International Journal of Zoology and Applied Biosciences **ISSN: 2455-9571**
Volume 10, Issue 5, pp: 157-166, 2025
https://doi.org/10.55126/ijzab.2025.v10.i05.018 **http://www.ijzab.com**

Research Article

STRESS, SLEEP PATTERNS, AND REPRODUCTIVE HEALTH AMONG FEMALE COLLEGE STUDENTS: EVIDENCE FROM A CROSS-SECTIONAL STUDY IN VIZIANAGARAM, INDIA

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Article History: Received 10th August 2025; Accepted 14th September 2025; Published 30th September 2025

ABSTRACT

This study investigated the interplay between stress, sleep quality, and reproductive health among female university students in Vizianagaram, India, highlighting a substantial burden of interconnected health challenges. A cross-sectional mixed-methods survey of 435 students aged 17–25 years revealed that 65% experienced high perceived stress, 45% reported sleeping fewer than 6 hours per night, 30% faced menstrual irregularities, and 60% suffered from moderate-to-severe dysmenorrhea. Both poor sleep and elevated stress were independently linked to adverse reproductive health outcomes, while their combined effect amplified menstrual disturbances and pain through synergistic physiological disruption. Despite moderate awareness of the impact of stress on hormonal health, nearly half of the students had never consulted a gynaecologist, although 80% expressed willingness to use free counselling services. These findings emphasize the urgent need for holistic, university-based interventions integrating stress management, sleep hygiene promotion, and menstrual health education to safeguard student well-being and academic success.

Keywords: Stress, Sleep quality, Menstrual irregularity, Dysmenorrhea, Reproductive health.

INTRODUCTION

The transition to college presents a unique set of academic, social, and lifestyle challenges for young women, often resulting in elevated stress levels and disrupted sleep patterns. Both factors have been independently linked to adverse reproductive health outcomes, yet their combined impact remains underexplored in student populations. Chronic psychological stress activates the hypothalamic-pituitary-adrenal (HPA) axis, increasing cortisol levels and disrupting the hypothalamic-pituitary-ovarian (HPO) axis, thereby impairing gonadotropin release and normal ovulatory cycles (Shen *et al*., 2022). Similarly, sleep disturbances, including reduced duration and poor quality, have been associated with menstrual irregularities, dysmenorrhea, and exacerbation of polycystic ovary syndrome (PCOS) symptoms (Liu *et al*., 2023). Female college students are particularly vulnerable to these risks because of academic pressures, irregular schedules, and lifestyle changes during early adulthood. The evidence suggests that more than half of young women in higher education systems experience menstrual irregularities, many of which are linked to psychosocial stress and inadequate sleep hygiene (Huang *et al*., 2021). The bidirectional relationship between stress and sleep loss may further amplify endocrine imbalances, worsening reproductive health issues such as premenstrual syndrome (PMS), amenorrhea, and hormonal fluctuations (Zhang *et al*., 2024). These disturbances not only affect fertility potential but also compromise physical and psychological well-being. Polycystic ovary syndrome remains one of the most common endocrine disorders among women of reproductive age, affecting 8–13% of women globally, with a higher prevalence among younger women in academic

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environments (Bozdag *et al*., 2022). Stress and inadequate sleep have been shown to exacerbate PCOS by dysregulating the HPO axis and amplifying hormonal imbalances (Zhou *et al*., 2023). Among university students, greater perceived stress is correlated with menstrual irregularities, PMS, and dysmenorrhea (Lee *et al*., 2023), whereas sleep deprivation has been linked to irregular cycles, greater bleeding, and luteal phase disruption (Musa *et al*., 2022; Zhang *et al*., 2024). The interaction between stress and poor sleep may therefore have a compound effect, leading to more severe reproductive dysfunction than either factor alone (Huang *et al*., 2021). In addition to their biological effects, stress and sleep problems in young women are closely associated with anxiety, depression, body image concerns, and reduced academic performance (Lee *et al*., 2023; Musa *et al*., 2022). These psychosocial burdens may reinforce a cycle of poor health, as menstrual disturbances and PCOS symptoms contribute to stigma, underreporting, and delays in seeking care (Zhou *et al*., 2023). Despite their prevalence, reproductive health concerns are seldom prioritized in student health programs, which often focus more on mental health and academic stress than on their reproductive consequences. Lifestyle-based interventions offer promising avenues for prevention and management. Mindfulness, physical activity, dietary modifications, and cognitive behavioural therapy have been shown to improve stress resilience and menstrual health outcomes (Lee *et al*., 2023; Musa *et al*., 2022). Similarly, sleep hygiene practices, including consistent schedules, limiting stimulants, and optimizing the sleep environment, can enhance both sleep quality and reproductive function (Liu *et al*., 2023). However, few studies have evaluated the synergistic effects of stress and sleep quality on reproductive health in a holistic manner, particularly in the context of female college students. This gap underscores the need for research that examines the integrated influence of stress and sleep on reproductive health.

