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Original Article

Biochemistry Section

Association of Poor Sleep Quality and Reduced Sleep Duration with the Risk of Development of Metabolic Syndrome in Young Adults Attending Medical College in Southern India: A Cross-sectional Study

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ABSTRACT

Introduction: Sleep deprivation and metabolic disorders are rising in parallel worldwide. The academic pressures and rigorous schedules associated with the medical curriculum may predispose college students to erratic sleep patterns. Social Jetlag (SJL) is the imbalance between sleep duration on workdays and free days, resulting from the mismatch between a person's biological rhythm and the daily timing set by social obligations. College students often attempt to compensate for sleep debt during the weekends. Changes in sleep patterns have been linked to the development of insulin resistance, diabetes mellitus and cardiovascular diseases in adults.

Aim: To determine the prevalence of sleep disturbances and to evaluate the relationship between sleep quality, SJL and Metabolic Syndrome (MetS) in young adults attending medical school.

Materials and Methods: In this analytical cross-sectional study conducted over two months, from August 2022 to September 2022, 153 medical students from SRM Medical College Hospital and Research Centre, Kattankulathur, Chengalpattu, Tamil Nadu, India participated to evaluate the relationship between sleep disturbances and MetS. Sleep quality and SJL were assessed using the Pittsburgh Sleep Quality Index (PSQI) questionnaire and the Munich Chronotype Questionnaire (MCTQ). The presence of MetS was determined according to the criteria provided by the National Cholesterol Education Program - Adult Treatment Panel III (NCEP ATP III). Descriptive statistics, Chi-square (χ^2) tests, Spearman correlation, logistic regression analysis and odds ratios were used to analyse the data.

Results: The mean age of the study participants was 20.24±1.12 years. The prevalence of sleep disturbance (PSQI score above 5) demonstrated in the present study is 63/153 (41.2%) using the PSQI questionnaire. Nearly 40/83 (48.2%) of the female students had sleep disturbances. Short sleep duration (p-value=0.04) was found to be associated with MetS, with a reduction in sleep duration by one hour increasing the odds by 2.12. Out of the 153 student participants, 9.8% (n=15; 8 males and 7 females) met the criteria for MetS.

Conclusion: A reduction in sleep duration was associated with an increased risk of developing MetS.

Keywords: Central obesity, Dyslipidemia, Sleep disturbances, Sleep latency

INTRODUCTION

Globally, there is a parallel increase in sleep deprivation, obesity and related metabolic disorders. A study estimated that 33% of adults in India suffer from insomnia [1]. Sleep disturbances have been noted not only in adults but also in adolescents and young adults. The transition from school to college results in a major change in lifestyle for young adults, including academic stress, social pressure and erratic sleep schedules. A study on the adaptation to college from high school by students showed a considerable decrease in the amount of sleep, along with a postponement in the onset of nighttime sleep [2]. In addition to quantity, the quality of sleep also appears to be altered, affecting college students' well-being [3].

The SJL is the imbalance between sleep times on workdays and free days. The time difference between the Midpoint of Sleep on Workdays (MSW) and on free days is known as SJL, which results from the mismatch between a person's biological rhythm and the daily timing set by social obligations [4]. Compared to weekdays, college students tend to have delayed sleep and wake times during the weekend in an attempt to compensate for the sleep debt accumulated during the week, which equates to a delayed circadian phase [5]. Imbalances in cortisol and melatonin, along with inflammation and metabolic disturbances, have been associated with circadian misalignment [6]. The majority of adolescents and adults around the world are affected by SJL, which has been found to correlate with a higher prevalence of obesity [7].

Metabolic processes such as Blood Pressure (BP) and glucose utilisation exhibit a circadian rhythm. Studies have shown that glucose synthesis and utilisation decrease during the initial part of sleep and increase during the pre-dawn phase [8]. Scheen AJ et al., showed that when individuals were sleep deprived but remained at rest, glucose levels were maintained constant throughout the night. Alterations in the normal sleep pattern have been linked to the occurrence of insulin resistance, obesity, diabetes and cardiovascular disease [9].

