CHRONOTYPE, SLEEP, AND SOCIAL JETLAG IN BULGARIAN FEMALE SPORT STUDENTS

Mariya Zaharinova, Nikolay Zaekov & Milena Nikolova
National Sports Academy "Vassil Levski", Sofia, Bulgaria

ORCID
Mariya Zaharinova
https://orcid.org/0000-0002-6480-7212
Nikolay Zaekov
https://orcid.org/0009-0005-2624-3654
Milena Nikolova
https://orcid.org/0009-0005-3666-6482
Cite this article as:
Zaharinova, M., Zaekov, N., Nikolova, M. (2025). Chronotype, sleep, and social jetlag in bulgarian female sport students. *Proceeding book of the 4th International Scientific Congress "Applied Sports Sciences", 2025, Sofia.* pp. 349 - 353.
https://doi.org/10.37393/ICASS2025/55

ABSTRACT
Introduction: Recent studies showed the crucial role of chronotype, sleep, and circadian misalignment for athletes' performance and health. Exercise training outside of circadian preferences could be at the cost of performance. The objective of the paper was to establish the relationship between chronotype, sleep quality, and social jetlag in Bulgarian female sport students.
Methodology: A total of 25 female university students were surveyed using the Morningness-Eveningness questionnaire, Pittsburgh Sleep Quality Index, and a self-report questionnaire to determine social jetlag.
Results: The mean total sleep duration of our sample was 7 hours and 7 minutes. Chronotype identification was categorized into three groups: morning type (n = 3), intermediate type (n = 14), and evening type (n = 8). Regarding sleep quality, we obtained three groups: good sleepers (n = 6), difficult sleepers (n = 15), and bad sleepers (n = 4). The students who have social jetlag more than an hour per week were 20%. The ANOVA test revealed an association between social jetlag and chronotype (p = .03) and between social jetlag and sleep scores (p = .04).
Discussion: The data suggest a higher proportion of late chronotypes in our sample. A total of 76% of the students have poor sleep quality, while 72% of them experienced social jetlag. These findings are age-related and common in Western societies.
Conclusions: Eveningness in the sample was associated with poor sleep quality and higher levels of social jetlag. Furthermore, disturbed sleep was associated with higher social jetlag. We believe that circadian preferences should always be taken into account when sleep quality is considered and training schedules are arranged.

Keywords*: circadian typology, circadian misalignment*

INTRODUCTION

Recent studies have highlighted the key role of chronotype, sleep, and circadian misalignment for athletes' performance and overall health. This relationship is particularly important for physically active students, as they often engage in intensive training at various times throughout the day (McGinnis et al., 2022). The body's inner sleep-wake cycle is normally synchronized with both the solar and social clocks. Disruptions in this synchronization can lead to sleep problems (Martin et al., 2012), impaired performance, and an increased risk of musculoskeletal injury (McGinnis et al., 2022). Variations in individuals' biological clocks result in different preferences for sleep and activity timing – referred to as chronotypes (Adan et al., 2012). Chronotype is commonly assessed using standardized questionnaires and classified into three chronotype groups: morning (MT), intermediate (IT), and evening types (ET) (Montaruli et al., 2017). These chronotypes differ in sleep–wake cycle and mental or physical performance, including attention, memory, and executive functioning (Alshana & Khan, 2022). Research has shown that ETs are more likely to experience poor sleep quality and reduced sleep duration, which increases their vulnerability to circadian disruption (Shibata et al, 2024). This is especially pronounced in young individuals, who are more susceptible to circadian misalignment such as social jetlag (SJL) – a mismatch between biological and social time (Roenneberg et al., 2019). SJL typically occurs when individuals adjust their sleep patterns between school/work days and free days, often resulting in chronic sleep loss (Aumiller, 2021). This misalignment may negatively impact performance and health, leading to symptoms such as excessive daytime sleepiness and fatigue (Facer-Childs et al., 2019).

