

The Relationship Between Chronotype, Well-Being and Sleep Among College Students

Wahaj A. Khan, Ph.D Hatim Matoonq Badri, Ph.D* Albaraa Milibari, Ph.D* Sarah S. Monshi, Ph.D** Mohamed Osman Elamin, Ph.D*, Hatim A. Natto, Ph.D*** Khalid Haries, Ph.D**** Omar Almurahhem, Ph.D**** Abdullah Alrubaiaan, Ph.D**** Abdulaziz Rayes, Ph.D**** Khalid Alshahrani, Ph.D****

ABSTRACT

There are many factors that can impact people's quality of life such as sleeping patterns, eating habits, and other health behaviours. Current scientific evidence indicates that there is a possible relationship between the aforementioned variables. Additionally, insomnia is a common sleep disorder that can significantly impact an individual's quality of life. Therefore, this study aims to investigate; (i) the relationship between chronotypes and health behaviors among university students in Saudi Arabia; (ii) explore the prevalence of insomnia among university students and its potential impact on their health behaviors. A cross-sectional study design was used. Data was collected from a convenience sample of 325 Umm Al Qura University students via an electronically validated Arabic-language survey distributed from October 2022 to March 2023. Students classified as evening persons reported significantly higher levels of insomnia compared to those classified as intermediate and morning persons ($p < 0.001$). Insomnia was negatively correlated with energy/fatigue, emotional well-being, social functioning, and general health ($p < 0.001$), indicating a broader impact on well-being beyond sleep-related issues. Chronotype was significantly associated with several aspects of well-being ($p < 0.05$), including role limitations due to physical and emotional problems, energy/fatigue, emotional well-being, social functioning, and general health, highlighting the potential impact of an individual's sleep-wake preferences on their overall health and well-being. Factors such as social jetlag, psychological disorders, and lifestyle habits may contribute to the association between chronotype and well-being outcomes. These findings could have important implications for the development of interventions to improve sleep and well-being among university students.

INTRODUCTION

Health behaviors refer to actions that individuals engage in that could lead to either positive or negative health outcomes. Examples of health behaviors include eating healthy food, participating in physical exercise, and avoiding tobacco and alcohol use (1). Adopting healthy behaviors is associated with several demographic, physiological, interpersonal, and environmental factors. Health behaviors are also related to the social context, culture, and friends' practices. Studies have indicated that individuals raised in families that are adopting healthy behaviors increase their likelihood to adhere to a healthy lifestyle. Also, several factors in our built environment promote a healthy lifestyle; neighbourhoods that allow people to walk around safely could contribute to minimizing the risk of a sedentary lifestyle (2-4).

A chronotype is the body's clock that manifests in sleep patterns which in turn influences an individual's daily activities (5). There are mainly three types of chronotypes; morning, intermediate, and evening types.

Morning types are known to wake up and sleep earlier compared to evening types. Additionally, morning types are known to perform better during the morning compared to the evening while the opposite can be said about evening types. Studies have indicated that the chronotype is linked to health behaviors (6). Previous studies have revealed that evening people, individuals who prefer to complete their daily tasks at night, are more likely to have poor eating habits compared to morning people (7). Furthermore, previous studies have also indicated that tobacco use is more prevalent among people with a late chronotype (8).

Insomnia is a sleep disorder characterized by difficulty falling asleep, staying asleep, or waking up too early and not being able to fall back asleep (9, 10). Insomnia can be classified as acute, lasting for a few days or weeks, or chronic, lasting for months or even years (11). It can be caused by a variety of factors, such as stress, anxiety, depression, medical conditions, medications, and environmental factors (12, 13). Insomnia can lead to several problems, such as difficulty concentrating, memory problems, and irritability (14, 15). The impact of insomnia

* Assistant Professor, Department of Environmental and Occupational Health
College of Public Health and Health Informatics
Umm Al-Qura University, Makkah, Saudi Arabia.
E-mail: wakhan@uqu.edu.sa

** Assistant Professor, Department of Health Services Management
College of Public Health and Health Informatics
Umm Al-Qura University, Makkah, Saudi Arabia.

*** Assistant Professor, Department of Epidemiology
College of Public Health and Health Informatics
Umm Al-Qura University, Makkah, Saudi Arabia.

