

Article

Sleep Duration and BMI: A Study Among First-Year Students of a Malaysian Muslim Gifted and Talented Institution

Nur Fazidah Asmuje¹, Muhammad Nashwan Mohd Nasarudin¹,
Abdul Razzak Khan Rustum Ali Khan², Rahayu Ahmad¹, and Nurdalila
A'wani Abdul Aziz^{1,3}

¹Kolej PERMATA Insan, Universiti Sains Islam Malaysia, 71800, Nilai, Negeri Sembilan, Malaysia.

²Faculty of Natural, Mathematical & Engineering Sciences, King's College London, Strand, WC2R 2LS, United Kingdom.

³Institute of Fatwa and Halal, Universiti Sains Islam Malaysia, 71800, Nilai, Negeri Sembilan, Malaysia.

Correspondence should be addressed to:

Nur Fazidah Asmuje; nurfazidah@usim.edu.my

Article Info

Article history:

Received: 22 November 2024

Accepted: 30 January 2025

Published: 18 February 2025

Academic Editor:

Azira Khalil

Malaysian Journal of Science,
Health & Technology

MJoSHT2025, Volume 11, Issue No. 1

eISSN: 2601-0003

<https://doi.org/10.33102/mjosht.v11i1.467>

Copyright © 2025 Nur Fazidah
Asmuje et al. This is an open access
article distributed under the Creative
Commons Attribution 4.0

International License, which permits
unrestricted use, distribution, and
reproduction in any medium,
provided the original work is
properly cited.

Abstract— Sleep is widely recognized as a public health concern due to its impact on societal well-being and healthcare expenses. Emerging evidence suggests that insufficient sleep may significantly increase the risk of obesity and cardiovascular event. To date few studies have examined sleep duration and patterns within Malaysian boarding school particularly in Muslim Gifted and Talented institution. This study aims to identify sleep duration and investigate its relationship with body mass index (BMI) among first-year students of Kolej PERMATA Insan. Demographic data including gender, height, and weight were analysed using descriptive analysis. A linear regression test was applied to explore the relationship between BMI and sleep duration. Result indicated that male students slept significantly longer compared to female students. However, no association was found between sleep duration and BMI. This postulates that the structured environment and healthy lifestyle prepared by the Muslim Gifted and Talented Institution may mitigate potential negative impacts of insufficient sleep on BMI.

Keywords— Sleep; Body Mass Index; Muslim Gifted and Talented Institution; Boarding School

I. INTRODUCTION

Sleep is widely recognized as a public health concern, profoundly influencing psychological, emotional, and physical well-being. While sleep is not only influence to individual health, it has broader implications for societal well-being and healthcare expenses. For instance, sleep disorders affect approximately 70 million Americans, leading to \$16 billion in healthcare costs and \$50 billion in lost productivity [1]. The public health burden of poor sleep extends to an increased risk of chronic health issue such as diabetes, cardiovascular disease (CVD), and mental disorders. This highlights the needs for

widespread education and intervention to promote healthy sleep habits.

Healthy sleep is characterized by an appropriate duration, high-quality and the absence of sleep disorders [2]. Review done by Chaput et al., (2020) and Li et al., (2017) has identified that the optimal duration of sleep varies throughout the lifespan and is inversely related to age [3,4]. The American Academy Sleep Foundation suggests that newborns require about 14 to 17 hours of sleep, toddlers need 11 to 14 hours, and school-aged children 9 to 11 hours. Meanwhile, for teenagers, 8 to 10 hours was considered sufficient, 7 to 9 hours for adults, and 7 to 8 hours of sleep for older adults [5].

II. MATERIAL AND METHOD

Geographical location, daily living activities, environmental factors and sleep habits however, can influence the optimal duration of sleep. For instance, a study suggested that healthy sleep can be encouraged by establishing structured night-time routines and limiting technology use before bed, particularly in some boarding school environment [6]. At Kolej PERMATA Insan, a Muslim Gifted and Talented Institution, the integrated curricula comprising enrichment programs and contents, accelerated learning and extracurricular activities presents unique challenges and opportunities for optimizing student's sleep duration.