The MetS is a collection of metabolic deviations that includes high BP, abdominal obesity, dysglycaemia and lipid alterations. Although the World Health Organisation (WHO) formulated the criteria in 1998, they were reclassified by the National Cholesterol Education Program Adult Treatment Panel III, 2005 (NCEP-ATP III) to require meeting any three of the five following criteria: a Waist Circumference (WC) of more than 40 inches for men and over 35 inches for women, fasting glucose levels greater than 100 mg/dL, dyslipidemia with Triglycerides (TGL) exceeding 150 mg/dL, High Density Lipoprotein-cholesterol (HDL-c) below 40 mg/dL (for males) or below 50 mg/dL (for females) and Systolic Blood Pressure (SBP) greater than 130 mmHg or Diastolic Blood Pressure (DBP) greater than 85 mmHg, or treatment for hypertension [10].

A meta-analysis using 18 cross-sectional studies (with a total population of 75,657 adults) revealed that short sleep duration was associated with MetS, with an odds ratio of 1.23 (95% CI, 1.11-1.37; $p<0.001$; I^2, 71%) [11]. Researchers identified that the probability of obesity increased by 80% for every hour of sleep lost in American adolescents [12]. There is evidence that sleep fragmentation, even without sleep loss, decreases insulin sensitivity [13]. By suppressing deep Non-rapid Eye Movement (NREM) sleep without changing sleep duration in healthy adults, Tasali E et al., demonstrated a decrease in insulin sensitivity that resulted in impaired glucose tolerance, along with an increased risk of diabetes [14].

Pilcher JJ et al., studied the health effects of sleep on college students and found that sleep quality was better linked to health measures such as life satisfaction, anger, fatigue and sleepiness [15]. Over 60% of college students were classified as poor sleepers in an analysis that used the PSQI [16].

The SJL is a form of circadian disruption created by current work schedules. It reflects the discord between an individual's circadian rhythm and actual sleep times. Using actigraphy to quantify SJL, Wong PM et al., demonstrated a link between sleep disruption and metabolic abnormalities, such as insulin resistance, higher TGL levels, higher BMI and WC among shift workers [17]. Similar sleep fragmentation is common among medical college students due to high academic and social pressures and poor time management.

There is a dearth of literature linking sleep quality with MetS in young adults in India, despite the fact that many studies have been conducted on the impact of sleep quality on academic performance, stress and obesity in this population.

Null Hypothesis: There is no significant association between sleep disturbances and the risk of developing MetS in young adults.

Alternative Hypothesis: There is a significant association between sleep disturbances and the risk of developing MetS in young adults.

The present study aimed to determine the prevalence of sleep disturbances in terms of sleep quality and SJL among young adults attending medical school and to assess the correlation between sleep quality, SJL and MetS in this group.

MATERIALS AND METHODS

The present analytical cross-sectional study involved 153 medical college undergraduates (first and second year) aged between 18 and 25 years, studying at SRM Medical College Hospital and Research Centre, Kattankulathur, Chengalpattu, Tamil Nadu, India. The study was conducted over a period of two months, from August 2022 to September 2022. Approval for the study was granted by the Institutional Ethical Committee (8366/IEC/2022). The study participants provided consent after being informed about the protocol.

Sample size calculation: It was based on the prevalence of MetS in young adults [18].

Z=1.96; p=11.2%=0.063; q=1-p=1-0.112=0.888; d=5%

$n=(1.96)^2\times0.112\times0.888/(0.0025)$

n=153

Inclusion criteria: Apparently healthy young adults with no self-reported medical illnesses (n =153) aged between 18 and 25 years were recruited for the study.

Exclusion criteria: Individuals with any self-reported major depression, anxiety disorders, panic attacks, or those using medications that cause sleep disorders or sedating drugs were excluded from the study.

