5 showed significant links between demographic factors and sleep parameters. Notably, subjective sleep quality had substantial correlations with sleep duration, sleep efficiency, and overall PSQI classification. These findings highlight the relationships among sleep characteristics in women with infertility, suggesting that poorer subjective sleep quality often comes with shorter sleep durations, reduced sleep efficiency, and higher overall PSQI scores.

In contrast, the control group showed fewer significant correlations as shown in table 6. While sleep duration and sleep efficiency were related, as in the infertility group, these associations were weaker. A strong positive correlation was seen between age and duration of married life, which reflects expected demographic trends. Interestingly, a negative correlation appeared between BMI and PSQI classification, suggesting that in the control group, higher BMI was associated with better sleep quality. This finding contrasts with common beliefs and highlights the complexity of factors affecting sleep in healthy women.

These findings show a significant relationship between infertility and poor sleep quality, as well as demographic factors like age, extremes in BMI, and

length of marriage. The stronger correlations observed among sleep parameters in women with infertility suggest that sleep disturbances may contribute to infertility, emphasizing the need to consider sleep health in infertility assessment and care.

| Component | Subgroups | Cases (n, %) | Controls (n, %) | $\chi^2$ (*p*-value) |
|---|---|---|---|---|
| **Subjective Sleep Quality** | Very Good | 64 (44.1) | 58 (60.4) | 6.91 (0.032)* |
| | Fairly Good | 58 (40) | 24 (25) | |
| | Fairly Bad | 23 (15.9) | 14 (14.6) | |
| **Sleep Duration** | >7 hours (Normal) | 83 (57.2) | 72 (75) | 32.64 (<0.001)* |
| | 5–7 hours (Short) | 19 (13.1) | 23 (24) | |
| | <5 hours (Very Short) | 43 (29.7) | 1 (1) | |
| **Sleep Efficiency** | >85% (Normal) | 128 (88.3) | 85 (88.5) | 3.01 (0.390) NS |
| | 75–84% (Mild Reduction) | 13 (9.0) | 11 (11.5) | |
| | 65–74% (Moderate) | 2 (1.4) | 0 (0) | |
| | <65% (Severe) | 2 (1.4) | 0 (0) | |
| **PSQI Classification** | Good Sleep (≤5) | 84 (57.9) | 93 (96.9) | 44.91 (<0.001)* |
| | Poor Sleep (>5) | 61 (42.1) | 3 (3.1) | |

**Table 4:** Comparison of PSQI Components Between Infertility Cases and Controls*

Statistically significant ($p < 0.05$) and NS = Not significant.

| Variable 1 | Variable 2 | Pearson Correlation (r) | *p*-value |
|---|---|---|---|
| Type of Infertility | Infertility Factor | -0.191 | 0.021 |
| Type of Infertility | Age | 0.205 | 0.014 |
| Subjective Sleep Quality | Sleep Duration | 0.405 | <0.001 |
| Subjective Sleep Quality | Sleep Efficiency | 0.184 | 0.027 |
| Subjective Sleep Quality | PSQI Classification | 0.663 | <0.001 |
| Sleep Duration | Sleep Efficiency | 0.413 | <0.001 |
| Sleep Duration | PSQI Classification | 0.578 | <0.001 |
| Sleep Efficiency | PSQI Classification | 0.377 | <0.001 |
| Age | BMI | 0.202 | 0.015 |
| BMI | Married Life | 0.183 | 0.028 |

**Table 5:** Significant Correlations in Infertility Cases (n = 145)

| Variable 1 | Variable 2 | Pearson Correlation (r) | *p*-value |
|---|---|---|---|
| Sleep Duration | PSQI Classification | 0.417 | <0.001 |
| Sleep Efficiency | PSQI Classification | 0.311 | 0.002 |
| Age (new) | Married Life | 0.637 | <0.001 |
| BMI (new) | PSQI Classification | -0.285 | 0.005 |