**** Undergraduate Student, Epidemiology Department
College of Public Health and Health Informatics
Umm Al-Qura University Makkah, Saudi Arabia.

on individuals and society is significant, as it can lead to decreased quality of life, impaired work performance, and increased healthcare utilization (16). A previous study on the prevalence of insomnia in Saudi Arabia found that out of 3000 adults, 37.6% had insomnia with a higher prevalence among women compared to men (17).

A few studies have investigated the relationship between chronotypes and several parameters in Saudi Arabia including sleep and wake-up times, BMI, dietary intake, and sleeping habits amongst many others. Al Abdullatif et al. (2023), explored the relationship between chronotype and obesity-related lifestyle behaviors, including dietary intake, physical activity, and sleep patterns, among young females. Among a sample of 387 college female students, the authors reported a significant association between chronotypes and sleep quality and daytime sleepiness. However, they did not find a significant association between chronotype and dietary intake, physical activity, and sleep duration (18). Also, Mirghani et al. (2019), investigated meal timing and chronotype among Saudi medical students. Among a sample of 169 clinical phase medical students, the authors found no significant correlation between meal timing and chronotype (19). Moreover, Al-Hazmi & Noorwali (2022), assessed the relationship between chronotypes and eating behaviours. Among a sample of 599 adults, the authors found a significant association between evening types and their consumption of fried foods, chips, and french fries (20).

Even though much has already been done to explore the relationship between chronotypes and different parameters in Saudi Arabia, some limitations are still present in the current scientific literature regarding chronotype research among the Saudi population in general and specifically chronotype among young population. Therefore, this study aims to add to current knowledge by investigating and measuring the relationship between students' chronotypes, well-being and sleep. We hypothesize that students with late chronotype will report worse health outcomes when compared with intermediate and morning types.

METHOD

Participants: A cross-sectional study was conducted using a convenience sample of undergraduate students from Umm Al-Qura University, Makkah, Saudi Arabia. Students specialized in various health specialties were asked to fill out an electronic survey that was sent via email and/or social media platforms. All participants consented electronically before they started the actual survey. The study was ethically approved by the Institutional Review Board of Umm Al-Qura University (Approval No. HAPO-02-K-012-2022-09-1217).

Materials: Two validated questionnaires were used to collect the required information. The first questionnaire assessed chronotypes (Horne and Ostberg Morningness-eveningness Questionnaire), while the second questionnaire aimed to collect information on general well-being (SF-36 general health questionnaire) (21, 22). Both questionnaires are validated and available in the Arabic language.

Procedure: The distribution of the survey started from October 2022 to March 2023. Microsoft forms was the platform used to collect responses. Participation was voluntary and anonymous.

Statistical analyses: One-Way ANOVA and/or regression analyses were used to investigate the suggested hypothesis. Figures and descriptive data were presented using tables. JASP software, Macintosh version 0.16.4, University of Amsterdam was used for the statistical analysis.

RESULTS

A total of 325 (mean age = 20.68 ± 3.30 years) participants completed the survey of which 144 were males and 181 were females. The SF-36 questionnaire provided information on the following; (i) physical functioning (73.23 ± 26.84); (ii) role limitations due to physical health (62.681 ± 39.833); (iii) role limitations due to emotional problems (41.98 ± 43.27); (iv) energy/fatigue (47.14 ± 20.82); (v) emotional well-being (57.09 ± 20.81); (vi) social functioning (64.46 ± 26.44); (vii) pain (77.35 ± 22.83); (viii) general health (61.85 ± 16.83); and (ix) insomnia (11.55 ± 5.67). In addition to information obtained from the SF-36 questionnaire, participants were asked about their BMI and found the following (33.70 ± 18.73).

Results indicate there was no correlation between insomnia and physical functioning. There was a negative moderate significant correlation between insomnia and energy/fatigue, emotional well-being, social functioning, and general health (all *p* < 0.001). There was a negative weak significant correlation between insomnia and role limitations due to physical health, role limitations due to emotional problems, and pain (all *p* < 0.001) (Table 1).