Despite the growing interest in circadian biology and athletic performance, studies examining the relationship between chronotype, sleep, and SJL in female sport students remain limited. Therefore, this study aims to establish the relationship between chronotype, sleep quality, and social jetlag in Bulgarian female sport students.

METHODOLOGY

Participants

This study was conducted with 25 healthy female university students aged between 19 and 22 years. Individuals were recruited through an announcement posted in several locations on the university campus. Appointments were scheduled for volunteers in the laboratory of the Department of Physiology and Biochemistry at the National Sports Academy, Sofia, Bulgaria. Participants from various sports disciplines were screened for eligibility. Participants were fully informed about the nature of the study. They gave their voluntary consent, which was obtained in line with ethical principles. Exclusion criteria included incomplete questionnaire responses, shift work, and continuous use of sleep medication.

Measures

Participants who met the inclusion requirements completed three instruments:

1. Morningness-Eveningness Questionnaire (MEQ): The MEQ, developed by Horne and Ostberg (1976), was used to determine individuals' chronotype. It includes 19 items, each with four or five answers scored from one to five points. Total scores range from 16 (definite evening type) to 86 (definite morning type). Individuals scoring 58 or above were classified as morning types, those scoring 41 or below as evening type (ET), and those scoring between 42 and 57 as intermediate types (IT).
2. Pittsburgh Sleep Quality Index (PSQI): The PSQI, developed by Buysse et al. (1989), was used to determine sleep quality. It consists of seven subscales: subjective sleep quality (SQ), sleep efficiency (SE), sleep duration (SDr), sleep latency (SL), sleep disturbance (SDst), use of sleep medication (SM), and daytime dysfunction (DD). Each component is evaluated on a scale of 0 to 3 points, and the total global score ranges from 0 to 21. An overall total score of 5 points indicates poor sleep quality.
3. Self-report questionnaire to determine social jetlag: A self-report questionnaire assessed the difference in sleep timing between free days and work days. Based on the results, participants were divided into three groups: low SJL (≤ 1 hour), moderate SJL (1 – 2 hours), and high SJL (≥ 2 hours).

Statistical analysis

All statistical analyses were executed using IBM® SPSS® Statistics for Windows, Version 19.0. Descriptive statistics were performed using the MeanStandard deviation. One-way analysis of variance (ANOVA) was used to evaluate the difference between groups. Statistical significance was set at $p \le .05$. The effect size was measured with eta squared (η^2). Only statistically significant results ($p \le .05$) are reported.

RESULTS

The final sample consisted of 25 healthy female university students, all in their second year of study, with a mean age of 20.0 ± 0.7 years and an average weekly training activity of 320.0 ± 160.2 minutes. All sociodemographic characteristics of the students are summarized in Table 1.

Table 1. *Sociodemographic Characteristics of the Sample (N = 25).*

Characteristics	*Mean ± SD*
Age (years)	20.0 ± 0.7
Education level	Second-year students
Training (min/week)	320.0 ± 160.2
Weight (kg)	58.0 ± 7.5
Height (cm)	167.0 ± 4.9
Body mass index (BMI; kg/m²)	20.9 ± 2.3
Chronotype scores	47.6 ± 10.3
Pittsburgh sleep quality scores	6.4 ± 2.3
Social jetlag (min/week)	63.6 ± 31.6

Data are presented as mean ± standard deviation (SD).

Chronotype and Sleep Quality

The mean chronotype scores, as measured by MEQ, were 47.6 ± 10.3, indicating an intermediate chronotype for the sample as a whole. Chronotype distribution was as follows: morning type (n = 3), intermediate type (n = 14), and evening type (n = 8). No individuals were classified as definite morning or evening types.

The mean global score on the PSQI was 6.4 ± 2.3, indicating overall poor sleep quality in the sample. Sleep quality was categorized as follows: good sleepers (n = 6), difficult sleepers (n = 15), and bad sleepers (n = 4). In total, 76% of the participants were classified as having difficult or bad sleep. Poorer sleep quality was associated with lower MEQ scores (eveningness tendency) and significantly higher PSQI scores, indicating a strong link between chronotype and sleep quality. The results are summarized in Table 2.