Boarding school environment, characterized by extended academic hours, extracurricular commitments, and social activities pose challenges to achieving adequate and restful sleep. Irregular sleep habits, delayed bedtime and early wake up times are particularly common especially during examination period. Additionally, factors such as homesickness, unfamiliar living arrangements, and increased academic pressure can disrupt students' sleep patterns. Recent data reveal that six out of ten middle school students and seven out of ten high school students fail to get the recommended amount of sleep, highlighting a concerning trend [7].

Furthermore, studies have demonstrated a relationship between sleep and Body Mass Index (BMI). Emerging evidence suggests that insufficient sleep may significantly increase the risk of obesity, cardiovascular issues, particularly among vulnerable population such as college freshmen males [8], medical students [9] and high school students [10,11]. The physiological mechanism underlying this relationship involves the disruption of endocrine hormones such as insulin, which regulates blood sugar levels. Disruption of hormonal balance can lead to elevated blood sugar, resulting increased fat storage ultimately contributing to a higher BMI. Sleep deprivation can lead to hormonal imbalances, elevated blood sugar levels, and increased fat storage, ultimately contributing to a higher BMI.

Elevated BMI has become a pressing issue among school students in Malaysia, closely monitored by Ministry of Health and Ministry of Education Malaysia [12,13]. To date limited studies have examined sleep duration and patterns within Malaysian boarding school particularly in Muslim Gifted and Talented institution. This gap underscores the need for targeted research to better understand how sleep duration impacts health outcomes in this unique student population.

This study therefore, aims to identify sleep duration and investigate its relationship with BMI among first-year students of Kolej PERMATA Insan. By examining this relationship, the research seeks to provide valuable insights into the specific sleep challenges faced by Muslim Gifted and Talented students. Understanding this relationship is vital for developing targeted strategies to improve sleep quantity and quality among Muslim Gifted and Talented students, potentially influencing thrive health outcomes and enhancing students' academic and personal well-being.

A. Participants

A cross-sectional survey was conducted to identify the association between sleep duration and body mass index (BMI) among boarding school students. Data was collected in Mei 2023 and involved 65 first-year students, aged 13-years, enrolled at Kolej PERMATA Insan (KPI), Universiti Sains Islam Malaysia. At the time of data collection, participants had been enrolled in the institution for approximately two months.

Kolej PERMATA Insan is a specialized institution offering the Muslim gifted and talented (IGEd) curriculum, designed to nurture Muslim Nobelle Laureates by integrating Islamic studies with a combination of gifted and talented curriculum model and the Malaysia National Curriculum [14]. The curriculum encompasses the following components:

- National curriculum which covers 11 subjects of Sijil Pelajaran Malaysia (SPM) including Malay language, English, History, Mathematics, Additional Mathematics, Physics, Chemistry, Biology, Syariah Islamiah, Quran and Sunnah Education as well as Arabic.
- Ulumuddin or known as Islamic Studies emphasizes Quran memorization and contemplation (tadabbur). Students are required to memorize minimum of ten juzu' over four years of study.
- Research component is conducted by assigning a supervisor for each student based on their specific field of interest to guide them in research projects.
- Insaniah focuses on moral and social development which is evaluated through project-based learning.
- Co-curricular activities includes participation in sports, uniformed bodies and students clubs promoting holistic growth and teamwork.

The school week integrates all these components, with classes running from 6:00 am to 4:30 pm on weekdays. In addition to these academic hours, students attend Al-Quran classes from 7:30 pm to 9:30 pm, followed by a self-study period, which extends until 11:00 pm. Students typically go to bed at 11:00 pm.

B. Data Collection

To collect the data, participants were called to gather in a school's hall where they were briefed about the study and asked to complete the survey. Informed consent was obtained from all participants before study prior to the commenced of the study, ensuring ethical compliance and participant understanding. The survey included self-reported sleep questionnaire adapted from Sleep Questionnaire for Adults by Sleep Disorders Clinic Department of Clinical Neurophysiology.