Table 1. Outcomes from Pearson's correlation between the items from SF-36 and insomnia

SF-36 items	Insomnia (<i>r</i>)	<i>p</i> -value
Physical functioning	-0.075	0.180
Role limitations due to physical health	-0.271	< .001
Role limitations due to emotional problems	-0.291	< .001
Energy/fatigue	-0.397	< .001
Emotional well-being	-0.368	< .001
Social functioning	-0.413	< .001
Pain	-0.271	< .001
General health	-0.309	< .001

With regards to chronotypes, the most prevalent chronotype found was intermediate with 50.46%, followed by evening 25.53% and morning 24%. A one-way ANOVA was performed to evaluate the relationship between chronotype and the following variables; (i) Insomnia; (ii) role limitations due to physical health; (iii) role limitations due to emotional problems; (iv) energy/fatigue; (v) emotional well-being; (vi) social functioning; and (vii) general health. The mean and standard deviations are illustrated in Table 2.

Table 2. Outcomes from the variation between chronotype and study variables via One-Way ANOVA

Variable	Chronotype		
	Evening (<i>M</i> ± <i>SD</i>)	Intermediate (<i>M</i> ± <i>SD</i>)	Morning (<i>M</i> ± <i>SD</i>)
Insomnia	(15.97 ± 5.27)	(10.25 ± 4.81)	(9.53 ± 5.27)
Role limitations due to physical health	(54.51 ± 42.15)	(70.14 ± 37.32)	(55.59 ± 39.91)
Role limitations due to emotional problems	(28.91 ± 39.33)	(43.49 ± 43.11)	(52.81 ± 44.70)
Energy/fatigue	(39.75 ± 22.09)	(46.76 ± 18.78)	(55.76 ± 20.56)
Emotional well-being	(48.33 ± 22.86)	(58.75 ± 18.66)	(62.92 ± 20.13)
Social functioning	(54.51 ± 28.66)	(66.92 ± 24.91)	(69.87 ± 24.54)
General health	(57.10 ± 20.07)	(63.68 ± 15.02)	(63.01 ± 15.88)

The results of the One-Way ANOVA indicate the presence of a relationship between an individual's chronotype and:

- 1- Insomnia was significant at the 0.05 level, $F(2, 322) = 43.47, p < 0.001$. A post hoc Tukey test indicated that the mean of evening type (15.97 ± 5.27) reported significantly higher insomnia ($p < 0.001$) when compared to intermediate (10.25 ± 4.81) and morning (9.53 ± 5.27) (all $p < 0.001$).
- 2- Role limitations due to physical health was significant at the 0.05 level, $F(2, 319) = 5.987, p < 0.05$. A post hoc Tukey test indicated that the mean of evening (54.51 ± 42.15) and morning types (55.59 ± 39.91) were significantly lower than intermediate type (70.14 ± 37.32) (all $p < 0.05$).
- 3- Role limitations due to emotional problems was significant at the 0.05 level, $F(2, 321) = 6.513, p < 0.05$. A post hoc Tukey test indicated that the mean of evening type (28.91 ± 39.22) reported significantly lower scores when compared to morning (52.81 ± 44.70) and intermediate (43.49 ± 43.11) (all $p < 0.05$).
- 4- Energy/fatigue was significant at the 0.05 level, $F(2, 322) = 12.813, p < 0.001$. A post hoc Tukey test indicated that the mean of evening type (39.75 ± 22.09) reported significantly lower scores when compared to morning (55.76 ± 20.56) and intermediate (46.76 ± 18.78) (all $p < 0.001$).
- 5- Emotional well-being significant at the 0.05 level, $F(2, 322) = 11.645, p < 0.001$. A post hoc Tukey test indicated that the mean of evening type (48.33 ± 22.86) reported significantly lower scores when compared to morning (62.92 ± 20.13) and intermediate (58.75 ± 18.66) (all $p < 0.001$).
- 6- Social functioning was significant at the 0.05 level, $F(2, 322) = 8.601, p < 0.001$. A post hoc Tukey test indicated that the mean of evening type (54.51 ± 28.66) reported significantly lower scores when compared to morning (69.87 ± 24.54) and intermediate (66.92 ± 24.91) (all $p < 0.001$).
- 7- General health was significant at the 0.05 level, $F(2, 322) = 4.556, p < 0.05$. A post hoc Tukey test indicated that the mean of evening type (57.1 ± 20.07) reported significantly lower scores when compared to morning (63.01 ± 15.88) and intermediate (63.68 ± 15.02) (all $p < 0.05$).