Table 2. *Comparison of Sleep Quality (SQ) Groups by MEQ and PSQI Scores*

SQ Group	*n*	MEQ Score ± *SD*	PSQI Score ± *SD*
Good sleepers	6	51.2 ± 14.7	3.6 ± 1.5
Problem sleepers	15	47.1 ± 9.7	6.4 ± .63
Bad sleepers	4	44.2 ± 2.7 *p* = .05	10.3 ± 1.9 *p* < .0
Total	25	47.6 ± 10.3	6.4 ± 2.3

Data are presented as mean ± standard deviation (SD). Superscript a (a) indicates statistical significance at p ≤ .05.

Social Jetlag, Chronotype, and Sleep Quality

The mean weekly SJL across the sample was 63.6 ± 31.6 minutes. Based on reported differences between weekday and weekend sleep schedules, participants were divided into three SJL groups: low SJL (n = 7), moderate SJL (n = 13), and high SJL (n = 5).

Nearly three-quarters of all female students (72%) experienced moderate or high SJL.

A one-way ANOVA showed a significant association between the SJL group and MEQ scores, $F(2.22) = 4.39$; $p = .02$, as well as between the SJL group and PSQI scores, $F(2.22) = 3.8$; $p = .04$. Games-Howell post hoc analyses indicated that subjects with lower MEQ scores (evening types) and higher PSQI scores (bad sleepers) were more likely to belong to the high SJL (see Table 3).

Table 3. *Comparison of Social Jetlag Groups by MEQ and PSQI Scores*

SJL Group	*n*	MEQ Score ± *SD*	PSQI Score ± *SD*
Low	7	52.8 ± 9.4	5.3 ± 1.4
Moderate	13	48.8 ± 9.4	6.1 ± 2.0
High	5	37.4 ± 7.7 *p* = 0.02	8.6 ± 3.0 *p* = 0.0
Total	25	47.6 ± 10.3	6.4 ± 2.3

Data are presented as mean ± standard deviation (SD). Superscript a (a) indicates statistical significance at p ≤ .05
PSQI Subcomponents by SJL Group

To explore which aspects of sleep were most affected by social jetlag, PSQI subscale scores were analyzed across the three SJL groups. Statistically significant differences were found in the following subscales: subjective sleep efficiency (SE): $p < .01$, sleep duration (*SD*): $p < .01$, sleep latency (SL): $p = .03$, use of sleep medication (SM): $p = .02$, and total subgroups score $p < .01$). No significant differences were observed for subjective sleep quality and daytime dysfunction ($p > .05$), although all subjects reported experiencing daytime dysfunction (DD) at least once per week, and the entire sample rated their subjective sleep quality (SQ) as poor (see Table 3).

Table 4. *Pittsburgh Sleep Quality Subgroups by SJL*

Subgroups	SJL-Low	SJL-Moderate	SJL-High	*p*-value
SQ	0.7 ± 0.8	0.9 ± 0.6	1.2 ± 0.5	p > .05
SE	0.0 ± 0.0	0.8 ± 0.7	2.0 ± 0.1	p < .001[a]
SD	0.2 ± 0.4	0.9 ± 0.4	1.4 ± 0.6	p < .01[a]
SL	0.1 ± 0.4	1.2 ± 0.9	1.2 ± 0.8	p = .03[a]
SM	0.0 ± 0.0	0.8 ± 0.8	1.2 ± 0.8	p = .02[a]
DD	1.4 ± 0.8	1.3 ± 0.7	1.4 ± 0.5	p > .05
TOTAL	2.4 ± 1.1	6.1 ± 0.3	8.4 ± 0.9	p < .01[a]

Data are presented as mean ± standard deviation (SD). Superscript a (a) indicates statistical significance at p ≤ .05.

