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The Relationship Between Chronotype and Social Jetlag in Adolescents: Are Premenstrual Symptoms a Mediator?

Adölesanlarda Kronotip ve Sosyal Jetlag Arasındaki İlişki: Premenstrüel Semptomlar Bir Aracı mıdır?

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ABSTRACT

Objective: Chronotype and social jetlag are related in adolescents. Specifically, an evening chronotype can extend the duration of social jetlag, posing a threat to adolescent health. Identifying the factors mediating this relationship is important for managing negative outcomes. However, there is limited information in the literature on this topic, and the role of premenstrual symptoms in this relationship has not yet been fully explored. This study aims to examine the mediating role of premenstrual symptoms in the effect of chronotype on social jetlag in adolescents.

Method: The sample of this descriptive and correlational study included 309 adolescents (n=309). Data were collected using the Personal Information Form, Premenstrual Syndrome Scale, and Morningness-Eveningness Scale for Children.

Results: As chronotype scores increased, social jetlag duration (β: -0.457; p<0.001) and premenstrual syndrome score (β: -0.342; p<0.001) decreased, while an increase in premenstrual syndrome score had no effect on social jetlag (β: 0.096; p>0.05). When the mediation effect was analysed, premenstrual symptoms did not mediate the interaction between chronotype and social jetlag (95% CI [-0.073; 0.006]; p>0.05).

Conclusion: Chronotype affects social jetlag and premenstrual symptoms, while premenstrual symptoms have no effect on social jetlag. Also, premenstrual symptoms do not mediate the relationship between chronotype and social jetlag. To effectively answer the question, "Are premenstrual symptoms a mediator?", it is recommended to plan similar studies in different regions, taking into account diverse cultural and sociodemographic characteristics and mental/cultural/governmental policies.

Keywords: Adolescence, chronotype, premenstrual symptoms, social jetlag

ÖZ

Amaç: Adölesanlarda kronotip ve sosyal jetlag birbiri ile ilişkilidir. Özellikle akşamcıl kronotip sosyal jetlag süresini uzatarak adölesan sağlığı açısından tehdit oluşturabilmektedir. Bu ilişkiye aracılık eden faktörlerin belirlenmesi olumsuz sonuçların yönetilmesi açısından önemlidir. Ancak literatürde bu konuda sınırlı bilgi bulunmakta olup, premenstrual semptomların bu ilişki üzerindeki rolü henüz tam olarak incelenmemiştir. Bu çalışmanın amacı kronotipin sosyal jetlag üzerindeki etkisinde premenstrual semptomların aracılık rolünü incelemektir.

Yöntem: Tanımlayıcı ve ilişki arayacı desendeki bu çalışmanın örneklemi 309 adölesan (n=309) oluşturmaktadır. Veriler, Kişisel Bilgi Formu, Premenstrual Sendrom Ölçeği ve Çocuklar için Sabah-Akşam Ölçeği kullanılarak toplanmıştır.

Bulgular: Kronotip puanları arttıkça sosyal jetlag süresi (β: -0,457; p<0,001) ve premenstrual sendrom puanı (β: -0,342; p<0,001) azaldı, premenstrual sendrom puanındaki artışın sosyal jetlag üzerinde bir etkisi olmadı (β: 0,096; p>0,05). Aracılık etkisi analiz edildiğinde, premenstrual sendrom puanı kronotip ve sosyal jetlag arasındaki etkileşime aracılık etmedi (%95 CI [-0,073; 0,006]; p>0,05).

Sonuç: Kronotip sosyal jetlag ve premensrüel sepmtopları etkilerken, premensrüel sepmtopların sosyal jetlag üzerinde bir etkisi yoktur. Ayrıca, premensrüel sepmtoplar kronotip ile sosyal jetlag arasındaki ilişkiye aracılık etmez. Bu ilişkide "Premenstrual semptomlar aracı mıdır?" sorusuna daha kapsamlı bir şekilde yanıt verebilmek için, farklı kültürel ve sosyo-demografik özellikler ile ruhsal, kültürel ve hükümet politikalar/ı göz önünde bulundurularak benzer çalışmaların farklı bölgelerde gerçekleştirilmesi önerilmektedir.

Anahtar sözcükler: Adölesan, kronotip, premenstrual semptom, sosyal jetlag

Introduction

Adolescence is a critical period for the individual to reach his or her potential and is characterised by dynamic brain development (Patton et al. 2016), where sleep plays a crucial role (Tarokh et al. 2016, Chan et al. 2021, Wang et al. 2022). Sleep behaviour and physiology in adolescents undergo significant maturation, which is even reflected in sleep EEG. This process supports learning, memory, attention, cognition and emotional processing (Tarokh et al. 2016). It also has a vital role in mood, functioning, academic performance, general health and development (Chan et al. 2021). Therefore, sleep-based studies in adolescents have become a priority (Tarokh et al. 2016, Chan et al. 2021).