The present study addresses this need by investigating the prevalence of menstrual irregularities and PCOS symptoms among female college students in Vizianagaram, India, and by evaluating how stress levels and sleep patterns individually and jointly affect reproductive outcomes. It is hypothesized that higher perceived stress levels are significantly associated with menstrual irregularities, including amenorrhea and dysmenorrhea, and that poorer sleep quality and shorter sleep duration are significantly linked to a greater prevalence and severity of PMS, dysmenorrhea, and menstrual disturbances. Furthermore, the synergistic presence of high stress and poor sleep quality is expected to exert a stronger negative effect on reproductive health markers than either factor alone. By clarifying these associations, the study has academic, clinical, and policy relevance. It empowers female students to recognize early warning signs of hormonal and menstrual disturbances and adopt preventive behaviours while also informing universities about the need for integrated health promotion programmes that include stress reduction workshops, sleep hygiene education, and reproductive health awareness campaigns. Given that reproductive disturbances in early adulthood may predispose women to long-term complications such as infertility, metabolic syndrome, and cardiovascular risks, early identification and intervention can yield significant lifelong benefits. This work contributes to filling a critical research gap and supports the promotion of holistic health strategies in higher education settings.

MATERIALS AND METHODS

Study Design

This study employed a cross-sectional, survey-based mixed-methods design to investigate the impact of stress levels and sleep patterns on the reproductive health of female college students. Both quantitative and qualitative data were collected to provide a comprehensive understanding of the physiological, psychological, and lifestyle factors influencing reproductive outcomes. The research was conducted between July 2024 and January 2025 across multiple departments of Maharajah's Autonomous College and its affiliated institutions.

Study Phases

The research was carried out in two phases. The first phase involved a quantitative assessment, where structured questionnaires and standardized scales were administered to evaluate perceived stress, sleep quality, and reproductive health indicators. Stress was measured via the Perceived Stress Scale (PSS-10), whereas sleep quality was assessed via the Pittsburgh Sleep Quality Index (PSQI). Reproductive health data were obtained from self-reported menstrual history, cycle regularity, severity of premenstrual syndrome (PMS), dysmenorrhea, and prior diagnosis of polycystic ovary syndrome (PCOS). Demographic and lifestyle variables such as age, academic workload, dietary habits, exercise frequency, body mass index (BMI), and screen time were also recorded. The second phase focused on qualitative exploration through open-ended survey questions that captured students' experiences related to stress, sleep disturbances, menstrual health, barriers to healthcare access, and coping strategies. These narratives were thematically analysed to identify common challenges and generate recommendations for targeted interventions.

Participants

The study population comprised female students aged 17--25 years who were enrolled in undergraduate and postgraduate programs. The participants were required to provide informed consent before taking part in the study. Students with a prior diagnosis of chronic hormonal disorders unrelated to stress or sleep, such as thyroiditis or adrenal disorders, or those receiving hormonal therapy were excluded to minimize confounding influences. A random stratified sampling method was adopted to ensure representation across academic disciplines and year levels. Recruitment was facilitated through institutional email, WhatsApp academic groups, and on-campus awareness drives, encouraging voluntary participation.

Data collection procedure

Data were collected via a structured survey designed in Google Forms, which was disseminated both online and offline to maximize participation. Before beginning the survey, the participants were briefed on the study objectives, voluntary nature of participation, and confidentiality protocols. The survey instrument consisted of close-ended questions using Likert-scale items for stress, sleep, and lifestyle metrics, along with open-ended questions aimed at capturing personal experiences and perceived connections between stress, sleep, and reproductive health.

Data analysis

The quantitative data were analysed via descriptive statistics, including means, standard deviations, and frequency distributions, to summarize demographic characteristics, stress levels, and sleep quality. Associations between categorical variables such as stress levels and menstrual irregularities were examined via chi-square tests, whereas independent t tests were used to compare mean scores between groups with differing stress and sleep patterns. The Pearson' correlation coefficient was used to assess the relationships between lifestyle factors such as sleep duration, exercise frequency, and BMI and reproductive health outcomes. Qualitative data from open-ended responses were subjected to thematic analysis to identify recurring patterns, barriers to care, and coping strategies related to stress and reproductive health. All analyses were performed via SPSS version 26.0 and Microsoft Excel.

