

## Original Research Article

# Sleep quality and its correlates among undergraduate students of a medical school in North Karnataka, India

Suhasini R. Kanyadi<sup>1\*</sup>, Shivalingappa B. Javali<sup>2</sup>, Nabeel Ahmed Gadi<sup>1</sup>

<sup>1</sup>Department of Community Medicine, USM-KLE International Medical Programme, Belagavi, Karnataka, India

<sup>2</sup>Department of Bio-statistics, USM-KLE International Medical Programme, Belagavi, Karnataka, India

**Received:** 08 April 2024

**Revised:** 26 April 2024

**Accepted:** 29 April 2024

### \*Correspondence:

Dr. Suhasini R. Kanyadi,

E-mail: suha\_kanyadi@ymail.com

**Copyright:** © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

## ABSTRACT

**Background:** Poor sleep quality is a global health concern and is fast becoming one of the silent epidemics. Sleep quality among medical students is of particular interest as they are considered high risk groups for developing sleep related issues because of their demanding schedules. This study aims to estimate the magnitude of poor sleep and its correlates among undergraduate medical students of a medical school in Belgaum, India.

**Methods:** An institutional based descriptive cross-sectional study was conducted among 293 undergraduate medical students using a self-administered questionnaire. Sleep quality was assessed using Pittsburgh sleep quality index (PSQI). The potential determinants of quality of sleep were identified using logistic regression. A  $p < 0.05$  was considered statistically significant and adjusted odds ratio with 95%CI was used to present the strength of association.

**Results:** The prevalence of poor sleep quality among medical students was 69.3%. Factors like gender, female students (AOR=2.381, 95%CI=1.359-4.172), being overweight or obese (AOR=2.499, 95%CI=1.297-4.817) were associated with poor sleep quality. Students with good sleep hygiene (AOR=0.415, 95%CI=0.231-0.745) and who did not use technology during bedtime (AOR=0.38, 95%CI=0.168-0.878) were less likely of having poor sleep quality at  $p < 0.05$ .

**Conclusions:** Prevalence of poor sleep quality among substantial proportion of medical students in the current study is alarming. The already existing personal and professional development programme committee can conduct routine screening to assess sleep quality among students and focus on programmes to improve their sleep hygiene.

**Keywords:** Sleep quality, Medical students, Academic performance, Sleep hygiene, Technology use

## INTRODUCTION

Humans spend as much as one third of their life sleeping. Sleep, like eating or drinking is a non-negotiable biological necessity. It is, physiologically a complex process of homeostatic restoration, thermoregulation, tissue repair, immune control and memory processing. A study done among Chinese healthy doctors has shown disrupted sleep can affect genes associated with both DNA repair and DNA damage.<sup>1</sup> Animal studies revealed that sleep deprivation exerted alterations in proteins

associated with proliferation and apoptosis in carcinogenesis.<sup>2</sup> Sleep loss and poor sleep quality are global health concern and is fast becoming one of the silent epidemics. Sleep loss commonly disrupts metabolism, increases the risk of obesity.<sup>3</sup> Sleep quality which is defined as, an individual's self-satisfaction with all aspects of the sleep experience has four attributes: sleep efficiency, sleep latency, sleep duration, and wake after sleep onset.<sup>4</sup> Poor sleep quality has significant adverse health outcomes. Long-term co-morbidities arising from sleep deprivation can include heart disease,

stroke and high blood pressure.<sup>5</sup> Sleep hygiene has been defined as practicing behaviours that facilitate sleep and avoiding behaviours that interfere with sleep. Sleep hygiene is a collection of behaviours and environmental condition that aims to ensure a restorative and good quality sleep and to avoid/to treat certain sleep disorder.<sup>6</sup>