**Table 6:** Significant Correlations in Controls (n = 96)

| Country (Year) | Design & Population | Sleep Measure & Results | Notes |
|---|---|---|---|
| **India (our study)** | Case–control: Infertile women (n=145) vs fertile controls (n=96) | PSQI global: 4.94 ± 3.60 vs 1.60 ± 1.60; 42.1% vs 3.1% PSQI > 5 | First Indian study with infertility-specific case-control design |
| India, Bhopal (2021)[24] | PCOS vs controls (62 vs 31) | PSQI 7.97 ± 3.61 vs 5.42 ± 2.73 | Higher sleep disturbance in PCOS women |
| India, Chennai (2024)[25] | PCOS women | PSQI-based; reported significant sleep impairment | Confirms Tamil Nadu's PCOS–sleep link |
| China, Li et al. (2023)[26] | Cohort: infertile women (n=1002) pre-ART | PSQI 7.53 ± 1.78; 24.3% PSQI > 5 | Poor sleep linked to primary infertility |
| Multinational systematic review (2024)[4] | 19 observational studies across Asia | Sleep disturbance is significantly associated with infertility | Confirms broader Asian link |
| Meta-analysis pooled (2023)[9] | Eleven studies, global | SMD -0.75 in sleep quality among infertile women (significant) | Strong evidence of poor sleep in infertile women |

**Table 7:** Comparative Studies on Sleep & Female Infertility (Case–Control & Cohort)

 

Name: Date:

**Pittsburgh Sleep Quality Index (PSQI)**

Instructions: The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. **Please answer all questions.**

1. During the past month, what time have you usually gone to bed at night?
2. During the past month, how long (in minutes) has it usually taken you to fall asleep each night?
3. During the past month, what time have you usually gotten up in the morning?
4. During the past month, how many hours of actual sleep did you get at night? (This may be different than the number of hours you spent in bed.)

| 5. During the past month, how often have you had trouble sleeping because you… | Not during the past month | Less than once a week | Once or twice a week | Three or more times a week |
|---|---|---|---|---|
| a. Cannot get to sleep within 30 minutes | | | | |
| b. Wake up in the middle of the night or early morning | | | | |
| c. Have to get up to use the bathroom | | | | |
| d. Cannot breathe comfortably | | | | |
| e. Cough or snore loudly | | | | |
| f. Feel too cold | | | | |
| g. Feel too hot | | | | |
| h. Have bad dreams | | | | |
| i. Have pain | | | | |
| j. Other reason(s), please describe: | | | | |
| 6. During the past month, how often have you taken medicine to help you sleep (prescribed or “over the counter”)? | | | | |
| 7. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity? | | | | |
| | No problem at all | Only a very slight problem | Somewhat of a problem | A very big problem |
| 8. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done? | | | | |
| | Very good | Fairly good | Fairly bad | Very bad |
| 9. During the past month, how would you rate your sleep quality overall? | | | | |
| | No bed partner or room mate | Partner/room mate in other room | Partner in same room but not same bed | Partner in same bed |
| 10. Do you have a bed partner or room mate? | | | | |
| | Not during the past month | Less than once a week | Once or twice a week | Three or more times a week |
| If you have a room mate or bed partner, ask him/her how often in the past month you have had: | | | | |
| a. Loud snoring | | | | |
| b. Long pauses between breaths while asleep | | | | |
| c. Legs twitching or jerking while you sleep | | | | |
| d. Episodes of disorientation or confusion during sleep | | | | |
| e. Other restlessness while you sleep, please describe: | | | | |

**Table 8:** PSQI questionnaire and scoring

**Scoring the PSQI**

The order of the PSQI items has been modified from the original order in order to fit the first 9 items (which are the only items that contribute to the total score) on a single page. Item 10, which is the second page of the scale, does not contribute to the PSQI score.

In scoring the PSQI, seven component scores are derived, each scored 0 (no difficulty) to 3 (severe difficulty). The component scores are summed to produce a global score (range 0 to 21). Higher scores indicate worse sleep quality.