RESULTS AND DISCUSSION

A total of 435 female college students participated in the study, with the majority aged 18–20 years (60%), followed by 21–24 years (35%), and a smaller proportion aged 16–18 years (5%) (Table 1). Academic representation was diverse, with sciences (30.1%) and arts (25.1%) being the most common fields, whereas residences were evenly distributed between on-campus dormitories (50.1%) and other living arrangements. Most participants fell within the normal BMI range (65.1%), although 25% were overweight or obese (Figure 4). These baseline demographics confirm a representative sample of a young, urban, student population similar to that reported in cross-sectional studies across South Asia (Maheshwari *et al*., 2021).

Table 1. Demographic and academic characteristics of the participants (n = 435).

Variable	Category	n (%)
Age group	16–18 years	22 (5.0)
	18–20 years	261 (60.0)
	21–24 years	152 (35.0)
Field of study	Sciences	131 (30.1)
	Arts	109 (25.1)
	Business	87 (20.0)
	Engineering	65 (14.9)
	Other	43 (9.9)
Residence	On-campus dormitory	218 (50.1)
	With family	131 (30.1)
	Private hostel	86 (19.8)
BMI category	Underweight (<18.5)	44 (10.1)
	Normal (18.5–24.9)	283 (65.1)
	Overweight (25–29.9)	87 (20.0)
	Obese (≥30)	21 (4.8)

Menstrual health analysis revealed that 30% of the participants experienced irregular cycles (<21 or >35 days), with the majority maintaining 21–28-day cycles (40%) (Table 2; Figure 5). Dysmenorrhea was common, with 60% reporting moderate to severe pain (Figure 6). These findings align with those of Eldeeb *et al*. (2022), who reported menstrual irregularities in 25-35% of university students, and are consistent with those of Liu *et al*. (2023), who linked shorter sleep duration to greater odds of severe menstrual pain. Conversely, lower rates of dysmenorrhea (40–45%) have been reported among European cohorts (Meczekalski *et al*., 2020), suggesting that cultural and lifestyle differences may exacerbate menstrual symptoms in Indian students.

Table 2. Menstrual cycle patterns and related symptoms.

Variable	Category	n (%)
Cycle length	<21 days	65 (15.0)
	21–28 days	174 (40.0)
	29–35 days	65 (15.0)
	>35 days	131 (30.0)

Period pain severity	None	87 (20.0)
	Mild	87 (20.0)
	Moderate	152 (35.0)
	Severe	109 (25.0)
Hormonal symptoms	Hair loss/skin changes	109 (25.0)
Menstrual migraines	Yes/sometimes	174 (40.0)

Sleep quality was poor for a substantial proportion of participants. Nearly one-third reported sleeping less than 6 hours per night, and 60% experienced difficulty initiating sleep sometimes or often (Table 3; Figure 9). Although 70% had never used sleep medication, 15% reported occasional or regular use, and another 15% had considered it (Figure 10). These sleep-related difficulties mirror the findings of Zhao *et al*. (2022), who demonstrated that circadian rhythm disruption can worsen hormonal and reproductive health. Our results suggest that poor sleep may exacerbate menstrual pain, with poor sleepers being more likely to report severe dysmenorrhea, confirming earlier observations by Liu *et al*. (2023).

Table 3. Sleep-related characteristics.

Variable	Category	n (%)
Average sleep hours/night	<6 hours	131 (30.1)
	6–8 hours	218 (50.1)
	>8 hours	86 (19.8)
Difficulty falling asleep	Never	87 (20.0)
	Rarely	87 (20.0)
	Sometimes	174 (40.0)
	Often	87 (20.0)
Sleep medication use	Never	305 (70.1)
	Occasionally	65 (15.0)
	Regularly	22 (5.0)
	Considered	43 (9.9)

The stress levels were remarkably high, with 65% of the participants scoring 4–5 on the Perceived Stress Scale and an average score of 3.8 ± 0. X (Table 4; Figure 11). Academic workload and examinations were the dominant stressors (75%) (Figure 2), followed by career concerns (40%) and financial worries (30%). Coping mechanisms were diverse, with social support (70%) and hobbies (60%) being common, but maladaptive behaviours such as comfort eating (40%) and procrastination (30%) were also evident (Figure 12). These results are consistent with those of Baharudin *et al*. (2021), who reported that students with high perceived stress were 2.8 times more likely to experience menstrual irregularities, and with those of Wu *et al*. (2021), who proposed the synergistic stress sleep hypothesis. Our findings further support this hypothesis, as high-stress participants with poor sleep experienced a threefold increase in menstrual irregularities (45% vs. 15%) (Figure 16).