Students often tend to have insufficient and poor-quality sleep with irregular sleep habits, such as sleeping less during the weekdays and longer during the weekends. The indirect consequences associated with sleep loss or poor sleep quality includes irritability, day-time dysfunction, slowed responses, decreased ability to learn and maintain information, increased accidents, increased caffeine/alcohol intake which are due to decreased alertness and changes in behavior.<sup>7</sup> Many students mistakenly believe they can compensate for weeknight sleep deprivation by sleeping long hours on the weekend. Research on sleep hygiene and other factors associated with sleep quality among undergraduate medical students is of particular interest because they are high risk groups for developing sleep related issues because of their demanding schedules which are often said to be necessary for learning and development of professionalism among doctors. This in turn affects their physical and mental health, academic performance, future work performance as practitioners, the health care system and in turn the community.<sup>8,9</sup> The health concern over poor sleep has increased demand for effective sleep promotion strategies that are easily adaptable and accessible. In this study we hypothesized that medical students would have poor sleep quality which would correlate with factors such as poor sleep hygiene practice, various demographic variables and bedtime technology use. Thus, this study was conducted to estimate magnitude of poor sleep quality using PSQI and its correlates among undergraduate students of a medical school during July to September 2022.

## METHODS

### *Study design and setting*

An institutional based descriptive cross-sectional study was conducted among undergraduate medical students of a USM-KLE international medical programme, Belgaum, India. It was conducted between July to September 2022 for a period of 3 months. Universal sampling technique was used and all the medical students who attended this medical institute were eligible for participation in the study. Students who are absent during the study period or taking treatment for insomnia or were on medications like sedatives, opioids or anti-depressants were excluded from the study. Only the students who consented to participate in the study were given a brief description about the study and its objectives. The study participants were free to discontinue from the study at any point of time. There was no risk involved in this study and confidentiality was assured to each study participant. Ethical clearance was obtained from the institutional ethics committee.

### *Data collection and tools*

A self-administered pre-designed, pre-tested questionnaire was administered and data was collected from 1st year to 5th year students. The questionnaire consisted of 3 sections, demographic details like age, gender, ethnicity, marriage, year in medical school, whether they had a steady bed partner (partnered status) and bedtime technology use (self and partner use, active and passive use), PSQI and sleep hygiene index (SHI).<sup>10,11</sup> Necessary instructions and directions were provided in the questionnaire for each section. The approximate time that was needed to complete the questionnaire was between 20-25 min after which the volunteers were instructed to collect the questionnaires.

### *Study variables*

Bedtime technology use: Active self-I check e-mails, text messages or watch/post on social media between going to bed and waking up (sleep time). Passive self-I sleep where my mobile makes lights, sound or vibrates, active partner-I sleep where my bed partner/roommate checks e-mails, texts or social media during sleep time. Passive partner-I sleep where my bed partner/ roommate's phone makes lights, sounds or vibrates during sleep time.

PSQI is a validated 19-item self-report questionnaire designed to measure sleep quality and disturbances over a one-month period. It provides seven component scores. The score for each component ranges from 0 to 3; with score 0 indicating no difficulty and 3 indicating severe difficulty. A total global PSQI score is derived by summing up the seven components, scores ranged from 0 to 21; high scores indicating poor sleep quality global score of 5 or more has been established as clinical cut-off.

SHI a validated tool was used to assess the sleep hygiene behaviors through a 13-item questionnaire developed by Mastin, Bryson and Corwyn, 2006. The 13 items were summed to provide a global assessment of sleep hygiene with scores ranging from 13-65. Higher the global scores more maladaptive sleep hygiene practices. For the purposes of this study, a score of 35 and above was considered as poor sleep hygiene.

### *Measurement*

All participants were subjected to measuring the weight in kilograms with a digital scale in minimal clothing. Height was measured to the nearest 0.1 cm on a portable stadiometer. The body mass index (BMI) was calculated and classification was done as per the recommendations of the WHO (South-East Asian classification).<sup>12</sup>

### *Statistical analysis*

The collected data was verified for completeness and then coded before entry. Data were entered into SPSS software version 20.0 and analyzed. Numerical variables were

analysed as means and standard deviations. Categorical data were summarized using frequencies and percentages. Bivariate binary logistic analysis was performed to test association between various study variables with outcome variable (Sleep quality) using Pearson's chi-square. Statistical significance was set at  $p < 0.05$ . Variables which showed significant association during bivariate analysis were subjected to logistic regression analysis. Strength of association was presented by adjusted OR with 95%CI and  $p = 0.05$  was considered statistically significant.