**Component 1: Subjective sleep quality—question 9**

| Response to Q9 | Component 1 score |
|---|---|
| Very good | 0 |
| Fairly good | 1 |
| Fairly bad | 2 |
| Very bad | 3 |

Component 1 score:

**Component 2: Sleep latency—questions 2 and 5a**

| Response to Q2 | Component 2/Q2 subscore |
|---|---|
| ≤ 15 minutes | 0 |
| 16-30 minutes | 1 |
| 31-60 minutes | 2 |
| > 60 minutes | 3 |

| Response to Q5a | Component 2/Q5a subscore |
|---|---|
| Not during past month | 0 |
| Less than once a week | 1 |
| Once or twice a week | 2 |
| Three or more times a week | 3 |

| Sum of Q2 and Q5a | Component 2 score |
|---|---|
| 0 | 0 |
| 1-2 | 1 |
| 3-4 | 2 |
| 5-6 | 3 |

Component 2 score:

**Component 3: Sleep duration—question 4**

| Response to Q4 | Component 3 score |
|---|---|
| > 7 hours | 0 |
| 6-7 hours | 1 |
| 5-6 hours | 2 |
| < 5 hours | 3 |

Component 3 score:

**Component 4: Sleep efficiency—questions 1, 3, and 4**

Sleep efficiency = (# hours slept/# hours in bed) X 100%
#hours slept—question 4
# hours in bed—calculated from responses to questions 1 and 3

| Sleep efficiency | Component 4 score |
|---|---|
| > 85% | 0 |
| 75-84% | 1 |
| 65-74% | 2 |
| < 65% | 3 |

Component 4 score:

**Component 5: Sleep disturbance—questions 5b-5j**

Questions 5b to 5j should be scored as follows:

| | |
|---|---|
| Not during past month | 0 |
| Less than once a week | 1 |
| Once or twice a week | 2 |
| Three or more times a week | 3 |

| Sum of 5b to 5j scores | Component 5 score |
|---|---|
| 0 | 0 |

| | |
|---|---|
| 1-9 | 1 |
| 10-18 | 2 |
| 19-27 | 3 |

Component 5 score:

**Component 6: Use of sleep medication—question 6**

| Response to Q6 | Component 6 score |
|---|---|
| Not during past month | 0 |
| Less than once a week | 1 |
| Once or twice a week | 2 |
| Three or more times a week | 3 |

Component 6 score:

**Component 7: Daytime dysfunction—questions 7 and 8**

| Response to Q7 | Component 7/Q7 subscore |
|---|---|
| Not during past month | 0 |
| Less than once a week | 1 |
| Once or twice a week | 2 |
| Three or more times a week | 3 |
| Response to Q8 | Component 7/Q8 subscore |
| No problem at all | 0 |
| Only a very slight problem | 1 |
| Somewhat of a problem | 2 |
| A very big problem | 3 |
| Component 7 score | |

In this case-control study of Indian women, we examined the relationship between sleep problems and infertility. We found significant differences in demographics, health, and sleep between infertile women and healthy controls. Our results suggest that infertility is not just a physical issue; it is also closely related to lifestyle and psychosocial factors, particularly sleep quality. We discovered that women who were unable to have children were much older and had been married for a longer time than healthy controls. This finding is in line with what other studies have found: older mothers and longer periods of infertility are both linked to lower fertility potential27. Also, while previous Indian studies have mostly focused on how being overweight or obese affects infertility, our study found that only infertile women were underweight.

## 5. Discussion:

Regarding infertility causes, our results showed tubal factors and male factor infertility as the most common etiologies in primary infertility, while unexplained infertility was significantly associated with secondary infertility. Studies have reported a higher occurrence of structural issues, like blocked tubes, among primary infertility cases in India28-29 The higher rate of unexplained infertility in secondary cases suggests possible subtle endocrine dysfunction or post-pregnancy issues, supporting the need for in-depth etiological investigations.

A particularly important finding was the significantly poorer sleep quality reported by infertile women. The average PSQI score, the proportion of poor sleepers (PSQI >5), and the prevalence of short sleep duration (<5 hours) were all much higher in the infertility group compared to controls. These results support previous reviews, like those by Liu et al. and Gençtürk et al. [6,11] which identified sleep disturbances as related to both infertility-related psychological stress and reduced fertility. However, the lack of such studies in India makes our findings an important addition to the literature.