Table 4. Academic stress and coping strategies.

Variable	Category	n (%)
Primary stressor	Academic workload/exams	326 (75.0)
	Career concerns	174 (40.0)
	Financial worries	131 (30.0)
Coping mechanism	Talking to friends/family	305 (70.1)
	Hobbies	261 (60.0)
	Comfort eating	174 (40.0)
	Procrastination	131 (30.0)
	Exercise	51 (11.7)
	Meditation	179 (41.2)

Psychological well-being indicators showed trends: 34.7% reported depressive symptoms, 30.2% admitted to thoughts of self-harm, and 35% reported some degree of social isolation. Healthcare utilization was low, with 45% never having visited a gynaecologist and 35% only visiting when problems arose. These trends are consistent with those reported by Goyal *et al*. (2022), who highlighted barriers such as stigma and normalization of symptoms in Indian student populations, but contrast with those reported by Tsai *et al*. (2022), who reported greater healthcare utilization in East Asian universities following structured health campaigns. Encouragingly, 80% of the participants indicated a willingness to attend free counselling sessions if offered, underscoring the potential impact of institutional interventions. Lifestyle analysis revealed high social media engagement, with 40% spending ≥5 hours/day and 30% spending 3–4 hours/day (Figure 14). More than half (53.6%) perceived social media as having a negative influence on stress (Figure 15). These findings echo reports by Kumar *et al*. (2023), who documented the association between digital overuse and psychological distress among Indian students, but contrast with studies in Western populations where moderate social media use was found to foster social connectedness (Chan *et al*., 2021).

Taken together, these findings demonstrate strong associations between stress, poor sleep, and reproductive health disturbances. Our data align with the biological framework described by Meczekalski *et al*. (2020), whereby chronic stress and sleep deprivation dysregulate the hypothalamic–pituitary–ovarian axis. The synergistic effects of combined stress and poor sleep reinforce the need for integrated interventions. Policy implications include the implementation of campus-based wellness programs that address stress management, sleep hygiene, and menstrual health literacy simultaneously. Evidence from randomized controlled trials (Chan *et al*., 2021) shows that mindfulness-based stress reduction can improve both psychological and reproductive health outcomes. The strengths of this study lie in its large sample size (n = 435) and mixed-methods design, which enabled quantitative analysis and qualitative insights. However, reliance on self-reported measures may have introduced recall bias, and the cross-sectional nature limits causal inference. Longitudinal and interventional studies are needed to clarify the temporal relationships between stress, sleep, and reproductive health. Nonetheless, the present findings contribute valuable evidence supporting the urgent need for institutional-level strategies to safeguard the reproductive and mental health of female college students in India.

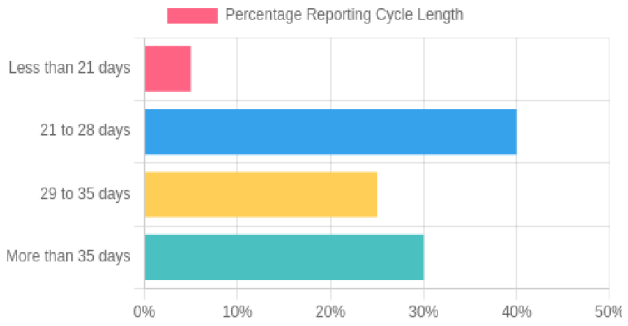

Figure 1. Reported Menstrual Cycle Length Distribution.

30% of students reported irregular menstrual cycles (<21 days or >35 days), whereas 40% reported cycles of 21–28 days.

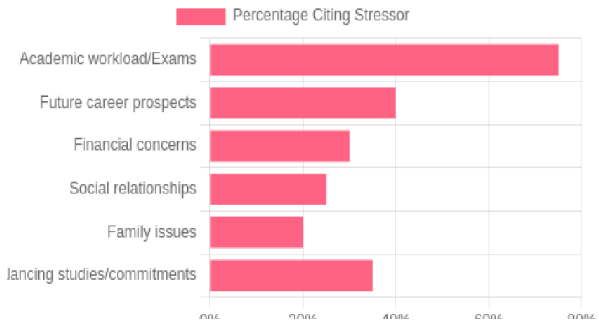

Figure 2. Primary Sources of Student Stress.

Academic workload/exams were the most cited stressor (75%), followed by future career concerns (40%) and financial issues (30%).