Also, the results of the One-Way ANOVA indicate the absence of a relationship between an individual's chronotype and:

- 1- Physical functioning was insignificant at the 0.05 level, $F(2, 321) = 0.449, p = 0.63$.
- 2- Pain was insignificant at the 0.05 level, $F(2, 321) = 0.449, p = 0.109$.

DISCUSSION

This study explored the relationship between students' chronotypes, general well-being, and sleep. With regards to insomnia levels (11.55 ± 5.67), the results show kind of similar and/or slightly higher levels compared to other studies. Alshammari et al. (2022), investigated the prevalence of insomnia among university students. The authors found that among a sample of 495 students from different specialities, universities, and regions of Saudi Arabia, insomnia levels were (8.72 ± 4.46) (23). Even though higher insomnia levels did not significantly

impact physical functioning, it did have a significant negative impact on energy/fatigue, emotional well-being, social functioning, general health, role limitations due to physical health, role limitations due to emotional problems, and pain. The results are consistent with the findings revealed by Yilmaz & Kugu (2022), who investigated the prevalence of sleep disorders and their relationship with several variables including the aforementioned ones among Turkish university students. The authors reported that among a sample of 856 students, physical function, role limitation (physical), pain, general health, vitality (energy), social function, role limitation (emotional), and mental health were significantly lower for those with insomnia (24)

With regards to students' chronotypes, the results showed that the most prevalent chronotype among students was intermediate at 50%, followed by evening 26%, and morning at 24%. BaHamam et al. (2011), found similar results when assessing the distribution of chronotypes in college-aged Saudis. The authors found that among a sample of 769 students, the morning type was 18%, the intermediate 55%, and the evening was 27% (25). Also, Tan et al. (2020), found similar results when assessing the distribution of chronotypes in Turkish pre-clinical medical students. The authors found that among a sample of 564 students, the morning type was 6.7%, the intermediate 67%, and the evening was 27% (26).

The results show that more than 70% of our sample is classified as morning and intermediate types. It has been previously reported that morning and intermediate types tend to score higher in almost all aspects related to the quality of life (26, 27). As for those classified as evening types, a plethora of studies have indicated that they tend to score less in almost all aspects related to the quality of life. Ota, Tan, Ishii, & Shiotani (2022), investigated the effects of chronotypes on university nursing students. The authors reported that 80% of nursing students classified as evening types scored less in sleep-related parameters such as bedtime, sleep latency, wake-up time, sleep duration, and social jetlag (28). Another study, which was conducted on 450 medical students, reported similar results (29). Also, Tan et al. (2020), investigated the relationship between Turkish pre-clinical medical students' chronotypes and happiness. The authors found that students classified as evening types showed were less happy compared to the other types (26). Moreover, current scientific evidence indicates that the evening type is independently associated with obesity development (18).

In general, current evidence suggests that those classified as evening types usually report worse health outcomes compared to morning and intermediate types. This could be attributed to many factors including social jetlag, which occurs when individuals attempt to adapt their biological clock to societal norms that are against their natural sleep-wake cycle. Eventually, this can result in sleep deprivation and fatigue and decreased overall health and well-being (30). Additionally, evening types are at a higher risk of developing mental health disorders such as depression and anxiety which can significantly affect their quality of life (31). Moreover, lifestyle factors, such as diet and exercise habits, may also serve as a contributing factor to the correlation between evening types and worse health outcomes. For instance, evening types tend to be more likely to consume caffeine and alcohol and hence, experience sleep disturbances (32).

Although this study highlights the relationship between chronotypes, well-being, and sleep in Saudi Arabia, and contributes to the field of public health in understanding to improve the overall health for the community, it has a number of limitations including ; (i) causality cannot be detected using cross-sectional studies; (ii) sample size was enough to conduct statistical analysis, however, larger samples are always preferred in such designs; (iii) as college students were only

included in the study, the mean age of the sample was younger than other international reports; and (iv) sample was taken from one region from Saudi Arabia (Western region).