## RESULTS

Total 307 students studying during period of study 293 eligible students participated in the study. Mean age ( $\pm$ SD) of students was 21.77 ( $\pm$ 1.66) with age ranging from 19 to 28 years and more than half, 187 (63.8%) were females. Majority of study participants were Malays 267 (91.1%) and remaining 26 (8.9%) either belonged to Malaysian Chinese, Malaysian Indians or were Indian in origin, 293 students 78 (26.7%) were overweight and 32 (10.9%) were obese according to South-East Asian classification of BMI. More than half, 164 (56%) students were studying in phase 2 (academic year 3/4/5) and 129 (44%) were in phase 1 (academic year 1/2) and 60 (20.5%) students did not have any roommates or bed-partners.

According to this study, of the total 293 medical undergraduate students 203 (69.3%) of them had poor sleep quality with 6.4 ( $\pm$ 2.45) as the mean sleep quality score. Regarding the components scores, only 88 (30%) of the students had normal sleep latency with the 50.5%

taking less than 15 minutes to fall asleep and only 56 (19.1%) of them slept more than 7 hours per night. More than half of the students, 168 (57.3%) thought that their subjective experience of sleep quality was fairly good. Good sleep efficiency was seen only among 52 (17.8%) students and only 93 (31.7%) stated they had no daytime dysfunction. The use of sleep medication for sleep once or twice a week and three or more times a week was 10 (3.4%) and 5 (1.7%) respectively (Table 1).

In bivariate analysis of the factors like female gender ( $p = 0.001$ ), Malay ethnicity ( $p = 0.026$ ), poor sleep hygiene practice ( $p = 0.001$ ), active self-use of bedtime technology ( $p = 0.001$ ) showed statistically significant associated with poor sleep quality also poor sleep quality was significantly associated with poor academic performance and BMI ( $p = 0.011$ ,  $p = 0.001$ ) respectively (Table 2).

In logistic regression analysis variables; gender, sleep hygiene, bedtime technology use and BMI were statistically significant with poor quality sleep at  $p$  value less than 0.05. The odds of having poor sleep quality were 2.4 times more among female students as compared to males (AOR=2.381, 95% CI=1.359-4.172). Students with overweight or obesity were 2.5 times more likely of having poor sleep quality (AOR=2.499, 95% CI=1.297-4.817). Students with good sleep hygiene practices were 0.4 times less likely of having poor sleep quality (AOR=0.415 95% CI=0.231-0.745). The odds of having poor quality were 0.4 times less among students who did not use technology during bedtime as compared to their counterparts AOR=0.38, 95% CI=0.168-0.878) (Table 3).

**Table 1: Sleep quality and its component score among undergraduate medical students.**

| Sleep quality and component scores   | N   | Percentage (%) |
|--------------------------------------|-----|----------------|
| <b>Sleep quality score</b>           |     |                |
| Good sleep                           | 90  | 30.7           |
| Poor sleep                           | 203 | 69.3           |
| <b>Components of sleep quality</b>   |     |                |
| <b>Sleep latency</b>                 |     |                |
| 0                                    | 88  | 30             |
| 1                                    | 65  | 22.2           |
| 2                                    | 68  | 23.2           |
| 3                                    | 72  | 24.6           |
| <b>Sleep duration (in hours)</b>     |     |                |
| >7                                   | 56  | 19.1           |
| 6-7                                  | 115 | 39.2           |
| 5-6                                  | 82  | 28.0           |
| <5                                   | 40  | 13.7           |
| <b>Habitual sleep efficiency (%)</b> |     |                |
| >85                                  | 52  | 17.8           |
| 75-84                                | 79  | 26.9           |
| 65-74                                | 6   | 2.1            |
| <65                                  | 156 | 53.2           |
| <b>Day time dysfunction</b>          |     |                |
| 0                                    | 93  | 31.7           |
| 1                                    | 99  | 33.8           |
| 2                                    | 65  | 22.2           |
| 3                                    | 36  | 12.3           |

Continued.

| Sleep quality and component scores | N   | Percentage (%) |
|------------------------------------|-----|----------------|
| <b>Sleep disturbance</b>           |     |                |
| 0                                  | 26  | 8.9            |
| 1                                  | 230 | 78.5           |
| 2                                  | 34  | 11.6           |
| 3                                  | 3   | 1.0            |
| <b>Subjective sleep quality</b>    |     |                |
| Very good                          | 91  | 31.1           |
| Fairly good                        | 168 | 57.3           |
| Fairly bad                         | 32  | 10.9           |
| Very bad                           | 2   | 0.7            |
| <b>Use of sleep medication</b>     |     |                |
| Not during the past month          | 260 | 88.7           |
| Less than once a month             | 18  | 6.2            |
| Once or twice a week               | 10  | 3.4            |
| Three or more times a week         | 5   | 1.7            |