DISCUSSION

This study is among the first to examine the relationship between sleep quality, chronotype and social jetlag in Bulgarian female sport students. The results provide preliminary insight into the sleep-wake patterns of this population and the potential consequences of circadian misalignment.

The distribution of chronotype in our sample showed a predominance of intermediate types (56%), followed by evening types (32%) and a minority of morning types (12%). There are no definitive morning or evening types of individuals. These results are consistent with previous research indicating a tendency toward delayed sleep phase in young adult females, especially in their early 20s (Shibata et al., 2024). Silva and Paiva (2019) also reported that evening-type university students tend to experience poorer sleep quality and higher levels of anxiety compared to their morning-type peers. This delayed chronotype often leads to a mismatch between individuals' biological rhythms and societal schedules, particularly early class or training start times. This misalignment manifests as a social jetlag (SJL), characterized by differing sleep patterns on weekdays and weekends. In our sample, the mean SJL was 63.6 minutes per week (1 hour and 3 minutes), with 72% of students experiencing SJL ≥ 1 h. Notably, 20% had a SJL of 2 hours or more, along with lower MEQ scores and higher PSQI scores, suggesting a later chronotype and poor sleep quality. These findings are comparable to prior studies, which report a high prevalence of SJL in young adult populations. For example, Komada et al. (2019) found that 78% of female university students experienced SJL for at least 1 hour, a result echoed by Shibata et al. (2024), who reported a prevalence of 76.5%. That proportion is bigger than the 69% reported in a European population (Roenneberg et al., 2012).

Our data also revealed a significant association between SJL and several sleep components. Participants with high SJL showed reduced sleep efficiency ($p < .01$), shorter sleep duration ($p < .01$), increased sleep latency ($p = .03$), higher use of sleep medication ($p = .02$), and elevated overall PSQI scores ($p < .01$). These findings align with prior evidence that social jetlag contributes to sleep disturbances and circadian misalignment (Roenneberg et al., 2012; Morgenthaler et al., 2016). Contributing factors may include academic demands, shared living environments (Rankov, 2020), climate change, excessive use of tablets and smartphones (Zhang et al., 2019), and institutional scheduling norms. In Bulgaria, for instance, most public schools and universities begin at 8:00 a.m. or earlier, which forces many students – especially those with evening types – to operate during their biological night (Arbinaga et al., 2019).

This desynchronization has broader implications. Chronic SJL has been associated with lower academic performance (Haraszti et al., 2014), increased fatigue, a low level of physical activity, and an elevated risk of injury (Shibata et al., 2024; McGinnis et al., 2022). Delaying school start times has been proposed as an effective strategy to improve sleep outcomes and well-being among students (Morgenthaler et al., 2016).

Contributions

This study provides preliminary data on the relationship between chronotype, social jetlag, and sleep quality among Bulgarian female sport students—a previously understudied population. It confirms the high prevalence of social jetlag and its negative associations with multiple aspects of sleep. The findings highlight the potential impact of early institutional schedules on circadian misalignment and support calls for delayed start times. While our findings contribute valuable data, they should be interpreted cautiously due to several limitations:

1. Small sample size ($n = 25$), which limits statistical power and generalizability;
2. Lack of male participants, preventing gender comparisons;
3. The menstrual cycle phase was not controlled.

Further studies should include larger, more diverse samples and consider biological factors such as hormonal fluctuations across the menstrual cycle.

CONCLUSIONS

Female sports students with evening chronotype demonstrated poorer sleep quality and experienced higher levels of social jetlag compared to their morning and intermediate type peers. These outcomes likely result from the interaction of social obligations (e.g., early classes, training sessions) and biological predispositions toward late sleep timing.

Social jetlag appears to significantly impact young women's health, academic performance, and potentially, athletic outcomes. As such, reducing SJL should be considered a priority in both chronobiology and public health interventions.