The questionnaire focused on participant's typical sleep habits, including responses to the questions:

- "What time do you usually go to sleep?"
- "What time do you usually get up?"

The duration of sleep was defined as the difference between the time participants reported going to sleep and the time they reported waking up. This was calculated separately for weekday and weekends. The weekly average sleep duration was then determined by averaging the total hours of sleep across all seven days of the week. This measure provided a comprehensive understanding of participant's overall sleep pattern.

C. Anthropometric Measurements

Participant's body weight and height were measured using the Esco Weight Scale & Height (Model: MEA/1200-SD). Weight was measured to the nearest 0.1 kilogram (kg), while height was recorded to the nearest 0.1 centimeter (cm). The height was conducted without shoes to ensure accuracy.

D. Body Mass Index Measurements

Using the measurement of height weigh that were taken, the body mass index (BMI) was calculated by dividing the participants weight in kilogram by their height in centimetres squared.

The BMI values were then categorized based on World Health Organization (WHO) 2007 BMI-for-age percentile chart which provides age-and sex-specific BMI as shown in Figure 1 and Figure 2:

- Underweight is defined as less than the 50th percentile; normal weight is between 50th and less than 85th percentile.
- Overweight is from the 85th to less than the 97th percentile and obesity is at the 97th percentile or greater.

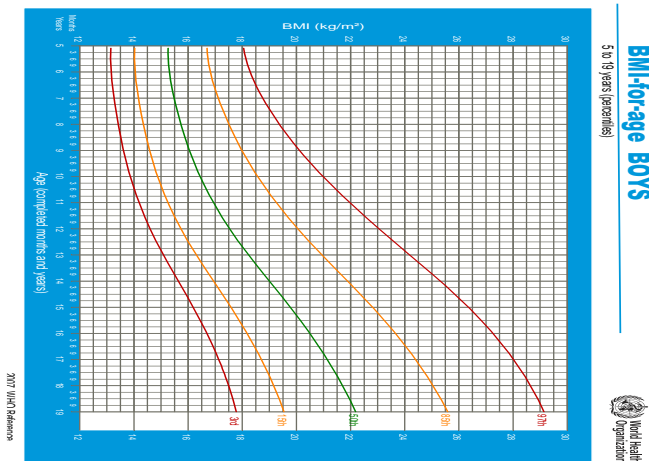


Figure 1. BMI-for-age percentile chart for boys

For male,

- Underweight: BMI below 18.0
- Normal weight: : BMI between 18.0 and 20.9
- Overweight: BMI between 20.9 and 24.2
- Obesity: BMI above 24.3



Figure 2. BMI-for-age percentile chart for girls

For female,

- Underweight: BMI below 19.0
- Normal weight: BMI between 19.0 to 22.0
- Overweight BMI between 22.0 to 24.4
- Obesity: BMI above 24.5

E. . Statistical Analysis

The demographic data, including height, weight, were first analyzed using descriptive statistics to provide an overview of the participants' characteristics. This analysis aimed to summarize the basic features of the dataset, offering insights into variations across gender and ensuring data accuracy.

To further investigate the relationship between BMI and sleep duration, a correlation coefficient test was conducted to assess the strength and direction of the association between these two variables. This statistical method was selected as it provides a quantitative measure of the relationship, indicating whether BMI and sleep duration are positively or negatively correlated, or if there is no significant correlation between them.

III. RESULTS

The participants of this study were first-year students, aged-13 of Kolej PERMATA Insan comprising 26 males and 39 females. Their demographic including weight, height, body mass index (BMI), changes in weight, caffeine intake and sleep duration according to gender, are summarised in Table I. According to World Health Organization (WHO) 2007 BMI-for-age percentile chart, the gender specific cut-off value were used for BMI classification.

However, this study shows no statistically significant difference between males and females in terms of weight, height, BMI, changes in weight or caffeine intake ($p > 0.05$).