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Chronotype is a fundamental concept related to sleep. It is regulated by the circadian system and refers to the synchronisation of an individual's circadian rhythm to the 24-hour day (Wittmann et al. 2006). Adolescents may perform daily activities contrary to their chronotype due to altered sleep patterns and obligations of social life (such as going to school) (Wittmann et al. 2006, Kim et al. 2022). This brings along the risk of social jetlag (SJL). Common in adolescents, SJL is defined as a mismatch between the chronotype controlled by the circadian rhythm and the social clock or a misalignment of the biological and social clock (Roenneberg et al. 2019). The relationship between chronotype and SJL in adolescents has been demonstrated in many studies. It has been associated with problems such as cardiometabolic (Feliciano et al. 2019), endocrine (Malone et al. 2016), depressive (Qu et al. 2023), emotional (Yue et al. 2023), somatic, social (Zhu et al. 2023) , and cognitive performance (Taillard et al. 2021). The factors mediating this relationship with the potential to affect adolescents negatively should be known to protect adolescents from this effect. As seen, chronotype and SJL are closely related to each other. The relationship between these two variables can be influenced by premenstrual symptoms, which causes hormonal changes, sleep disturbances, and psychological effects in adolescents (Matsumoto et al. 2019, Armini et al. 2022, Itriyeva 2022).

Premenstrual symptoms are recognized particularly in adolescent girls, with a prevalence rate ranging from 49% to 86% (Dutta and Sharma 2021, Armini et al. 2022). Premenstrual symptoms typically occur during the luteal phase of the menstrual cycle (Dutta and Sharma 2021) and can negatively impact adolescents' emotional, physical, and cognitive functioning (Matsumoto et al. 2019, Armini et al. 2022, Itriyeva 2022), potentially impairing their sleep (Ryu and Kim 2015, Buddhabunyakan et al. 2017, Armini et al. 2022, Wang et al. 2022, Jeong et al. 2023). It is particularly emphasized that there is a strong connection between evening chronotype and premenstrual symptoms (Uekata et al. 2019, Kim and Jang 2022, Arslan and Deniz 2024). Additionally, a study showed that more than one hour of SJL is significantly associated with severe menstrual symptoms (Komada et al. 2019). However, this issue has been rarely explored in adolescents (Jehan et al. 2016, Jeong et al. 2023). There is also no consensus on whether menstrual problems affect sleep habits or vice versa (Conzatti et al. 2021, Wang et al. 2022) and no studies have been found demonstrating the effect of premenstrual symptoms on the relationship between chronotype and SJL. The examination of this relationship, which could pose a threat to adolescent health, may guide healthcare professionals in managing the risk and the problem.

This study aims to investigate the relationship between chronotype and SJL in adolescents and the mediating role of premenstrual symptoms in this relationship. In this context, the hypotheses addressed in this study are (i) H1-1: Chronotype affects premenstrual symptoms, (ii) H1-2: Premenstrual symptoms affect SJL (iii) H1-3: Chronotype affects SJL (iv), and H1-4: Premenstrual symptoms mediate the relationship between chronotype and SJL. In this context, this study may contributes to understanding the effects of the relationships between chronotype, social jetlag, and premenstrual symptoms on sleep patterns and health in adolescents, providing valuable insights for health professionals to develop targeted interventions that promote healthier sleep habits and better overall well-being in this age group.

Method

This study was designed using a descriptive and correlational model. The model was constructed according to the mediating variable conditions determined by Baron and Kenny (1986). Accordingly, three criteria should be met for a variable to be a mediating variable: (i) the independent variable affects the mediator variable, (ii) the mediator variable affects the dependent variable, and (iii) the independent variable affects the dependent variable, and when the mediator variable is added to the model (c'), the independent variable loses its effect on the dependent variable (full mediator variable) or its effect decreases (partial mediator variable) (Baron and Kenny, 1986). The research design is shown in Figure 1 (Figure 1).

The independent variable of the study was chronotype, the mediating variable was premenstrual symptoms, and the dependent variable was SJL.