**Table 2: Association of socio-demographic characteristics, sleep hygiene practice and bed-time technology use with sleep quality.**

| Variables                         |            | Sleep quality |      | Total (%)  | Pearsons' chi square tests       |
|-----------------------------------|------------|---------------|------|------------|----------------------------------|
|                                   |            | Poor          | Good |            |                                  |
| Socio-demographic characteristics |            |               |      |            |                                  |
| Gender                            | Male       | 58            | 48   | 106 (36.2) | X <sup>2</sup> =16.559, p=0.001* |
|                                   | Female     | 145           | 42   | 187 (63.8) |                                  |
| Age group (in years)              | 19-21      | 99            | 51   | 150 (51.2) | X <sup>2</sup> =3.855, p=0.145   |
|                                   | 22-24      | 95            | 32   | 127 (43.3) |                                  |
|                                   | >24        | 9             | 7    | 16 (5.5)   |                                  |
| Ethnicity                         | Malaya     | 190           | 77   | 267 (91.1) | X <sup>2</sup> =4.985, p=0.026*  |
|                                   | Others     | 13            | 13   | 26 (8.9)   |                                  |
| Phase                             | Phase 1    | 184           | 45   | 129 (44)   | X <sup>2</sup> =1.880, p=0.170   |
|                                   | Phase 2    | 119           | 45   | 164 (56)   |                                  |
| Attendance                        | Good       | 174           | 78   | 252 (86)   | X <sup>2</sup> =0.047, p=0.828   |
|                                   | Poor       | 29            | 12   | 41 (14)    |                                  |
| Academic performance              | Good       | 77            | 48   | 125 (42.7) | X <sup>2</sup> =8.969, p=0.011*  |
|                                   | Average    | 111           | 41   | 152 (51.9) |                                  |
|                                   | Poor       | 15            | 1    | 16 (5.5)   |                                  |
| BMI (kg/m <sup>2</sup> )          | ≤18.50     | 16            | 10   | 26 (8.9)   | X <sup>2</sup> =20.090, p=0.001* |
|                                   | 18.5-23.0  | 94            | 63   | 157 (53.5) |                                  |
|                                   | 23.1-27.50 | 64            | 14   | 78 (26.7)  |                                  |
|                                   | >27.50     | 29            | 3    | 32 (10.9)  |                                  |
| Sleep hygiene practice            | Poor       | 114           | 25   | 139 (47.4) | X <sup>2</sup> =0.011, p=0.001*  |
|                                   | Good       | 89            | 65   | 154 (52.6) |                                  |
| Bed-time technology use           |            |               |      |            |                                  |
| Self-active use                   | Yes        | 191           | 70   | 261(89)    | X <sup>2</sup> =17.052, p=0.001* |
|                                   | No         | 12            | 20   | 32 (11)    |                                  |
| Self-passive use                  | Yes        | 130           | 60   | 190 (64.8) | X <sup>2</sup> =0.189, p=0.664   |
|                                   | No         | 73            | 30   | 103 (35.2) |                                  |
| Partner-active use                | Yes        | 107           | 39   | 146 (49.8) | X <sup>2</sup> =2.197, p=0.333   |
|                                   | No         | 57            | 30   | 87 (29.7)  |                                  |
|                                   | NA         | 39            | 21   | 60 (20.5)  |                                  |
| Partner-passive use               | Yes        | 93            | 37   | 130 (44.3) | X <sup>2</sup> =1.327, p=0.515   |
|                                   | No         | 72            | 31   | 103 (35.2) |                                  |
|                                   | NA         | 38            | 22   | 60 (20.5)  |                                  |

Note: \*p value less than 0.05.