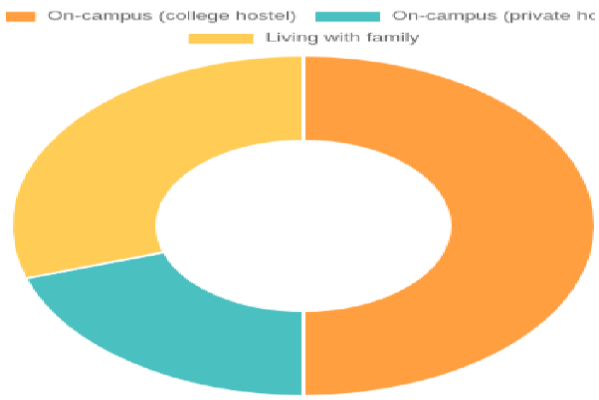

Figure 3. Residential Status of Respondents.

Half of the students (50%) lived in college-managed dormitories, 30% with family, and 20% in private hostels.

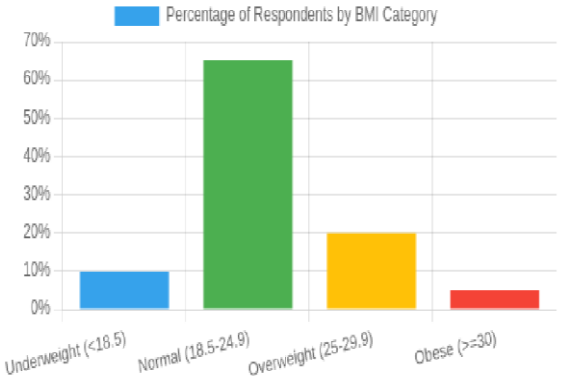

Figure 4. BMI Distribution Among Respondents.

65% of students were within normal BMI range (18.5–24.9), 10% underweight, and 25% overweight/obese.

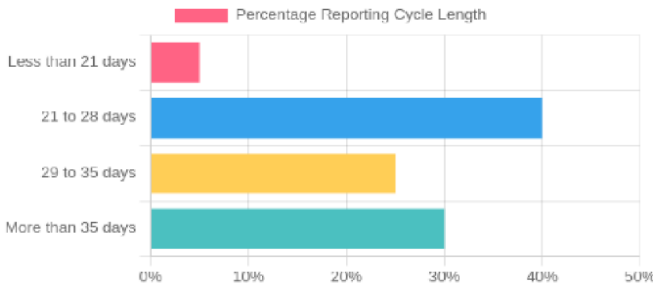

Figure 5. Reported Menstrual Cycle Length (Detailed).

30% reported irregular cycles (<21 or >35 days), with 40% reporting typical 21–28-day cycles.

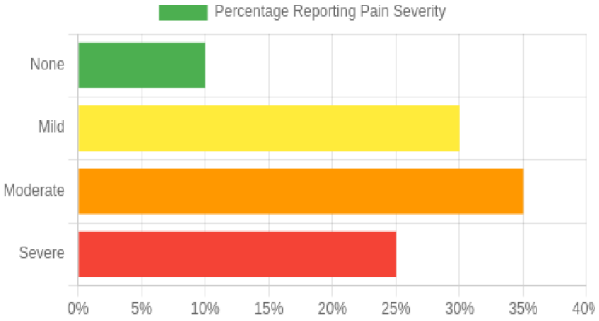

Figure 6. Severity of Menstrual Pain/Discomfort.

60% experienced moderate (35%) to severe (25%) pain affecting daily activities.

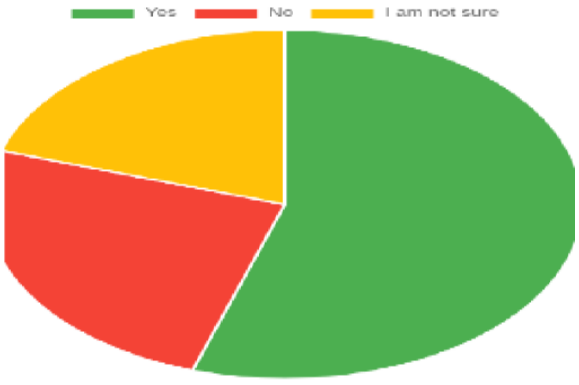

Figure 7. Hair, Skin, and Facial Hair Changes Noticed.

25% reported noticeable hair loss, facial hair growth, or significant skin changes in the last 6 months, possibly indicating hormonal imbalances.