The mean weight of female participants is slightly higher, with a mean (SD) weight of 47.39 (9.41) kg compared to males at 45.44 (13.19) kg. However, it is not statistically significant ($p = 0.069$). The mean height is almost similar for both genders, with males having a mean (SD) height of 152.38 (8.08) cm and female at 153.03 (6.21) cm with no significant difference observed ($p = 0.248$).

Body mass index classifications revealed no significant differences between males and female participants ($p = 0.904$). Most participants have a normal BMI but the number of obese participants is higher than underweight and overweight for both genders. A total of 22 participants reported experiencing changes in weight over the last six months, comprising 12.3% males and 21.5% females.

Caffeine consumption was common among the 52 participants, with 32.3% of males and 47.7% of females frequently consuming caffeinated beverages such as coffee, tea, or cola three hours before sleep.

In this study, the average sleep duration was significantly different between genders with male slept significantly longer with a mean (SD), 5 hours 13 minutes (1 hour 52 minutes), compared to female students, who had a mean (SD) of 4 hours 46 minutes (1 hour 49 minutes) ($p < 0.05$).

TABLE I. PARTICIPANT'S DEMOGRAPHIC BASED ON GENDERS

	Male (n=26)	Female (n=39)	p-value
Weight (kg), mean (SD)	45.44 (13.19)	47.39 (9.41)	0.069
Height (cm), mean (SD)	152.38 (8.08)	153.03 (6.21)	0.248
Body Mass Index (BMI), n (%)			0.904
Underweight	2 (3.1%)	4 (6.2%)	
Normal	16 (24.6%)	25 (38.5%)	
Overweight	3 (4.6%)	5 (7.7%)	
Obesity	5 (7.7%)	5 (7.7%)	
Changes in weight, n (%)	8 (12.3%)	14 (21.5%)	0.669
Caffein intake, (coffee, tea or Cola) n (%)	21 (32.3%)	31(47.7%)	0.899
Sleep duration*	5 hrs 13 min (1 hr 52 min)	4 hrs 46 min (1 hr 49 min)	<0.001

hrs= hours; min = minutes; * p-value = < 0.05

TABLE II. DISTRIBUTION OF BODY MASS INDEX

	Under- weight (n= 6)	Normal (n=41)	Over weight (n=8)	Obesity (n=10)	p-value
Caffein intake, n (%)	5 (9.6%)	33 (63.5%)	4 (7.7%)	10 (19.2%)	0.070
Sleep duration, mean (SD)	4 hrs 47 min (32 min)	4 hrs 22 min (1 hr 13 min)	4 hrs 15 min (1 hr 3 min)	4 hrs 2 min (1 hr 4 min)	0.111

hrs= hours; Min = minutes; * p-value = < 0.05

Caffein intake and sleep duration did not significantly differ between BMI classification, as shown in Table II. Among the BMI classification, more than half of participants consumed caffein before sleep; 5 out of 6 underweight participants, 33 out of 41 participants with normal BMI, 4 out of 8 overweight participants and all obese participants.

The average (SD) sleep duration for participants who are underweight is slightly higher at 4 hours and 47 minutes (32 minutes) compared to those with normal BMI at 4 hours and 22 minutes (1 hour and 13 minutes). The sleep duration is shorter among overweight participants at 4 hours and 15 minutes (1 hour and 3 minutes) and obese participants at 4 hours and 2 minutes (1 hour and 4 minutes) compared to participants with normal BMI.