Study Procedure

The sleep quality over the preceding month was analysed using the PSQI questionnaire. This is a validated and standardised, freely available questionnaire for the quantitative measurement of sleep quality [19]. Seven sleep-related components are included, such as subjective sleep quality, sleep latency, duration, efficiency, sleep disturbances and daytime dysfunction, with scores ranging from 0 to 3 for each component. Poor sleep quality is indicated by a global PSQI score over 5, while a score of 5 or less is considered indicative of good sleep quality. SJL was measured by subtracting the MSW from the Midpoint of Sleep on Free days (MSF), with a difference of ≥2 hours considered as SJL. The information was gathered using the MCTQ [20].

Anthropometric measurements: The height (cm) was measured using a stadiometer (MCP Stature-meter 2 m wall-mounted) without shoes. A calibrated electronic weighing machine (BPL Personal Weighing Scale PWS 01) was used to measure body weight. Body Mass Index (BMI) was calculated using the formula BMI=Weight/Height^2 (kg/m^2) for all subjects. According to the WHO criteria for Asian adults: underweight <18.5; normal range 18.5-22.9; overweight ≥23; at risk of obesity 23-24.9; obese ≥25 [21]. WC was measured using a tape above the iliac crest with the subject in an upright posture. A calibrated sphygmomanometer (Omron HEM 7124 fully automatic digital BP monitor) was used to measure BP in a sitting posture, with the cuff positioned on the arm at heart level, after five minutes of rest. The mean of two measurements taken at least five minutes apart was recorded.

Biochemical investigations: After overnight fasting, a 4 mL blood sample was collected and analysed. Fasting Plasma Glucose (FPG) and lipid profile parameters- TGLs and HDL-C- were estimated using an enzymatic method with dedicated reagents in the automated chemistry analyser Beckman Coulter AU480. According to the National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP III, 2005), MetS status is diagnosed by the presence of any three of the five following criteria: WC >40 inches (males) and >35 inches (females), fasting glucose levels ≥100 mg/dL or under therapy for diabetes, dyslipidemia with Triglycerides (TGL) ≥150 mg/dL or on treatment, HDL-C <40 mg/dL (males) or <50 mg/dL (females) or on treatment and SBP >130 mmHg or DBP > 85 mmHg or on therapy for hypertension [10].

STATISTICAL ANALYSIS

Data analysis was conducted using Datatab online software (Datatab e.U., Graz, Austria). Descriptive statistics, Chi-square tests, Spearman correlation, logistic regression analysis and odds ratios were used to demonstrate the effects of the PSQI global score and SJL on the components of MetS. A p-value of <0.05 was considered statistically significant.

RESULTS

The present analytical cross-sectional study was conducted by recruiting 153 medical college students (70 males and 83 females) with a mean age of 20.24±1.12 years. The demographic data, anthropometric measurements and biochemical parameters of the study participants are presented in [Table/Fig-1].

Parameters	Mean±SD
Total participants (N)	153
Male participants (n)	70
Female participants (n)	83
Age (years)	20.24±1.12
Height (cm)	166.21±10.17
Weight (kg)	66.98±12.63
BMI (kg/m^2)	24.3±4.33
Systolic BP (mmHg)	117.54±12.45
Diastolic BP (mmHg)	77.39±9.49
Waist (in)	32.09±4.2
FBS (mg/dL)	93.35±8.54

TGL (mg/dL)	73.7±33.06
HDL (mg/dL)	46.23±9.87

[Table/Fig-1]: Demographic, anthropometric and biochemical parameters of the study participants.

When comparing the anthropometric data and biochemical parameters based on gender, males had a significantly higher SBP [Table/Fig-2] (122.74±11.46 vs. 113.14±11.58, p<0.001). However, no significant difference in diastolic BP was observed (78.53±10.18 vs. 76.42±8.82, p=0.172). Abdominal obesity was more prevalent among male students compared to female students. HDL levels were significantly lower among males.