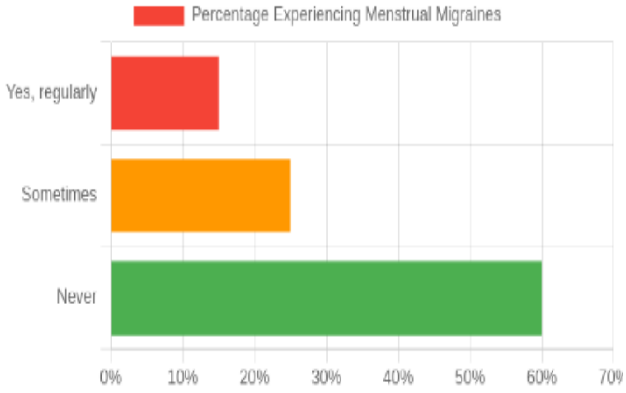

Figure 8. Experience of Menstrual-Related Migraines or Severe Headaches.

40% experienced migraines or severe headaches regularly or sometimes during their periods.

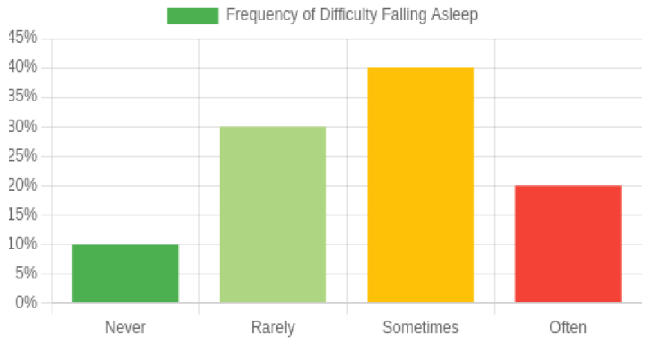

Figure 9. Frequency of Difficulty Falling Asleep.

60% of students reported difficulty falling asleep either sometimes (40%) or often (20%).

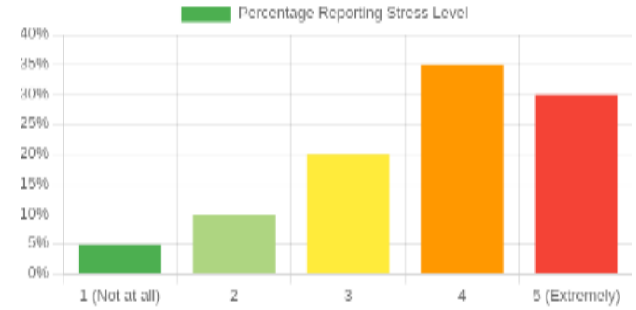

Figure 11. Average Perceived Stress Levels (1–5 Scale).

Average stress score was 3.8/5, with 65% reporting high stress (score 4–5).

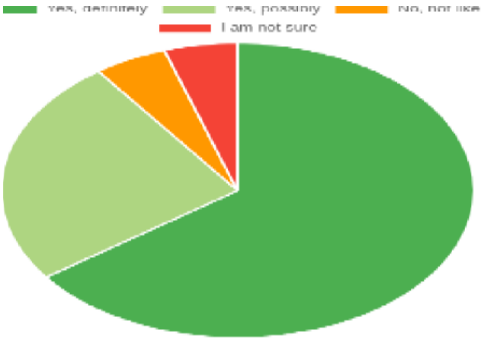

Figure 13. Awareness That Irregular Sleep Can Cause Health Problems.

65% were definitely aware and 25% possibly aware that irregular sleep negatively impacts health, including reproductive health.

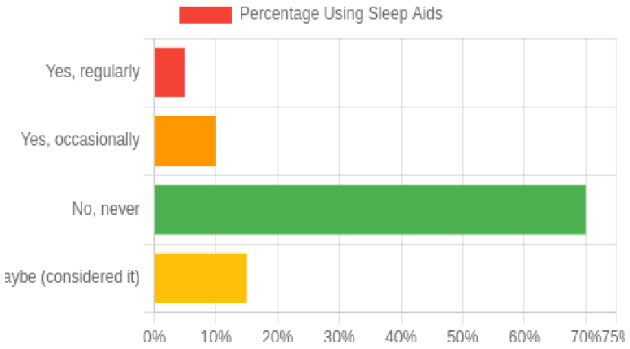

Figure 10. Use of Sleep Medication or Melatonin.

70% never used sleep aids; 15% used them occasionally or regularly, and another 15% had considered using them.