**Table 3: Logistic regression showing association between factors and sleep quality among undergraduate students.**

| Explanatory variables                      |            | Sleep quality |      | Adjusted odds ratio (95% CI) | P value |
|--------------------------------------------|------------|---------------|------|------------------------------|---------|
|                                            |            | Poor          | Good |                              |         |
| <b>Gender</b>                              | Male       | 58            | 48   | 1.00                         | 0.001   |
|                                            | Female     | 145           | 42   | 2.381 (1.359-4.172)          |         |
| <b>Ethnicity</b>                           | Malaya     | 190           | 77   | 1.00                         | 0.116   |
|                                            | Others     | 13            | 13   | 0.475 (0.188-1.201)          |         |
| <b>Academic performance</b>                | Good       | 77            | 48   | 1.00                         | 0.188   |
|                                            | Poor       | 126           | 42   | 1.455 (0.832-2.544)          |         |
| <b>BMI (kg/m<sup>2</sup>)</b>              | ≤18.5-22.9 | 110           | 73   | 1.00                         | 0.006   |
|                                            | ≥23        | 93            | 17   | 2.499 (1.297-4.817)          |         |
| <b>Sleep hygiene practice</b>              | Poor       | 114           | 25   | 1.00                         | 0.003   |
|                                            | Good       | 89            | 65   | 0.415 (0.231-0.745)          |         |
| <b>Bed-time technology self-active use</b> | Yes        | 191           | 70   | 1.00                         | 0.023   |
|                                            | No         | 12            | 20   | 0.384 (0.168-0.878)          |         |

Note: 1.00 reference, \*p value less than 0.05.

## DISCUSSION

The study was conducted among undergraduate students pursuing medical degree from a medical school in Belgaum which is an offshore international medical programme. Students here, study in India for five years and are awarded a doctor of medicine USM after completing their studies.

In this study the prevalence of poor sleep quality was 69.3% which was slightly higher when compared to study conducted among medical students of university Malaya 67% and university Putra Malaysia 60.9% also, few studies showed prevalence of poor sleep quality in Iran was 57.5%, 61% in Bahawalpur, Pakistan and 62% in Ethiopia.<sup>13-16</sup> The prevalence of poor sleep quality in our present study is lower than Saudi Arab 76% and 72.7% Haryana, India.<sup>17,18</sup> The possible reasons for the variability across the countries could be differences in sampling technique, difference in socio-cultural environment, study population (preclinical/clinical postings) and also the period of data collection (having exams/completed exams). The mean of total sleep quality score (GPQSI) in this study was 6.4 which was in the range of a meta-analysis report which showed the pooled mean total PSQI score across 41 studies among medical students was 6.1 (95% CI: 5.6 to 6.5).<sup>19</sup>

In this study, significant association was found between, gender and sleep quality. Being female medical student was a significant predictor of having higher rates of poor-quality sleep and the findings were consistent with study conducted among medical students of Jeddah, Saudi Arabia and Egypt.<sup>20,21</sup> The study shows, poor sleep hygiene practices might be one of the reasons for poor quality of sleep among medical students. These results are in line with previous studies.<sup>22,23</sup> Merely having good knowledge about sleep hygiene practices among students was not sufficient in improving sleep quality as reported by Brown et al.<sup>24</sup> In fact, implementing and the practicing

these principles would help to improve sleep quality which is consistent with the findings of our study showing the odds of having poor quality was 0.4 times less among students with good sleep hygiene practices. Though poor academic performance was an associated factor with poor sleep quality but on regression analysis it was not found to be statistically significant similarly few studies reported no significant association between sleep quality and academic performance.<sup>24,25</sup> We found high levels both active and passive social technology use during sleep time but our study did not consider the duration of use during sleep time. Studies conducted in Tamil Nadu and Kolkata revealed that increase in duration of mobile phone usage was associated with poor sleep quality.<sup>26,27</sup> Interestingly, in the current study partner social technology use was not associated with one's own sleep quality. Thus, suggesting sleep hygiene advice should focus primarily on reducing one's own social technology use rather than partner's technology use. Poor sleep quality was associated with a greater likelihood of being overweight and obese and the results were similar to a large sample study conducted among students of university of Zagreb.<sup>27</sup>

## Strength and limitations

The current study considered variables like bedtime technology use (both self and partner use) and BMI which is a unique feature of this study. This study used cross-sectional design; thus we were only able to establish associations and not temporal relationship between the study outcome and the independent variables. Though the sample size was good enough it was conducted only in one medical school which may limit the generalizability of the findings to other regions with different socio-cultural environment. Since the responses were collected using a self-administered questionnaire, there may be an information bias. Some important variables such as stress, anxiety and depression were not assessed to avoid prolongation of the questionnaire.