Parameters	Males	Females	t value	p-value
n (%)	70 (45.75)	83 (54.25)		
Age (years)	20.37±1.23	20.12±1.02	1.36	0.176
Height (cm)	174.86±6.35	159.12±6.56	14.11	<0.001*
Weight (kg)	72.12±12.18	62.76±11.43	4.63	<0.001*
BMI (kg/m²)	23.59±4.04	24.9±4.5	-1.88	0.062
Systolic BP (mmHg)	122.74±11.46	113.14±11.58	5.13	<0.001*
Diastolic BP (mmHg)	78.53±10.18	76.42±8.82	1.37	0.172
Waist Circumference (WC) (in)	33.62±4.12	30.79±3.82	4.41	<0.001*
FPG (mg/dL)	92.71±9.18	93.89±7.98	- 0.85	0.397
TGL (mg/dL)	76.04±37.38	72.04±29.03	0.75	0.457
HDL-c (mg/dL)	43.06±7.73	48.9±10.7	-3.81	<0.001*

[Table/Fig-2]: Demographic, anthropometric and biochemical parameters of the study participants.
Students' t-test: Numerical data are reported as mean±Standard Deviation (SD), with a *p-value <0.05 denoting significance. BP: Blood pressure; FPG: Fasting plasma glucose; TGL: Triglycerides; HDL-c: High Density Lipoprotein- cholesterol

Out of the 153 student participants, 15 (9.8%; 8 males and 7 females) met the criteria for MetS put forth by NCEP ATP III.

The data [Table/Fig-3] collected using the PSQI questionnaire indicated that only 14% of the students were sleeping more than seven hours per day and 24% of the students had less than 85% habitual sleep efficiency {(Number of hours slept/Number of hours in bed) × 100%}. Only 15 (9.8%) of the participants reported a sleep latency (time taken to fall asleep) of more than 30 minutes. About 10 (6.5%) of the participants reported having taken sleep medication more than twice a week. The global PSQI score was greater than 5 in 63 (41.2%) of the participants and the score was significantly higher [Table/Fig-3] among female students, with nearly half of them having a PSQI score above 5. However, the subjective sleep quality was reported as fairly bad or very bad by only 21 (13.7%) of the participants. SJL was calculated using the MCTQ. No significant difference was observed in SJL between males and females, but a significant difference was observed (p-value=0.048) in the PSQI score between males and females [Table/Fig-4].

Sleep duration and quality components	Overall (N=153)	Males (n=70)	Females (n=83)
Average time taken to fall asleep (minutes/d)	20.7	21.1	20.2
Average duration of actual sleep (hours/d)	6.3	6.4	6.2
Subjective sleep quality, n (%)			
Very good	28 (18.3)	21 (30)	7 (8.4)
Fairly good	104 (67.9)	42 (60)	62 (74.6)
Fairly bad	19 (12.4)	6 (8.6)	13 (15.7)
Very bad	2 (1.3)	1 (1.4)	1 (1.2)
Sleep latency (min), n (%)			
<15	73 (47.8)	37 (52.8)	36 (43.4)
15-30	65 (42.5)	25 (35.7)	40 (48.2)
31-60	10 (6.5)	6 (8.6)	4 (4.8)
>60	5 (3.3)	2 (2.8)	3 (3.6)
Sleep duration (h), n (%)			
>7	22 (14.3)	12 (17.1)	10 (12)
6-7	93 (60.8)	43 (61.4)	50 (60.2)
5-6	29 (18.9)	11 (15.7)	18 (21.7)
<5	9 (5.9)	4 (5.7)	5 (6)
Habitual sleep efficiency, n (%)			
>85	117 (76.5)	57 (81.4)	60 (72.2)
75-84	27 (17.6)	9 (12.8)	18 (21.7)
65-74	4 (2.6)	1 (1.4)	3 (3.6)
<65	5 (3.3)	3 (4.3)	2 (2.4)
Sleep disturbances, n (%)			
0	19 (12.4)	11 (15.7)	8 (9.6)
1-9	109 (71.2)	48 (68.6)	61 (73.5)
10-18	23 (15)	11 (15.7)	12 (14.4)
19-27	2 (1.3)	0	2 (2.4)
Use of sleep medication, n (%)			
0	134 (87.6)	59 (84.3)	75 (90.4
1	9 (5.9)	3 (4.3)	6 (7.2)
2	6 (3.9)	5 (7.1)	1 (1.2)
3	4 (2.6)	3 (4.3)	1 (1.2)
Daytime dysfunction, n (%)			
Trouble staying awake while driving, eating meals, or engaging in social activity			
Not during past month	23 (15)	12 (17.1)	11 (13.2)
Less than once a week	112 (73.2)	52 (74.3)	60 (72.3)
Once or twice a week	11 (7.2)	4 (5.7)	7 (8.4)
Three or more times a week	7 (4.6)	2 (2.8)	5 (6)
Problem to keep up enough enthusiasm to get things done			
Not during past month	30 (19.6)	9 (12.8)	21 (25.3)
Less than once a week	87 (56.8)	45 (64.3)	42 (50.6)
Once or twice a week	21 (13.7)	10 (14.3)	11 (13.2)
Three or more times a week	15 (9.8)	6 (8.6)	9 (10.9)
Global PSQI			
< or =5, n (%)	90 (58.8)	47 (67.1)	43 (51.8)
> 5, n (%)	63 (41.2)	23 (32.8)	40 (48.2)