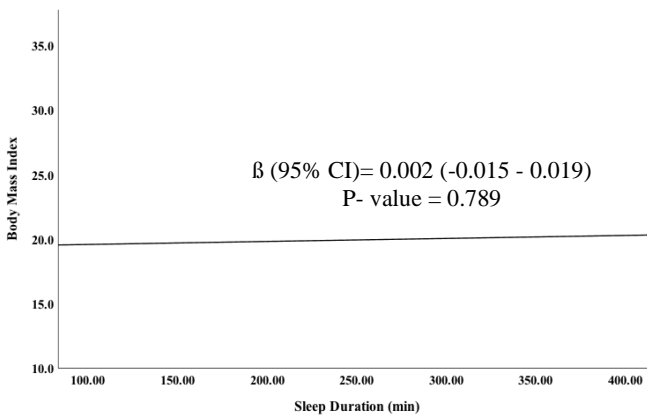


Figure 3. Correlation between Body Mass Index and Sleep Duration

The relationship between sleep duration and body mass index (BMI) is shown in Figure 3. The regression analysis shows a beta coefficient (β) of 0.002 with a 95% Confidence Interval (CI) of -0.015 to 0.019, indicating a very slight positive slope that is not significantly different from zero. Furthermore, the P-value is 0.789, which is well above the conventional threshold for statistical significance ($p < 0.05$). This suggests a minimal increase in BMI as sleep duration increases.

IV. DISCUSSION

Sleep is an active state of unconsciousness produced by the body. Brain activity during sleep is not at rest but predominantly responds to internal stimuli [15]. This highlights its vital role in maintaining overall health and well-being. Factors such as sleep hygiene, including sleep duration and quality, are often investigated for their potential relation to BMI, which is a common indicator of general health. The comparative analysis reveals that there are no statistically significant differences between male and female subjects in terms of weight, height, BMI categories, changes in weight and caffein intake. While most studies identify the relationship between sleep duration and BMI, the result of this study diverge from norm as it does not show any statistically significant impact on sleep duration, indicating a negligible impact on BMI among first year of KPI students.

This study, however, reveals a gender difference in sleep duration among first-year KPI students, with males significantly sleeping longer than female which may due to different activity or program involvement. This finding aligns with the study done by Putilov et al. (2021), which reported lower wakefulness weekday but longer sleep duration on free days among females compared to male students [16]. However, Souza et al., (2017) reported that females have a higher level of daytime sleepiness [17]. This discrepancy might be a limitation of this study as it does not measure daytime sleep. These gender differences might not have a clear biological explanation, but, they could be related to differences in academic and extra curriculum demands. Females students might face higher academic pressure and have more responsibility, including involvement in extracurricular activities, which could underlie the differences in sleep duration.

The mean sleep duration for first-year KPI students was observed to be lower than the suggested duration from previous study done by Chaput et al., (2020), which is eight to ten hours [3]. The lack of sleep duration, could likely be attributed to the student's demanding timetable, as they often stay up late to complete assignments or engage in self-study. Such a packed timetable is characteristic of a rigorous academic environment, which places high expectations on students and may inadvertently limit the time available for adequate rest. Despite this lower sleep duration, the finding of this study revealed no significant effect of sleep duration on BMI among participants.

This result contrast with other studies' finding, which suggests that insufficient sleep may contribute to cardiovascular disease, which is mediated by BMI. The lack of association between sleep duration and BMI in this study perhaps, may reflects the physiological characteristics of the participants. Specifically, the relationship between sleep duration and BMI may reflect underlying conditions related to metabolic rate and endocrine function [18]. It is presumed that

sleep among first-year students, aged 13, may not be influenced by slower metabolism, hormonal imbalance and cardiovascular dysfunction. Adolescents typically have a higher metabolic rate, which may enable them to maintain their weight despite variations in sleep duration [19]. This protective factor could help buffer the adverse effects of shorter sleep duration, allowing them to sustain a healthy BMI.

As KPI is a boarding school, the students might have more uniform and structured daily routines, and physical activities. This routine promotes a healthy lifestyle, as the students' activities, diet, and sleep patterns are regulated to ensure consistency. Proper nutrition, which is controlled by the school, ensures that students receive balanced meals that support their physical and mental development. This structured environment minimizes the variability that might otherwise arise from external factors such as irregular eating habits, lack of physical activity, or excessive screen time, which are more common among non-boarding students.