## CONCLUSION

Though poor sleep quality was prevalent among substantial proportion of medical students in the current study more than half of the students were not aware of it. Their subjective experience of sleep quality was fairly good. It warrants medical education programs to offer the students a deeper knowledge on importance of sleep quality and its implications on overall health. Regularising sleep among students and stopping the apparent trend towards self-imposed sleep deprivation, irregular schedules by avoiding bedtime technology self-use needs to be emphasized.

## Recommendations

Additional research that uses interventional design to determine if change in sleep-hygiene knowledge and practices influences overall sleep among students or a prospective study to investigate the cause-and-effect relationship of risk factors of poor sleep hygiene is recommended. Routine screening programmes regarding sleep quality and sleep hygiene is needed and can be included in the existing PPDP (Personal and professional development programme) committee.

## ACKNOWLEDGEMENTS

Authors would like to thank to Shilpa Hidkal the co-investigator, class representatives Nurul Fatehah Binti Abdul Aziz, Fadhilatun Farihin Binti Izhar Abadi, Nur Farzana Arina Binti Faozly, Muhammad Aiman Bin Tusoff, Muhammad Arief Fahim Bin Azmi, Muhammad Husnul Hakimi Bin Idris for their assistance.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: The study was approved by the Institutional Ethics Committee Ref no.: USM-KLE/IEC/09/2022-01*

## REFERENCES

- Cheung V, Yuen VM, Wong GTC, Choi SW. The effect of sleep deprivation and disruption on DNA damage and health of doctors. *Anaesthesia*. 2019;74(4):434-40.
- Noguti J, Alvarenga TA, Andersen ML, Tufik S, Oshima CT, Ribeiro DA. The influence of sleep deprivation on expression of apoptosis regulatory proteins p53, bcl-2 and bax following rat tongue carcinogenesis induced by 4-nitroquinoline 1-oxide. *Dent Res J (Isfahan)*. 2013;10(2):247-53.
- Skuladottir GV, Nilsson EK, Mwinyi J, Schiöth HB. One-night sleep deprivation induces changes in the DNA methylation and serum activity indices of stearoyl-CoA desaturase in young healthy men. *Lipids Health Dis*. 2016;15(1):137.
- Nelson KL, Davis JE, Corbett CF. Sleep quality: An evolutionary concept analysis. *Nurs Forum*. 2022;57(1):144-51.
- Javaheri S, Zhao YY, Punjabi NM, Quan SF, Gottlieb DJ, Redline S. Slow wave sleep is associated with incident hypertension: the sleep heart health study. *Sleep*. 2018;41(1):zsx179.
- Hauri P. Sleep hygiene. *Current Concepts: The Sleep Disorders*. The Upjohn Company; Kalamazoo, MI. 1977;21-35.
- Boudreau RL, Jiang P, Gilmore BL, Spengler RM, Tirabassi R, Nelson JA, et al. Transcriptome-wide discovery of microRNA binding sites in human brain. *Neuron*. 2014;81(2):294-305.
- Subhaprada SC, Vijayakumari S, Rajasekhar T, Venkateswarlu U. An interventional study on sleep hygiene among medical students. *Int J Community Med Public Health*. 2017;4(2):352-6.
- Azad MC, Fraser K, Rumana N, Ahmad FA, Nahid S, Patrick JH, et al. Sleep disturbances among medical students: a global perspective. *J Clin Sleep Med*. 2015;11(1):69-74.
- Aloba OO, Adewuya AO, Ola BA, Mapayi BM. Validity of the Pittsburgh sleep quality index (PSQI) among Nigerian university students. *Sleep Med*. 2007;8(3):266-70.
- Mastin DF, Bryson J, Corwyn R. Assessment of sleep hygiene using the sleep hygiene index. *J Behav Med*. 2006;29(3):223-7.
- Pan WH, Yeh WT. How to define obesity? Evidence-based multiple action points for public awareness, screening, and treatment: an extension of Asian-Pacific recommendations. *Asia Pac J Clin Nutr*. 2008;17(3):370-4.
- Masalamany K, Ngu ST, Abd MananN, Adam SK. Sleep quality among pre-clinical medical students in Universiti Putra Malaysia and Universiti Malaya, Malaysia. *Educ Med J*. 2017;9(3):23-31.
- Yazdi Z, Loukzadeh Z, Moghaddam P, Jalilolghadr S. Sleep hygiene practices and their relation to sleep quality in medical students of Qazvin university of medical sciences. *J Caring Sci*. 2016;5(2):153-60.
- Shafique Z, Syed F, Naz S, Urooj S, Khan S, Javed S. Assessment of factors affecting the sleep hygiene of medical students in Bahawalpur, Pakistan: a cross-sectional study. *Sleep Sci*. 2021;14(3):273-9.
- Wondie T, Molla A, Mulat H, Damene W, Bekele M, Madoro D, et al. Magnitude and correlates of sleep quality among undergraduate medical students in Ethiopia: Cross-sectional study. *Sleep Science and Practice*. 2021;5(1):1-8.
- Almojali AI, Almalki SA, Alothman AS, Masuadi EM, Alaqeel MK. The prevalence and association of stress with sleep quality among medical students. *J Epidemiol Global Heal*. 2017;7(3):169-74.
- Gupta S, Bhardwaj A, Nadda A, Gill A, Mittal A, Gupta S. A comparative study of sleep quality in different phases of the medical course: A study from Haryana (North India). *J Family Med Prim Care*. 2020;9(4):2006-10.