The present study also underscores the utility of non-invasive, cost-effective self-report tools such as the MEQ, PSQI, and SJL questionnaires for assessing circadian typology and sleep patterns in athletic and academic populations.

ACKNOWLEDGEMENTS

The authors would like to express their sincere gratitude to all respondents for their time and willingness to contribute to this study.

REFERENCES

Adan, A., Archer, S. N., Hidalgo, M. P., Di Milia, L., Natale, V. & Randler, C. (2012). Circadian typology: A comprehensive review. *Chronobiology International, 29*(9), 1153– 1175. https://www.tandfonline.com/doi/full/10.3109/07420528.2012.719971

Alshana, O., & Khan, M. H. (2022). Impacts of chronotype on personality, stress-anxiety, and physical activity in a university teaching staff. *Journal of Global Scientific Research, 7*(1): 2011-2018.

Arbinaga, F., Fernández-Cuenca, S., Fernández-Ozcorta, E., Toscano-Hermoso, M. D., & Joaquin-Mingorance, M. (2019). Level of physical activity and sleep characteristics in university students. *Sleep Science, 12*(4), 265-71. https://pmc.ncbi.nlm.nih.gov/articles/PMC7159078/

Aumiller, K. (2021). *The effect of social jetlag and chronotype on Healthy Eating Index (HEI) score, energy intake and body composition in non-shift workers aged 19-65: A NHANES 2017-2018 cross-sectional study* [Doctoral dissertation, Oregon Health and Science University], OHSU Digital Collections.
https://digitalcollections.ohsu.edu/record/9289?v=pdf

Buysse, D. J., Reynolds, C. F. 3rd, Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh Sleep Quality Index: A new instrument for psychiatric practice and research. *Psychiatry Research, 28*(2), 193-213.
https://doi.org/10.1016/0165-1781(89)90047-4

Facer-Childs, E. R., Campos, B. M., Middleton, B., Skene, D. J., & Bagshaw, A. P. (2019). Circadian phenotype impacts the brain's resting-state functional connectivity, attentional performance, and sleepiness, *Sleep, 42*(5), zsz033.
https://doi.org/10.1093/sleep/zsz033

Haraszti, R. A., Ella, K., Gyongyosi, N., Roenneberg, T., & Kaldi, K. (2014). Social jetlag negatively correlates with academic performance in undergraduates. *Chronobiology International, 31*(5), 603-612.
https://pubmed.ncbi.nlm.nih.gov/24491157/

Horne, J.A., & Ostberg, O. (1976). A self-assessment questionnaire to determine morningness-eveningness in human circadian rhythms. *International Journal of Chronobiology, 4*(2), 97-110.
https://pubmed.ncbi.nlm.nih.gov/1027738/

Komada, Y., Ikeda, Y., Sato, M., Kam, A., Masuda, C., & Shibata, S. (2019). Social jetlag and menstrual symptoms among female university students, *Chronobiology International, 36*(2), 258-264.
https://doi.org/10.1080/07420528.2018.1533561

Martin, J. S., Hebert, M., Ledoux, E., Gaudreault, M., & Laberge, L. (2012). Relationship of chronotype to sleep, light exposure, and work-related fatigue in student workers. *Chronobiology International, 29*(3), 295-304.
https://doi.org/10.3109/07420528.2011.653656

McGinnis, G. R., Thompson, S. T., Aguilar, C. D., Dial, M. B., Tandy, R. D., & Radzak, K. N. (2022). Chronotype and social jetlag influence performance and injury during reserve officers' training corps physical training. *International Journal of Environmental Research and Public Health, 19*(20), 13644.
https://doi.org/10.3390/ijerph192013644

Montaruli, A., Galasso, L., Caumo, A., Ce, E., Pesenti, C., Roveda, E., & Esposito, F. (2017). The circadian typology: the role of physical activity and melatonin. *Sport Sciences for Health, 13*, 469-76.
https://doi.org/10.1007/s11332-017-0389-y

Morgenthaler, T. I., Hashmi, S., Croft, J. B., Dort, L., Heald, J. L., & Mullington, J. (2016). High school start times and the impact on high school students: what we know, and what we hope to learn. *Journal of Clinical Sleep Medicine,12*(12), 1681-1689. https://doi.org/10.5664/jcsm.6358

Rankov, K. (2020). Sleep hygiene in sport. *Oxidation Communications, 43*(4), 870 – 886.
https://research.ebsco.com/linkprocessor/plink?id=bdc33bb9-f2a3-32cb-9a2a-51b9559c0719 (access date 01 July 2025).