The adaptation to these routines among first-year students appears to mitigate potential health concerns such as circadian disruptions or lifestyle-related health risks [20]. As the students are engaged in physical activities and consume well-balanced diets, poor sleep has not impact on their glucose regulation, insulin resistance and appetite regulating hormones [21]. Insulin resistance is a condition where the body's cells become less responsive to insulin, leading to higher blood sugar levels and often contributing to weight gain or difficulties in managing BMI. However, due to the structured and health-conscious environment at KPI, students are less likely to develop insulin resistance or related metabolic issues. Consequently, their BMI remains stable and unaffected by variations in their sleep duration. This highlights the protective role of a structured boarding school environment in maintaining a healthy metabolic profile despite potential fluctuations in sleep patterns.

Another possible explanation for the findings in this study may involve the role of autonomic nervous system in coordinating the sympatovagal balance. At the age of 13, participants are in the early stages of puberty, a period during which autonomic nervous system is generally robust, adaptable and able to regulate physiological process efficiently [21]. This resilience in autonomic function may protect against potential disruptions caused by variations in sleep duration, reducing susceptibility to autonomic dysfunction [21].to short-term physiological changes such as sleep deprivation, compared to older individuals. The ability to recover quickly from temporary disruption, may provide a buffer against any adverse effects on metabolic or cardiovascular health, thereby minimizing the impact on BMI, may explain the lack of association between sleep duration and BMI.

There are several limitations with current study that warrant consideration. Firstly, this study utilized a cross-sectional design, which inherently limits the ability to determine causality between sleep duration and BMI. While the study identifies associations, it cannot establish whether changes in sleep duration directly influence BMI or if other confounding factors are at play. To address this limitation, therefore, a longitudinal study is required to examine the relationship between sleep and BMI.

Furthermore, the sample size for this study was relatively small potentially reducing the statistical power to detect

significant associations. Increasing the number of participants with different age and adding additional data or variables related to sleep or BMI may increase the probability of identifying a relationship sleep and BMI.

Other than that, our measure of sleep was relied on a single self-report which are prone to recall bias and has been shown to underestimate sleep duration when compared the time of sleep from wake-up. Furthermore, the study did not account for sleep quality, which is another critical factor influencing overall health and BMI. Variations in sleep quality, such as the presence of sleep disturbances or disorders, may differ among students and could impact the findings.

Lastly, the study did not control for other important variables that could influence the relationship between sleep duration and BMI, such as mental health, stress levels, or hormonal changes. These factors may play a significant role in both sleep patterns and BMI, and their exclusion could lead to residual confounding. Addressing these limitations in future studies would not only strengthen the reliability of the findings but also provide a more nuanced understanding of the complex interplay between sleep and BMI.

The strength of this study lies in the use of the BMI-for-age percentile chart based on gender, which provides a standardized method to evaluate BMI according to global health guidelines. Additionally, the traditional BMI calculation using formula $\text{weight (kg)/height (m}^2\text{)}$ is best-suited for adult population. However, since this study focuses on adolescent aged-13 BMI-for-age percentile, appropriate as they account for age and sex-specific variation. This approach offers a tailored assessment, enabling early detection of potential health concern related to weight which may be influenced by various factors such as growth spurts, hormonal changes, and lifestyle patterns.

In addition, the unique demographic of the study population, Muslim gifted students with high intellectual quotient (IQ) studying at boarding school with a demanding curriculum—adds an important dimension to the research. These characteristics are rarely accounted for in existing studies, making this research particularly insightful in exploring how a structured and academically rigorous environment influences sleep duration and BMI. The findings from this specific population highlight the potential impact of academic pressures and packed schedules on sleep patterns, which could have broader implications for other high-achieving student groups in similar settings. It leads to the future study by determining the quality of sleep and identify the cause of less sleep duration among boarding school students.

Additionally, examining the quality of sleep—beyond just its duration—would provide a more comprehensive understanding of how these students' sleep patterns impact their overall health and academic performance. Such research could ultimately inform the development of targeted interventions to promote healthier sleep habits in boarding school environments and other high-pressure educational settings.

V. CONCLUSION

In conclusion, this study highlights the notable gender differences in sleep duration among first-year Muslim gifted and talented students, with males found to sleep significantly longer than female potentially due to differences in activity involvement and academic pressure. Despite these observed

differences, the insufficient sleep among students residing in a structured boarding school was not associated with their body mass index. The finding suggest that the structured environment and healthy controlled of the boarding school may act as a buffer, mitigating the potential negative effects of insufficient sleep on BMI.