Sample

The study population covered 574 students (N=574) enrolled in a public high school exclusively for female students in Eskişehir in the 2022-2023 academic year. Based on this population size, the sample size was determined using the sample size formula for a known population. In the calculation, the margin of error (d) was set at 0.05, the Type I error rate (α) at 0.05, and the proportion (p) was assumed to be 0.5, representing the most conservative estimate. Accordingly, the minimum required sample size was calculated as 231 participants. With this sample size, analyses conducted at a 95% confidence level and 5% significance level are assumed to have a statistical power of 80% (1 - β = 0.80). The study was completed with 309 students (n=309). In this study,

a stratified sampling method was used based on the participants' grade levels. The population was first divided into four strata: 9th grade, 10th grade, 11th grade, and 12th grade. Then, students were selected from each grade level using simple random sampling. The total sample consisted of 76 students from the 9th grade (n=76), 65 students from the 10th grade (n=65), 97 students from the 11th grade (n=97), and 71 students from the 12th grade (n=71).

The inclusion criteria were (i) being between the ages of 13-18, (ii) menstruating, (iii) being enrolled in the mentioned schools, and (iv) the adolescent and their families volunteering to participate. The exclusion criteria were adolescents diagnosed with any psychiatric disorder (including Premenstrual Dysphoric Disorder) or any chronic disease.

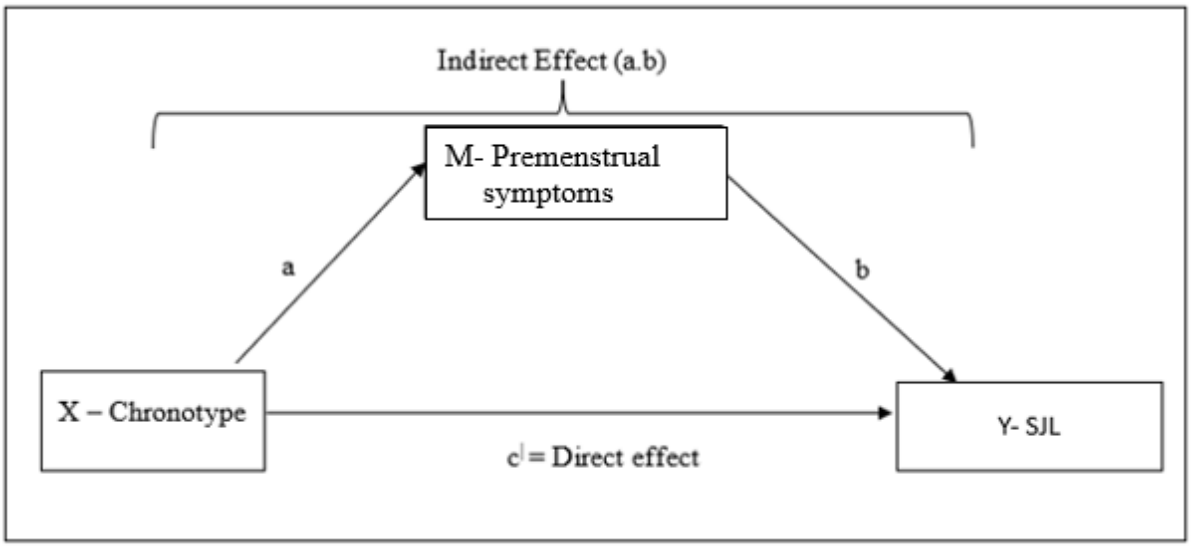

Figure 1. The conceptual model of the research

Procedure

Permissions to use the scales in the study were obtained from the scale owners via e-mail. Ethics committee permission required for the research was obtained from the Eskisehir Osmangazi University Non-interventional Research Ethics Committee (18.01.2022-49). The institutional permission was obtained from the Provincial Directorate of National Education (E.88074293-605.01-61492267). Verbal and written consent were obtained from the adolescents and parents who agreed to participate in the study.

The study was conducted in a state high school providing education to all girls in Eskişehir province. The data were collected between November 2022 and January 2023. The researcher visited the high school twice a week, and adolescents who met the inclusion criteria were included in the study. The measurement tools were filled out using a self-report method, taking approximately 15 minutes. The researcher who collected the data (HÇÖ) was from outside the institution and unfamiliar with the adolescents. The researcher is a clinician psychiatric nurse who received her expertise in mental health and psychiatric nursing. She conducts studies in this field, advises students during psychiatric nursing clinical practice and has clinical experience.