19. Rao WW, Li W, Qi H, Hong L, Chen C, Li CY, et al. Sleep quality in medical students: a comprehensive meta-analysis of observational studies. *Sleep Breath*. 2020;24(3):151-65.
20. Ibrahim N, Badawi F, Mansouri Y, Ainousa A, Jambi S. Sleep quality among medical students at King Abdulaziz University: a cross-sectional study. *J Community Med Health Educ*. 2017;7(561):2161-711.
21. Fawzy M, Hamed SA. Prevalence of psychological stress, depression and anxiety among medical students in Egypt. *Psychiatry Res*. 2017;255:186-94.
22. Bahmman AS, Al-Khairi OK, Al-Taweel AA. Sleep habits and patterns among medical students. *Neurosciences (Riyadh)*. 2005;10(2):159-62.
23. Suen LK, Tam WW, Hon KL. Association of sleep hygiene-related factors and sleep quality among university students in Hong Kong. *Hong Kong Med J*. 2010;16(3):180-8.
24. Brown FC, Buboltz WC, Soper B. Relationship of sleep hygiene awareness, sleep hygiene practices, and sleep quality in university students. *Behavioral Med*. 2002;28(1):33-8.
25. Madhusudan M, Anaswara DU, Aiswarya E, Jose A, Dileep N, Paul KM, et al. Sleep quality, its determinants and its association with academic performance among the students of a medical college in Kerala. *Ann Community Health*. 2019;7(1):05-08.
26. Alqarni AB, Alzahrani NJ, Alsofyani MA, Almalki AA. The interaction between sleep quality and academic performance among the medical students in Taif University. *Egypt J Hosp Med*. 2018;70(12):2202-08.
27. Anuradha R, Hemachandran S, Aruna BP. Sleep Quality and Daytime Sleepiness among Medical Undergraduate Students in Tamil Nadu: A Cross-sectional Study. *J Clin Diagnostic Res*. 2022;16(7):LC18-23.
28. Basu M, Saha SK, Majumder S, Chatterjee S, Misra R. A study on sleeping pattern among undergraduate medical students of a tertiary care teaching hospital of Kolkata. *Int J Med Pub Health*. 2019;9(4):118-24.
29. Krističević T, Štefan L, Sporiš G. The Associations between Sleep Duration and Sleep Quality with Body-Mass Index in a Large Sample of Young Adults. *Int J Environ Res Public Health*. 2018;15(4):758.

**Cite this article as:** Kanyadi SR, Javali SB, Gadi NA. Sleep quality and its correlates among undergraduate students of a medical school in North Karnataka, India. *Int J Community Med Public Health* 2024;11:2247-53.