Furthermore, the physiological resilience of adolescents to short-term physiological changes and robust autonomic function may further explain the insignificant relationship between sleep and BMI. This study underscores the importance of the structured and healthy lifestyle fostered by the boarding school environment, which appears to support students' overall health and development despite challenges such as reduced sleep duration. However, the complex interactions between sleep, BMI and overall health remain an area ripe for further exploration. Future studies should employ longitudinal designs, larger sample sizes, and more comprehensive measures, including sleep quality and other influencing factors, to better understand these relationships and their implications for the health and well-being of gifted and talented adolescents.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this paper.

ACKNOWLEDGEMENT

We extend our deepest gratitude to Bahagian PERTAMA and Kolej PERMATA Insan for their invaluable support and guidance throughout this project. Their provision of resources, logistical assistance, and expert advice have been instrumental in the successful completion of this study. We also acknowledge the contributions of the students and staff who participated and facilitated the data collection process. This work would not have been possible without their cooperation and commitment. Thank you for enabling us to pursue and complete this meaningful research.

REFERENCES

- [1] U.S Department of Health and Human Services & National Institutes of Health. (2011). National Center on Sleep Disorders Research
- [2] V. Chattu, M. Manzar, S. Kumary, D. Burman, D. Spence, & S. Pandi Perumal. (2019). The global problem of insufficient sleep and its serious public health implications. *Healthcare*, 7(1), 1. <https://doi.org/10.3390/healthcare7010001>
- [3] Chaput, J. P., Dutil, C., Featherstone, R., Ross, R., Giangregorio, L., Saunders, T. J., Janssen, I., Poitras, V. J., Kho, M. E., Ross-White, A., & Carrier, J. (2020). Sleep duration and health in adults: an overview of systematic reviews. *Applied physiology, nutrition, and metabolism = Physiologie appliquee, nutrition et metabolisme*, 45(10 (Suppl. 2)), S218–S231. <https://doi.org/10.1139/apnm-2020-0034>
- [4] Li, J., Vitiello, M. V., & Gooneratne, N. S. (2018). Sleep in normal aging. *Sleep medicine clinics*, 13(1), 1–11. <https://doi.org/10.1016/j.jsmc.2017.09.001>
- [5] Hirshkowitz, M., Whiton, K., Albert, S. M., Alessi, C., Bruni, O., DonCarlos, L., Hazen, N., Herman, J., Katz, E. S., Kheirandish-Gozal, L., Neubauer, D. N., O'Donnell, A. E., Ohayon, M., Peever, J., Rawding, R., Sachdeva, R. C., Setters, B., Vitiello, M. V., Ware, J. C., & Kheirandish-Gozal, L. (2015). National Sleep Foundation's sleep time duration recommendations: Methodology and results summary. *Sleep Health*, 1, 40–43.