[Table/Fig-3]: Sleep quality of college students as measured using Pittsburgh Sleep Quality Index (PSQI).

Variables	Males	Females	U	p-value
SJL (min) (range)	91.5 (63.25-138.75)	103 (60-142.5)	2.716	0.49
PSQI score (0-21)	4 (3-6)	5 (4-7)	2.369	0.048*

[Table/Fig-4]: Comparison of Social Jetlag (SJL) and PSQI score among male and female medical students.

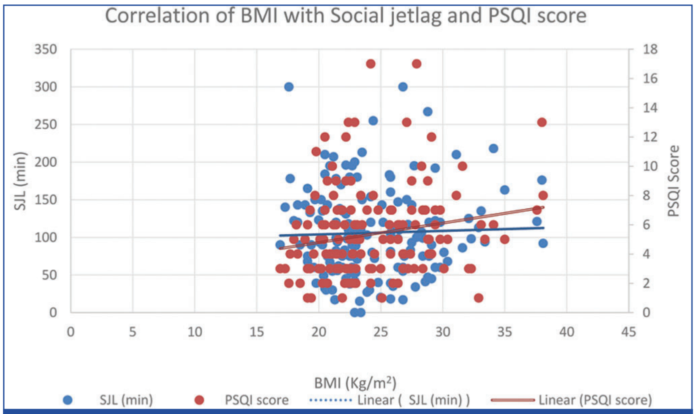
Since the data were not normally distributed, they are represented as median and range. The Mann-Whitney U test was performed to compare the data. A p-value <0.05 was considered significant. SJL stands for Social Jetlag and PSQI stands for Pittsburgh Sleep Quality Index.

Sleep quality and Metabolic Syndrome (MetS): A Chi-square test was conducted to investigate the association between sleep quality, measured using the global PSQI score, SJL and MetS. A significant relationship was observed between sleep quality and MetS {χ^2 (1, N=153)=4.23, p-value=0.04}. However, there was no significant relationship between SJL and MetS [Table/Fig-5].

Among the anthropometric measurements and biochemical analytes only BMI was found to correlate significantly with the global PSQI score in the study participants [Table/Fig-6]. No correlation was found with SJL.

Variables		Frequency	MetS present n (%)	MetS absent n (%)	Ch-square value and p-value
PSQI	<5	69	3 (4.35)	66 (95.65)	4.23, p-value=0.04*
	≥5	84	12 (14.28)	72 (85.72)	
SJL	<120 min	95	8 (8.42)	87 (91.57)	0.542, p-value=0.462[NS]
	≥120 min	58	7 (12.06)	51 (87.94)	

[Table/Fig-5]: Chi-square test and contingency table for Metabolic Syndrome (MetS) and PSQI and SJL.
*Significance at p-value <0.05 level. NS: Not significant; N=153; df=1; SJL: Social jetlag; PSQI: Pittsburgh sleep quality index



[Table/Fig-6]: Correlation of BMI with Social Jetlag (SJL) and PSQI score.

Spearman correlation between SJL (r=-0.002; p-value 0.831) and BMI shows no correlation, whereas a significant positive correlation exists between PSQI score (r=0.19; p-value 0.016) and BMI.