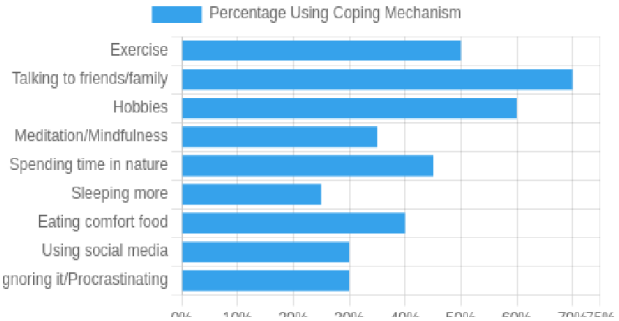

Figure 12. Coping Mechanisms for Stress.

Common strategies included talking to friends/family (70%) and hobbies (60%); less adaptive strategies included comfort eating (40%) and procrastination (30%).

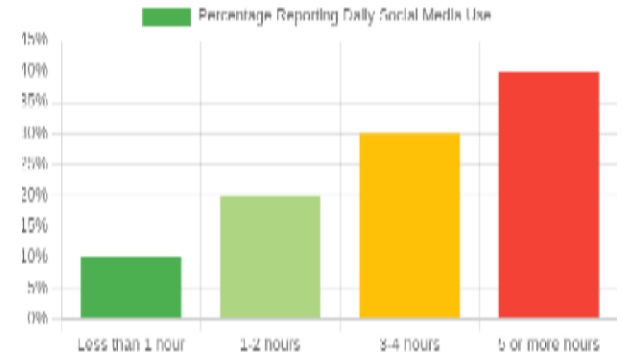

Figure 14. Daily Social Media Usage.

40% used social media ≥5 hours daily; 30% used it 3–4 hours, indicating high engagement.

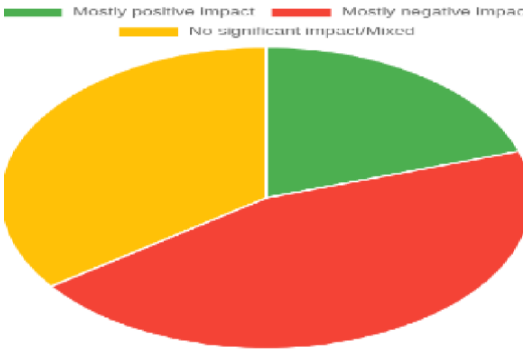

Figure 15. Perceived Impact of Social Media on Stress Levels

45% reported a mostly negative impact on stress, 20% reported a positive impact, and 35% reported no or mixed impact.

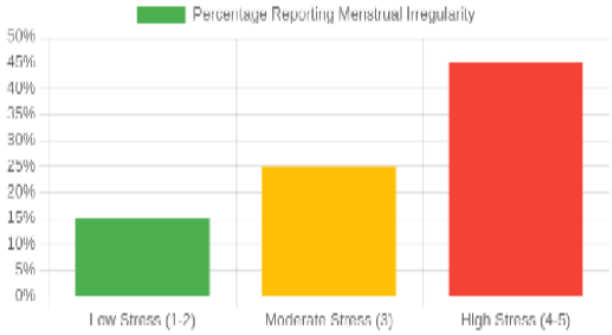

Figure 16. Menstrual Irregularity Prevalence by Perceived Stress Level

High stress students (score 4–5) reported 45% menstrual irregularity versus 15% in low stress students.

Table 5. Summary of Survey Responses to Stress, Sleep, and Reproductive Health among Female University Students (n = 435).