Our analysis of PSQI components showed significant differences in subjective sleep quality and sleep duration between the two groups. Interestingly, despite the high rate of obesity in both groups, underweight status was only found among infertile women, highlighting the complex relationship between nutrition and reproductive health. These findings support Kamboj et al.,30 who noted the link between sleep disorders and infertility outcomes.

Correlation analyses further showed that infertile women had stronger associations among sleep variables like subjective sleep quality, sleep duration, sleep efficiency, and PSQI classification compared to controls. These interconnections may reflect a combined effect of psychosocial stress, hormonal changes, and lifestyle factors. Lin et al.31 reported a similar connection between poor sleep quality and reduced ovarian reserve, suggesting that disrupted sleep could directly influence reproductive physiology

Additionally, we found significant correlations between demographic factors (age, BMI, duration of marriage) and sleep parameters within the infertility group, a pattern not seen in healthy controls. This suggests a multifactorial risk profile for infertile women, supporting Kloss et al.20 hypothesis that sleep disturbances may influence fertility through inflammatory processes and hormonal disruption.

Although sleep duration and PSQI classification correlated in both groups, the associations were notably stronger in infertile women. This may mean that while poor sleep affects overall well-being, it has particularly harmful effects on women dealing with infertility—a point that has not been widely explored in Indian research.

Our case-control study adds to the growing evidence linking poor sleep quality with infertility, especially in India, where such studies are sparse. We found a significantly higher prevalence of poor sleep quality among infertile women (42.1%) compared to healthy controls (3.1%), with mean PSQI scores also notably higher. These findings are consistent with both national and global research on sleep disturbances and reproductive health.

Notably, earlier Indian studies primarily focused on women with polycystic ovary syndrome (PCOS), such as those from Bhopal (2021) and Chennai (2024), which reported significantly poor sleep quality among PCOS patients. However, these studies did not use infertility-specific case-control approaches. Our research, which specifically enrolled women diagnosed with infertility regardless of PCOS status, offers a broader view of the connection between infertility and sleep patterns in the Indian population (Table 7).

Data from China and other global reviews consistently report similar outcomes, suggesting that poor sleep is a common issue among infertile

women worldwide. Systematic reviews and meta-analyses also back up this connection, highlighting its clinical significance (Table 7).

## 6. Clinical Implications

Our study is unique as the first Indian investigation, based on a literature review, to use a structured case–control design examining infertility beyond the commonly studied PCOS subset. The significant correlation we observed between poor sleep quality and infertility indicates a potential role for sleep assessments in infertility evaluations. However, causality cannot be established, and further longitudinal and mechanistic studies are needed to clarify whether sleep disturbances are a contributing factor to infertility or a consequence of infertility-related stress.

Our study highlights a significant association between poor sleep quality and female infertility, adding to the evidence that sleep disturbances may be both a contributing factor and a result of reproductive challenges. These findings suggest that assessing sleep quality should be a key part of infertility evaluations.

In practice, incorporating standardized tools like the Pittsburgh Sleep Quality Index (PSQI) into infertility assessments could help identify modifiable risk factors. Addressing sleep disturbances through behavioral interventions, sleep hygiene education, and referrals to sleep specialists may improve fertility outcomes.

Given the complex relationships between psychological and physiological factors in infertility, a team approach involving reproductive specialists, mental health professionals, and sleep experts may provide more comprehensive care. This is particularly important in settings like India, where sleep evaluation is often not included in infertility care, despite its potential effect on reproductive health.

Looking ahead, clinical guidelines might benefit from formally incorporating sleep quality assessments into infertility management protocols paving the way for targeted interventions that could enhance both sleep health and fertility outcomes.

## 7. Strengths and Limitations

This study stands out as one of the first Indian case–control investigations to thoroughly examine the link between sleep characteristics and infertility, with the inclusion of a well-matched control group adding strength to the comparisons made. Using a validated tool like the Pittsburgh Sleep Quality Index (PSQI) provided a uniform method for assessing sleep patterns.

However, several limitations need to be considered. The cross-sectional design limits our ability to draw conclusions about causality. Using self-reported sleep data also introduces the risk of recall bias. Moreover, as a single-center study, the findings may not represent the wider Indian population. An important limitation is the absence of objective sleep measurements, like actigraphy or polysomnography, which could have given more precise insights into sleep patterns.