The logistic regression analysis was used to explore the relationship between MetS and the PSQI global score, which indicates sleep quality, SJL and the individual components of the PSQI. The poor sleep quality and sleep duration are significant predictors of the development of MetS is shown in [Table/Fig-7].

PSQI Components (4-point scale)	OR	95% CI	p-value
Sleep quality based on Global PSQI score			
Good ≤5	Reference		**0.027***
Poor > 5	1.18	1.02-1.38	
Social Jetlag (SJL) (min)			
Absent (< 120 min/d)	Reference		0.08
Present (≥120 min/dSu)	1.01	1-1.02	
C1. Subjective quality			
0 (n=28)	Reference		0.237
1-3 (n=125)	1.68	0.71-3.99	
C2. Latency			
0 (n=73)	Reference		0.102
1-3 (n=80)	1.62	0.91-2.9	
C3. Duration			
0 (n=22)	Reference		**0.007***
1-3 (n=131)	2.53	1.29-4.96	
C4. Efficiency			
0 (n=117)	Reference		0.173
1-3 (n=36)	1.52	0.83-2.77	
C5. Disturbances			
0 (n=19)	Reference		0.572
1-3 (n=134)	0.78	0.33-1.84	
C6. Medication			
0 (n=134)	Reference		0.057
1-3 (n=19)	1.79	0.98-3.25	
C7. Daytime dysfunction			
0 (n=53)	Reference		0.376
1-3 (n=100)	1.27	0.74-2.18	

[Table/Fig-7]: Logistic regression analysis between Metabolic Syndrome (MetS) and PSQI global score.
p-value < 0.05 is considered significant. PSQI: Pittsburgh Sleep Quality Index.

Logistic regression with MetS as the dependent variable (MetS present =1, MetS absent =0) and sleep quality, SJL, PSQI global score and the seven components of PSQI (scored from 0 to 3) as independent variables.

{Subjective sleep quality: Very good -0; Fairly good -1; Fairly bad -2; Very bad -3. Sleep latency: < 15 minutes - 0; 16-30 minutes -1; 31-60 minutes -2; > 60 minutes -3. Sleep duration: > 7 hours -0; 6-7 hours -1; 5-6 hours -2; <5 hours -3. Sleep efficiency: >85% - 0; 75-84% -1; 65-74% - 2; < 65% -3. Sleep disturbance: 0-0; 1-9 –1; 10-18 –2; 19-27 –3. Sleep medication: Not during past month – 0; Less than once a week -1; Once or twice a week-2; Three or more times a week-3. Day time dysfunction: 0- 0; 1-2 - 1; 3-4 - 2; 5-6 -3}.

After adjusting for age and gender [Table/Fig-8], the risk of MetS was predicted solely by sleep duration {OR (odds ratio) =2.12, 95% CI: 1.04 - 4.34, p-value=0.04}.

PSQI Components (4-point scale)	OR	95% CI	p-value
C1. Subjective quality			
0 (n=28)	Reference		0.278
1-3 (n=125)	1.38	0.69-3.46	
C2. Latency			
0 (n=73)	Reference		0.117
1-3 (n=80)	1.43	0.89-2.7	
C3. Duration			
0 (n=22)	Reference		**0.04***
1-3 (n=131)	2.12	1.04-4.34	
C4. Efficiency			
0 (n=117)	Reference		0.145
1-3 (n=36)	1.47	0.63-2.68	
C5. Disturbances			
0 (n=19)	Reference		0.572
1-3 (n=134)	0.68	0.24-1.64	
C6. Medication			
0 (n=134)	Reference		0.07
1-3 (n=19)	1.54	0.88-3.14	
C7. Daytime dysfunction			
0 (n=53)	Reference		0.235
1-3 (n=100)	1.21	0.62-2.12	

[Table/Fig-8]: Logistic regression of Metabolic Syndrome (MetS) and the seven components of PSQI as independent variables after adjusting for age and gender.
*p-value <0.05 is considered significant. PSQI: Pittsburgh Sleep Quality Index

DISCUSSION

The average duration of seven to eight hours is considered a normal sleep time. Sleep deprivation occurs when the duration is less than six hours. Numerous epidemiological studies utilising self-reported sleep data, as well as several cross-sectional analyses using more objective actimetry-based sleep pattern measurements, have shown that sleep restriction is linked to an increased prevalence of obesity in both children and adults [22].