CONCLUSION

In conclusion, the current study investigated the relationship between chronotypes, well-being, and sleep in Saudi Arabia. The results indicated that individuals with insomnia had negative significant correlations with energy/fatigue, emotional well-being, social functioning, and general health, suggesting that insomnia may have a broader impact on an individual's well-being beyond just sleep-related issues. Also, an individual's chronotype was found to be significantly associated with role limitations due to physical health, role limitations due to emotional problems, energy/fatigue, emotional well-being, social functioning, and general health, highlighting the potential impact of an individual's sleep-wake preferences on their overall health and well-being. This study highlights a significant issue that requires further attention. Therefore, more detailed research is required to investigate the underlying mechanisms that link chronotype to insomnia and its impact on physical and mental health. Longitudinal studies could investigate the potential bidirectional relationship between chronotype and insomnia, as well as its influence on overall health and well-being. Also, future studies could investigate the potential benefits of chronotype-based interventions for individuals with insomnia or other sleep disorders. These interventions could be tailored to an individual's chronotype and may include sleep hygiene education, light therapy, or behavioral therapies such as cognitive-behavioral therapy for insomnia (CBT-I).

Authorship Contribution: All authors share equal effort contribution towards (1) substantial contributions to conception and design, acquisition, analysis and interpretation of data; (2) drafting the article and revising it critically for important intellectual content; and (3) final approval of the manuscript version to be published. Yes.

Acknowledgment: We would like to thank Lama Khalid Albishri and Lodaina Mohammed Bafaraj, who are students in department of Health Information Technology and Management, Faculty of Public Health and Health Informatics, Umm Al-Qura University, for helping us collect the study sample.

Potential Conflicts of Interest: None

Competing Interest: None

Acceptance Date: 07-12-2023

REFERENCES

- Hayden J. Introduction to health behavior theory: Jones & Bartlett Learning; 2022.
- Marconcin P, Ihle A, Werneck AO, Gouveia ER, Ferrari G, Peralta M, et al. The Association of Healthy Lifestyle Behaviors with Overweight and Obesity among Older Adults from 21 Countries. *Nutrients*. 2021;13(2).
- De Groot JI. Environmental psychology: An introduction. 2019.
- Subramaniam M, Devi F, AshaRani P, Zhang Y, Wang P, Jeyagurunathan A, et al. Barriers and facilitators for adopting a healthy lifestyle in a multi-ethnic population: A qualitative study. *Plos one*. 2022;17(11):e0277106.
- Makarem N, Paul J, Giardina E-GV, Liao M, Aggarwal B. Evening chronotype is associated with poor cardiovascular health and adverse health behaviors in a diverse population of women. *Chronobiology international*. 2020;37(5):673-85.
- Vitale JA, Weydahl A. Chronotype, Physical Activity, and Sport Performance: A Systematic Review. *Sports Med*. 2017;47(9):1859-68.
- Ekiz Erim S, Sert H. The relationship between chronotype and obesity: A systematic review. *Chronobiol Int*. 2023:1-13.
- Patterson F, Malone SK, Lozano A, Grandner MA, Hanlon AL. Smoking, Screen-Based Sedentary Behavior, and Diet Associated with Habitual Sleep Duration and Chronotype: Data from the UK Biobank. *Ann Behav Med*. 2016;50(5):715-26.
- Riemann D, Benz F, Dressler RJ, Espie CA, Johann AF, Blanken TF, et al. Insomnia disorder: State of the science and challenges for the future. *Journal of Sleep Research*. 2022;31(4):e13604.
- Bonnet MH, Arand DL. Risk factors, comorbidities, and consequences of insomnia in adults. UpToDate, Waltham, MA. 2021.
- Vargas I, Nguyen AM, Muench A, Bastien CH, Ellis JG, Perlis ML. Acute and chronic insomnia: what has time and/or hyperarousal got to do with it? *Brain Sciences*. 2020;10(2):71.
- Medicine AAoS. International classification of sleep disorders—third edition (ICSD-3). *AASM Resour Libr*. 2014;281:2313.
- Bjørøy I, Jørgensen VA, Pallesen S, Bjorvatn B. The prevalence of insomnia subtypes in relation to demographic characteristics, anxiety, depression, alcohol consumption and use of hypnotics. *Frontiers in psychology*. 2020;11:527.
- Brownlow JA, Miller KE, Gehrman PR. Insomnia and cognitive performance. *Sleep medicine clinics*. 2020;15(1):71-6.
- Zhao K, Zhang J, Wu Z, Shen X, Tong S, Li S. The relationship between insomnia symptoms and school performance among 4966 adolescents in Shanghai, China. *Sleep Health*. 2019;5(3):273-9.
- Morin CM, Benca R. Chronic insomnia. *Lancet*. 2012;379(9821):1129-41.
- Ahmed AE, Al-Jahdali H, Fatani A, Al-Rouqi K, Al-Jahdali F, Al-Harbi A, et al. The effects of age and gender on the prevalence of insomnia in a sample of the Saudi population. *Ethn Health*. 2017;22(3):285-94.
- Al Abdullatif RA, Alkahtani S, Finlayson G, Alhussain MH. Chronotypes and their Association with Obesity-Related Lifestyle Behaviors among Young Female Adults. *Int J Environ Res Public Health*. 2023;20(2).
- Mirghani HO, Albalawi KS, Alali OY, Albalawi WM, Albalawi KM, Aljohani TR, et al. Breakfast skipping, late dinner intake and chronotype (eveningness-morningness) among medical students in Tabuk City, Saudi Arabia. *The Pan African Medical Journal*. 2019;34.
- Al-Hazmi MH, Noorwali EA. Morning individuals in Saudi Arabia have higher self-regulation of eating behavior compared to evening types. *Chronobiology International*. 2022:1-11.
- Horne JA, Ostberg O. A self-assessment questionnaire to determine morningness-eveningness in human circadian rhythms. *International journal of chronobiology*. 1976;4(2):97-110.
- Sheikh KA, Yagoub U, Elsatouhy M, Al Sanosi R, Mohamad SA. Reliability and Validity of the Arabic Version of the SF-36 Health Survey Questionnaire in Population of Khat Chewers—Jazan Region—Kingdom of Saudi Arabia. *Applied Research in Quality of Life*. 2015;10(1):1-13.
- Alshammari TK, Rogowska AM, Basharahil RF, Alomar SF, Alseraye SS, Al Juffali LA, et al. Examining bedtime procrastination, study engagement, and studyholism in undergraduate students, and their association with insomnia. *Front Psychol*. 2022;13:1111038.