## 8. Conclusion

Our study demonstrates that infertile women in the Indian population show distinct demographic and clinical characteristics, particularly a higher prevalence of sleep disturbances compared to healthy controls. The strong links observed between sleep quality, infertility-related factors, and demographic variables highlight the complex and multifaceted nature of infertility.

These findings suggest that sleep disturbances may serve not only as a reflection of reproductive challenges but also as a potentially modifiable risk factor. The observation of underweight status among infertile women alongside the clear associations between sleep parameters and infertility characteristics underscores the need for a holistic approach to infertility assessment. This approach should take into account lifestyle factors and psychosocial influences as part of comprehensive patient care.

As evidence accumulates linking sleep disturbances to reproductive outcomes, incorporating regular sleep quality screenings and interventions into infertility care may enhance treatment success. Future longitudinal and intervention-based studies are essential to clarify causal relationships and explore targeted strategies aimed at improving sleep health in infertility management.

## Disclosures

**Conflict of interest**: None.

***Human rights statement and informed consent:*** All patients were well informed and written informed consent was obtained prior to the treatment period.

***The statement of approval from Institutional Review Board:*** All procedures in this study were in accordance with the ethical standards of the Ethical Committee in accordance with the ethical principles that have their origin in the Declaration of Helsinki 1964 and its later amendments. This study was approved by Institutional Ethics Committee(IEC) with reference number AIIMSA1273/03.05.2024

**Authorship contribution statement:**

The study was conceptualized and designed by NS and RR. RR and N were responsible for obtaining clinical data and informed consent. NS and RR were responsible for protocol implementation. NS supervised the overall study. AU, NS and RR. analyzed and interpreted the data. RR and NS drafted the first manuscript. RR, N. and NS were responsible for critically editing the manuscript. All authors contributed to the patient management and follow-up. All authors contributed to manuscript writing and critical evaluation of the final manuscript.

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***1.Data Availability statement:*** The data set used in the current study is available on request from the corresponding author.

## References

1. Choudhary, P., Dogra, P. & Sharma, K. (2025). Infertility and lifestyle factors: how habits shape reproductive health. *Middle East Fertil Soc J* 30, 14
2. (2004).World Health Organization. Infecundity, infertility, and childlessness in developing countries. DHS Comparative Reports No 9. Calverton, Maryland, USA: ORC Macro and the World Health Organization.
3. Azize Diallo A, Anku PJ, Darkoa Oduro RA. (2024). Exploring the psycho-social burden of infertility: Perspectives of infertile couples in Cape Coast, Ghana. PLoS One. 19(1):e0297428.
4. Leger D, Guilleminault C. (2020). Environmental open-source data sets and sleep-wake rhythms of populations: an overview. Sleep Med. 69:88–97.
5. Caetano G, Bozinovic I, Dupont C, Léger D, Lévy R, (2021).et al. Impact of sleep on female and male reproductive functions: a systematic review. *Fertil Steril.* 115(3):715–731.
6. Li J, Huang Y-L, Xu S, et al. (2024). Sleep disturbances and female infertility: a systematic review. *BMC Women's Health* 24(1);
7. Lateef OM, Akintubosun MO. (2020). Sleep and Reproductive Health. Journal of Circadian Rhythms [Internet]. 18(1):1.