The college phase for young adults, especially in medical school, is challenging due to academic pressures, social pressures, erratic sleep schedules and late bedtimes, which can result in sleep restriction. The prevalence of sleep disturbance demonstrated in the present study is 41.2%, as measured by the PSQI questionnaire. Community-based studies have identified the prevalence of poor sleep quality to be between 26% and 46% [23-26]. Another study on medical students based in Chennai showed poor sleep quality in 54.2%, with a male predominance (males 58.2% vs. females 51.6%) [27]. Vargas PA et al., reported poor sleep quality in 40% of college students (n=515), which predicted the development of obesity [3]. The authors found a weak yet significant correlation between BMI and PSQI score. A study on sleep quality and BMI among healthcare students revealed that poor sleep quality correlated with a higher degree of obesity [28]. The current study indicates that the global PSQI score is significantly higher among female medical students. A community-based study in South India, examining the association between sleep disorders and socio-demographic factors, found that being female was associated with low sleep quality. The role of hormonal perturbations in causing mood swings and sleep disturbances could be potential causative factors [24]. A cross-sectional study on Indian adolescents demonstrated decreased sleep duration and higher PSQI scores among girls [29].

The seven components of the PSQI questionnaire help evaluate subjective sleep quality, latency, duration, sleep efficiency, sleep disturbances, daytime dysfunction and medication use, yielding a global PSQI score between 0 and 21. The authors examined the relationship between sleep quality, based on this score and the risk of developing MetS. The current study highlights that poor sleep quality (OR of 1.18) and decreased sleep duration (OR of 2.53) are associated with the risk of developing MetS. There is an 18% increase in the probability of developing MetS for every one unit increase in the global PSQI score. However, after adjusting for age and gender, only sleep duration was found to be associated with the risk of MetS (OR of 2.12). A reduction in sleep duration by one hour increased the odds of developing MetS by 2.12, thus supporting the alternative hypothesis of the current study. A large-scale prospective study in the Taiwanese population identified short sleepers (< 6 hours/day) as being more likely to develop MetS [30]. Sleep duration was found to be a factor related to cardiovascular risk in MetS in the Penn State Adult Cohort [31]. Poor sleep quality and shorter sleep duration impacted the hormonal balance of adipocytokines and ghrelin in adolescent girls, affecting glucose homeostasis [32].

The SJL is considered a measure of circadian misalignment. The authors did not find any association between SJL and the risk of developing MetS. The New Hoorn Study (a population-based Dutch cohort) showed that SJL was linked to a two-fold higher risk of developing MetS [33]. This cohort consisted of older individuals aged 40 to 75 years, whereas the present study group consisted of young adults (mean age of 20 years). On the other hand, Castro N et al., reported a correlation between SJL and vascular health implications related to cardiometabolic risk but not with carbohydrate metabolism factors in preadolescent children [34].

Limitation(s)

The current study is not without limitations. The analysis of sleep patterns was based on self-reported data and data on physical activity and dietary history were not collected. As the present was a cross-sectional study, conclusions about the causal relationship between sleep disturbances and MetS could not be established. Future studies that utilise objective measures of sleep patterns, such as actigraphy and include dietary information and physical activity data, with a larger prospective sample size, would be beneficial in understanding and establishing the causal relationship.

CONCLUSION(S)

Sleep disturbances are prevalent among medical college students, with a comparatively higher incidence in female students. Poor sleep quality and sleep restriction are associated with an increased risk of MetS and obesity. In addition to affecting academic performance, poor sleeping habits can negatively impact the long-term health of students. Contrary to expectations, students in health-related fields are not immune to unhealthy sleeping patterns. The present study findings emphasise the need for health education to promote healthy sleeping behaviours among medical students.

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