- [6] Lushington K., Reardon A., Agostini A. (2022). Boarding school students sleep better than day-student peers! The positive effects of bedtime routine and restricting technology use at night. *SLEEP Advances*, 3(1).
- [7] Wheaton, A. G., Jones, S. E., Cooper, A. C., & Croft, J. B. (2018). Short sleep duration among middle school and high school students — United States, 2015. *MMWR Morbidity and Mortality Weekly Report*, 67(3), 85–90. <https://doi.org/10.15585/mmwr.mm6703a1>
- [8] Sullivan, Mary-Marie Austin, (2007). The association between sleep and body mass index in college freshmen at Utah state university Undergraduate Honors Capstone Projects. 752. <https://digitalcommons.usu.edu/honors/752>
- [9] Rathod SS, Nagose VB, Annepaka E, Bhuvangiri H, Kanagala A, Kanneganti J. Sleep duration among undergraduate medical and science degree college students: A comparative study. *Natl J Physiol Pharm Pharmacol* 2018;8(4):536-539.
- [10] Kanellopoulou, A., Notara, V., Magriplis, E., Antonogeorgos, G., Rojas-Gil, A. P., Kornilaki, E. N., Lagiou, A., Yannakoulia, M., & Panagiotakos, D. B. (2021). Sleeping patterns and childhood obesity: an epidemiological study in 1,728 children in Greece. *Journal of Clinical Sleep Medicine*, 17(5), 1093–1101. <https://doi.org/10.5664/jcsm.9160>
- [11] Litsfeldt, S., Ward, T. M., Hagell, P., & Garmy, P. (2020). Association between sleep duration, obesity, and school failure among adolescents. *The Journal of School Nursing*, 36(6), 458–463. <https://doi.org/10.1177/1059840520901335>
- [12] Rampal, G. R. L., Sidik, S. M., Rampal, S., Wong, Y. J. D., Chow, P. L., Liew, J. S., & Shum, Y. S. (2007). Prevalence of Overweight among Secondary School Students in Klang District, Selangor. *PubMed*, 13(1), 1–8. <https://pubmed.ncbi.nlm.nih.gov/22692184>
- [13] Jananey Ramachandran (2022) Education ministry to enforce BMI checks on students aged 5 to 9. FMT news
- [14] Kolej PERMATA Insan Mohd, S. M., Kaco, H., Idris, F. M., Ahmad, R., Spawi, M., & Theis, N. A. (2022). Muslim Gifted and Talented Curriculum: a design of framework. *International Journal of Academic Research in Progressive Education and Development*, 11(2). <https://doi.org/10.6007/ijarped/v11-i2/14191>
- [15] Brinkman, J. E., Reddy, V., & Sharma, S. (2023). Physiology of Sleep. In *StatPearls*. StatPearls Publishing.
- [16] Putilov, A. A., Sveshnikov, D. S., Bakaeva, Z. B., Yakunina, E. B., Starshinov, Y. P., Torshin, V. I., Alipov, N. N., Sergeeva, O. V., Trutneva, E. A., Lapkin, M. M., Lopatskaya, Z. N., Budkevich, R. O., Budkevich, E. V., Puchkova, A. N., & Dorokhov, V. B. (2021). Differences between male and female university students in sleepiness, weekday sleep loss, and weekend sleep duration. *Journal of adolescence*, 88, 84–96. <https://doi.org/10.1016/j.adolescence.2021.02.006>
- [17] Putilov, A. A., Sveshnikov, D. S., Bakaeva, Z. B., Yakunina, E. B., Starshinov, Y. P., Torshin, V. I., Alipov, N. N., Sergeeva, O. V., Trutneva, E. A., Lapkin, M. M., Lopatskaya, Z. N., Budkevich, R. O., Budkevich, E. V., Puchkova, A. N., & Dorokhov, V. B. (2021). Differences between male and female university students in sleepiness, weekday sleep loss, and weekend sleep duration. *Journal of adolescence*, 88, 84–96. <https://doi.org/10.1016/j.adolescence.2021.02.006>
- [18] Papatriantafyllou E, Efthymiou D, Zoumbaneas E, Popescu CA, Vassilopoulou E. Sleep Deprivation: Effects on Weight Loss and Weight Loss Maintenance. *Nutrients*. 2022 Apr 8;14(8):1549. doi: 10.3390/nu14081549. PMID: 35458110; PMCID: PMC9031614.
- [19] Gupta P, Srivastava N, Gupta V, Tiwari S, Banerjee M. Association of sleep duration and sleep quality with body mass index among young adults. *J Family Med Prim Care* 2022;11:3251-6.
- [20] Morselli, L. L., Guyon, A., & Spiegel, K. (2012). Sleep and metabolic function. *Pflugers Archiv : European journal of physiology*, 463(1), 139–160. <https://doi.org/10.1007/s00424-011-1053-z>
- [21] Pacheco SR, Miranda AM, Coelho R, Monteiro AC, Braganca G, Loureiro HC. Overweight in youth and sleep quality: is there a link? *Arch Endocrinol Metab*. 2017;61:367–73.