8. Wang ZJ, Lai Y, Huang S-Y, Liu Y, Chen S. (2024). Combined impact of sleep and obesity on female infertility in the NHANES 2017–2020. *BMC Women's Health.* 24(1).
9. Shujaat T, Ahmed Z, Liaqat S.(2024). The impact of modifiable lifestyle factors on women's fertility. *Journal of Pakistan Medical Association.*
10. Palomba S, Daolio J, Romeo S, et al. (2018). Lifestyle and fertility: the influence of stress and quality of life on female fertility. *Reproductive Biology and Endocrinology* 16(1):1–11.
11. Gençtürk N, Karaahmet AY, Laleh SS, Guksu Z. (2024). The relationship between infertility and sleep quality in women: Systematic review and meta-analysis. *Actas urológicas españolas.* 48(3):185–203.
12. Jeon B, Baek J.(2023). Menstrual disturbances and its association with sleep disturbances: a systematic review. *BMC Women's Health.* 1;23.
13. Wang C, Cao K-X, Zhang L, Xu Y-S, Liu Z-H, et al. (2023). Sleep characteristics before assisted reproductive technology treatment predict reproductive outcomes: a prospective cohort study of Chinese infertile women. *Frontiers in Endocrinology.*
14. Cai X, Wang B, Zhao J, Nian M-X, Lin Q-C, et al. (2024). Association of sleep disturbances with diminished ovarian reserve in women undergoing infertility treatment. Dental science reports. 14(1).
15. Beroukhim G, Esencan E, Seifer DB. (2022). Impact of sleep patterns upon female neuroendocrinology and reproductive outcomes: a comprehensive review. Reproductive Biology and Endocrinology. 20(1).
16. Lu G.(2008). Investigation on Etiological Factors of Infertile Couples. Life Science Research.
17. Sharma A, Mahajan C, Saraswathy KN, Puri M, Babu N. (2022). Struggling with Primary Infertility: Psychological Well-Being and Associated Factors in North Indian Women. Journal of the Anthropological Survey of India. 71:68–83.
18. Mahajan C. (2022). Struggling with Primary Infertility: Psychological Well-Being and Associated Factors in North Indian Women. Journal of the Anthropological Survey of India.
19. Sarkar S, Gupta P. (2016). Socio-Demographic Correlates of Women's Infertility and Treatment Seeking Behavior in India. JOURNAL OF REPRODUCTION AND INFERTILITY. 17(2):123–132.
20. Kloss JD, Perlis ML, Zamzow JA, Culnan EJ, Gracia CR. (2015). Sleep, sleep disturbance, and fertility in women. Sleep Med Rev. 78–87.
21. Nakamura K, Sheps S, Arck PC. (2008). Stress and reproductive failure: past notions, present insights and future directions. *J Assist Reprod Genet*. 25(2–3):47–62.
22. Lateef OM, Akintubosun MO. (2020). Sleep and Reproductive Health. *J Circadian Rhythms.* Mar;18:1.
23. Li S, Wang M, Ao X, Chang AK, Yang C, Zhao F, et al. (2013). CLOCK is a substrate of SUMO and sumoylation of CLOCK upregulates the transcriptional activity of estrogen receptor-α. Oncogene. 32(41):4883–4891.
24. Vitellius G, Trabado S, Bouligand J, Delemer B, Lombès M. (2018). Pathophysiology of Glucocorticoid Signaling. Ann Endocrinol (Paris). 79(3):98–106.
25. Buysse DJ, Reynolds CF 3rd, Monk TH, Berman SR, Kupfer DJ. (1989). The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry Res.* 28(2):193–213.
26. Özçelik C, Varlı B, Gökçe A, Takmaz T, Çetin Ç, et al. (2023). Evaluation of chronotype and sleep quality in infertile population and comparison with fertile population: a cross-sectional study. *J Psychosom Obstet Gynaecol.* 44(1):2148523.
27. Yang Q, Zhang J, Fan Z. (2025). The Association Between Sleep Disorder and Female Infertility: A Mediation Analysis of Inflammatory and Oxidative Markers. Mediators Inflamm. 4572392.
28. Al Subhi T, Al Jashnmi RN, Al Khaduri M, Gowri V.(2013). Prevalence of Tubal Obstruction in the Hysterosalpingogram of Women with Primary and Secondary Infertility. *Journal of reproduction and infertility.* 14(4):214–216.
29. Bhise S. Study of distribution of reproductive tract anomalies in infertile women through hysterosalpingography in central india.
30. Kamboj N, Saraswathy KN, Babu N, Puri M, Sachdeva MP, et al. (2022). Infertility and obesity: A Cross-Sectional study in North Indian women. Collegium antropologicum. 46(2):97-103.
31. Lin Y, Chen Y, Lin Y, Xin S, Ren A, et al. (2025). Association between sleep quality and ovarian reserve in women of reproductive age: a cross-sectional study. *Fertil Steril.* 123(3):520-528.

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