Roenneberg, T., Allebrandt, K. V., Merrow, M., & Vetter, C. (2012). Social jetlag and obesity. *Current Biology, 22*(10), 939-943.
https://doi.org/10.1016/j.cub.2012.03.038

Roenneberg, T., Pilz, L. K., Zerbini, G., & Winnebeck, E. C. (2019). Chronotype and social jetlag: A (self-) critical review. *Biology, 8*(3), 54.
https://www.mdpi.com/2079-7737/8/3/54

Shibata, M., Fujibayashi, M., Shibata, S., Kuzuhara, K., & Tanida, K. (2024). Association between social jetlag and objective physical activity among female university students of Japan: A cross-sectional study. *Sleep Science, 17*(2), e151–e156.
https://doi.org/10.1055/s-0043-1777777

Silva, M. R. G., & Paiva, T. (2019). Risk factors for precompetitive sleep behavior in elite female athletes. *Journal of Sports Medicine and Physical Fitness, 59*(4), 708-16.
https://pubmed.ncbi.nlm.nih.gov/29877674/

Zhang, Z., Cajochen, C., & Khatami, R. (2019). Social jetlag and chronotype in the Chinese population: Analysis of data recorded by wearable devices. *Journal of Medical Internet Research, 21*(6), e13482. https://www.jmir.org/2019/6/e13482

Corresponding author:
Mariya Zaharinova, PhD
National Sports Academy "Vassil Levski",
21, Acad. Stefan Mladenov str.
Sofia, Bulgaria
E-mail: mariazaharinova@nsa.bg

IV International Scientific Congress "Applied Sports Sciences"

PROCEEDING BOOK

Peer-Review Statement
All full-text papers included in this conference proceedings volume have undergone a rigorous peer-review process. Each submission was evaluated by at least two independent reviewers with academic expertise relevant to the topic of the paper. Reviews were conducted in accordance with established scholarly standards, ensuring the quality, validity, and originality of the published contributions. Only papers that met the required scientific and ethical criteria were accepted for publication.

Publication Ethics and Malpractice Statement
The editors of this conference proceedings volume are committed to upholding the highest standards of publication ethics, following the principles outlined by the Committee on Publication Ethics (COPE).

By submitting their manuscripts, all authors confirm that:

- their work is original and has not been previously published or submitted elsewhere;
- the research presented is conducted in accordance with accepted ethical standards;
- all sources used are properly cited;
- there is no plagiarism, data fabrication, or falsification;
- all authors have contributed substantially to the manuscript and approve its final version;
- any conflicts of interest have been disclosed.

The editors maintain responsibility for the integrity of the publication process, ensuring fair and unbiased review, confidentiality of submissions, and immediate action in cases of suspected misconduct. Any breaches of ethical standards will lead to correction, retraction, or other appropriate measures.

21–22 November 2025

Sofia, Bulgaria

IV International Scientific Congress “Applied Sports Sciences”

21–22 November 2025
Sofia, Bulgaria

PROCEEDING BOOK

EDITORS OF THE PROCEEDING BOOK:

Prof. Ognyan Miladinov, DSc
Assoc. Prof. Milena Kuleva, PhD
Assoc. Prof. Stefka Djobova, PhD

Design: Slavka Asenova, Svetla Kostova
Publisher: Scientific Publishing House NSA Press
ISBN (Online): 978-954-718-803-7