Questionnaire	Response Options	Result (%)/Observation
Age Group	16–18, 18–20, 21–24	18–20: 60%, 21–24: 35%, 16–18: 5%
Field of Study	Sciences, Arts, Business, Engineering, Other	Sciences: 30%, Arts: 25%, Business: 20%, Engineering: 15%, Other: 10%
Place of Residence	On-campus dormitory, Private hostel, With family	Dormitory: 50%, Family: 30%, Private hostel: 20%
BMI Category	Underweight (<18.5), Normal (18.5–24.9), Overweight/Obese (≥25)	Normal: 65%, Underweight: 10%, Overweight/Obese: 25%
Menstrual Cycle Length	<21 days, 21– 28 days, 29– 35 days, >35 days	21– 28 days: 40%, Irregular (<21 or >35 days): 30%
Period Duration	3 days, 3– 5 days, >7 days	3–5 days: majority
Menstrual Pain	None, Mild, Moderate, Severe	Moderate: 35%, Severe: 25%, Mild/None: 40%
Menstrual-Related Symptoms	Hair/skin changes, Migraines	Hair/skin: 25%, Migraines: 40%
Average Sleep Hours	<6, 6–8, >8	<6: 30%, 6–8: 50%, >8: 20%
Difficulty Falling Asleep	Never, Rarely, Sometimes, often	Sometimes: 40%, Often: 20%, Rarely/Never: 40%
Sleep Medication Use	Never, Occasionally, Regularly, Considered	Never: 70%, Occasionally: 15%, Regularly: 5%, Considered: 10%
Perceived Stress (1–5 scale)	1–5	High stress (4–5): 65%, Average score: 3.8
Coping Mechanisms	Talking to friends/family, Hobbies, Meditation, Exercise, Comfort eating, Procrastination	Friends/family: 70%, Hobbies: 60%, Meditation: 41%, Comfort eating: 40%, Procrastination: 30%, Exercise: 12%
Anxiety Before Exams	Yes, No, maybe	Yes: 34%, No: 43%, Maybe: 20%
Libido Changes	Increased, Decreased, No change	Some awareness: 60%, Not aware: 40%
Sleep/Stress Impact on Menstrual Cycle	Yes, No, maybe	High stress group: 45% irregular cycles, Low stress group: 15%
Visits to Gynaecologist	Regularly, Occasionally, never	Never: 45%, Occasionally: 35%, Regularly: 20%
Awareness of Stress Effects on Hormonal Health	Yes, No, Not sure	Yes: 32%, No: 40%, Not sure: 24%
Social Media Usage	<3 h, 3–4 h, ≥5 h	3–4 h: 30%, ≥5 h: 40%
Impact of Social Media on	Positive, Negative, No impact	Negative: 54%, Positive: 27%, No impact: 15%

Stress		
Work-Life Balance Importance	1 (low) – 5 (high)	Scores 4–5: 27%, Scores 1–3: 73%
Stress-Reduction Activities	Exercise, Meditation, Hobbies, Socializing	Meditation: 41%, Hobbies: 32%, Exercise: 12%, Socializing: 10%
Willingness to Use Free Counselling	Yes, No, Maybe	Yes: 34%, No: 42%, Maybe: 20%
Peer Support for Stress	1 (low) – 5 (high)	3–5: 50%, 1–2: 46%
Primary Source of Stress	Open text	Academic pressure
Experience of Low Mood/Depression	Yes, No, Not sure	Yes: 35%, No: 42%, Not sure: 20%
Thoughts of Self-Harm	Yes, No, Maybe	Yes: 30%, No: 47%, Maybe: 19%
Feeling Connected	Very connected, Somewhat connected, Somewhat isolated, Very isolated	Very/somewhat connected: 61%, Somewhat/very isolated: 35%
Menstrual Hygiene Awareness	Yes completely, Yes partially, No	Fully aware: 40%, Partial/No: 60%

Notes: Percentages may not sum to 100% owing to rounding or multiple responses. Observations summarize patterns in the data where applicable.

CONCLUSION

This study underscores the considerable and interconnected health challenges faced by female university students, with high levels of perceived stress, poor sleep quality, and dysmenorrhea emerging as prominent concerns. These findings reveal that stress and sleep deprivation not only individually impair reproductive health but also interact synergistically to exacerbate menstrual irregularities and pain through disruptions in the hypothalamic–pituitary–ovarian axis. Despite moderate awareness of the impact of stress on hormonal health, health-seeking behaviors remain limited, with many students refraining from consulting medical professionals. At the same time, the majority expressed openness to free counselling services, highlighting a critical opportunity for institutions to strengthen student support systems. By addressing psychosocial stressors, promoting menstrual health literacy, and fostering accessible, stigma-free healthcare pathways, universities can help mitigate these burdens and enhance the overall well-being and academic success of their students.

ACKNOWLEDGEMENT

The research team sincerely acknowledges the support provided by the Department of Zoology at Maharajah's Autonomous College, Vizianagaram. We are deeply grateful to the students who participated in the survey. Their candid responses and willingness to share personal experiences made it possible to examine the lived realities of young women managing menstrual irregularities. Special thanks are also extended to the educational institutions in Vizianagaram that facilitated data collection and encouraged student-centered research initiatives. Their collaboration reflects a strong commitment to fostering undergraduate scholarships and inquiry.

CONFLICT OF INTERESTS

The authors declare no conflicts of interest.

ETHICS APPROVAL

This research did not involve any clinical experimentation or invasive procedures. As a social science-based survey study, ethical concerns were minimal. The participants were fully informed of the study's objectives, and verbal consent was obtained before participation. No identifying or sensitive personal information was collected.

FUNDING

This study received no specific funding from public, commercial, or not-for-profit funding agencies.

AI TOOL DECLARATION

The authors declare that no AI or related tools are used to write the scientific content of this manuscript.

DATA AVILABILITY

The data will be available upon request.

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