24. Yilmaz Y, Kugu N. The prevalence of insomnia in university students and its relationship with quality of life: A university sample. 2022.
25. BaHammam AS, Almistehi W, Albatli A, AlShaya S. Distribution of chronotypes in a large sample of young adult Saudis. *Ann Saudi Med.* 2011;31(2):183-6.
26. Tan MN, Mevsim V, Pozlu Cifci M, Sayan H, Ercan AE, Ergin OF, et al. Who is happier among preclinical medical students: the impact of chronotype preference. *Chronobiology International.* 2020;37(8):1163-72.
27. Rique GLN, Fernandes Filho GMC, Ferreira ADC, de Sousa-Munoz RL. Relationship between chronotype and quality of sleep in medical students at the Federal University of Paraiba, Brazil. *Sleep Science.* 2014;7(2):96-102.
28. Ota T, Tan C, Ishii A, Shiotani H. Do differences in chronotypes affect sleep and health-related quality of life of nursing students? A cross-sectional study. *Chronobiology International.* 2022;39(11):1435-43.
29. Choi HJ, Lee YJ, Yoo YJ, Cho YW, Moon H-J. The effects of chronotype and social jetlag on medical students. *Sleep and Biological Rhythms.* 2019;17:269-76.
30. Taillard J, Sagaspe P, Philip P, Bioulac S. Sleep timing, chronotype and social jetlag: Impact on cognitive abilities and psychiatric disorders. *Biochemical pharmacology.* 2021;191:114438.
31. Khan WAA, Conduit R, Kennedy GA, Jackson ML. The relationship between shift-work, sleep, and mental health among paramedics in Australia. *Sleep Health.* 2020;6(3):330-7.
32. Roenneberg T, Mellow M. The Circadian Clock and Human Health. *Curr Biol.* 2016;26(10):R432-43.