Table 1. Calculation of SJL value	
Step 1: Calculate the weekly mean sleep time.	$[(TST_S \times 5) + (TST_F \times 2)] / 7$
Step 2: Calculate separately the midpoint of sleep on school days and the midpoint of sleep on free days.	MS_S = Evening bedtime on school days + ($TST_S \times 0,5$); MS_F = Evening bedtime on free days + ($TST_F \times 0,5$)
Step 3: Subtract MSF from MSS and find the SJL value from the absolute value obtained.	$SJL = \lvert MS_S - MS_F \rvert$

MSS: Midpoint of sleep on school days, MSF: Midpoint of sleep on free days, TST: Total sleep time, TST_S: Total sleep time during the school day, TST_F: Total sleep time on free days, SJL: Social Jetlag

Measures

Personal Information Form

The form includes questions about adolescents' demographics (grade), menstrual (menstruation pattern, having

bothersome problems during menstruation, taking medication during menstruation), sleep (daytime sleep, taking medication to sleep, watching TV/ using phone before going to sleep), chronotype (type), and SJL details (Sleep time school days/free days, wake up time school days/free days, time to fall asleep, school day/Free day sleep time), which were based on previous studies (Roenneberg et al. 2019, Uslu and Özsaban 2020, Uslu et al. 2021).

Premenstrual Syndrome Scale (PMSS)

The scale measures the severity of symptoms during the premenstrual period. The scale does not provide a medical diagnosis (Gençdoğan 2006). The 5-point Likert-type scale (Never-Always) has 44 items and nine categories (depressive affect, anxiety, fatigue, irritability, depressive thoughts, pain, appetite changes, sleep changes and bloating) and is evaluated on a total score. Possible scores vary between 44 and 220 points, with high scores indicating severe premenstrual symptoms. In this study, Cronbach's alpha value of the scale was 0.896.

Morningness-Eveningness Scale for Children (MESC)

The scale determines adolescents' chronotype (morning/evening) (Carskadon et al. 1993, Önder and Beşoluk 2013). There are ten questions with four or five answer options. Possible scores on the scale vary between 10 and 43 points. The lower the score, the more prominent the evening trait and the higher the score, the more prominent the morning trait. The scale score of the Turkish version is ≤21, 22-34, and ≥35 for evening, intermediate and morning types, respectively. In this study, Cronbach's alpha value of the scale was 0.96.

Social Jet Lag (SJL) Value

SJL value is calculated by the formula detailed in Table 1 (Wittmann et al. 2006, Roenneberg et al. 2019, Uslu and Özsaban 2020, Uslu et al. 2021) (Table 1).

Statistical Analysis

Statistical analyses in this study were performed using SPSS 23.0 and PROCESS Macro v3.4. To assess the internal consistency of each self-report instrument, Cronbach's alpha coefficients were calculated. Descriptive characteristics of the participants were analysed using frequency and percentage distributions. For the continuous variables obtained from the scales, mean and standard deviation values were computed. The Shapiro-Wilks test was applied to each continuous variable to test for normality. Pearson correlation analysis, linear regression, and hierarchical regression analyses examining the mediation effect between the continuous variables were conducted using PROCESS Macro v3.4., specifically employing Hayes' Model 87 (2017) within the statistical program. In the PROCESS model, the effect of the mediating variable on the relationship between the independent and dependent variable was analysed by reaching the total effect, indirect and direct effect scores. The analysis result was generated using a 95% confidence interval and 5000 bootstrap samples.

Results

Findings related to menstrual, sleep, chronotype and SJL characteristics of adolescents (9th grade 24.6%, 10th grade 21%, 11th grade 31.4% and 12th grade 23%) are presented. 64.7% of the adolescents had regular menstruation, 55.3% experienced disturbing problems during this period, and 83% did not use any medication despite the problems they experienced. Regarding sleep characteristics, more than half (53.4%) stated that they sometimes slept during the day. Almost all (85.8%) reported using TV/phone in bed before sleeping, and the majority (97.1%) did not use any sleep medication. 66.7% had an intermediate chronotype. The mean SJL duration was 2.43±1.16, and more than half (65.7%) had SJL levels ≥2 hours or more. The adolescents' mean MESC (chronotype) score was 24.40±5.67 and their mean PMSS score was 128.52±35.33 (Table 2).

There was a statistically significant negative correlation between the MESC score and SJL score ($r=-0.457$; $p<0.001$) and PMSS score ($r=-0.342$; $p<0.001$). In addition, a statistically significant positive correlation between PMSS and SJL scores ($r=0.242$; $p<0.001$) (Table 3).

The path coefficients between chronotype and premenstrual symptoms (path a; β:-0.342; $p<0.001$) and between chronotype and SJL (path c; β:-0.457; $p<0.001$) were statistically significant, while the path coefficients between premenstrual symptoms and SJL (path b; $p>0.05$) were insignificant. When the mediating effect of premenstrual symptoms in the model was analysed, the path coefficient for the indirect effect was -0.033, but since the 95% confidence interval included zero, this effect was not significant. Therefore, premenstrual symptoms do not have a mediating role in the effect of chronotype on SJL (path c': 95% CI [-0.073; 0.006]) (Table 4).

Table 2. Menstrual and sleep characteristics of adolescents (n=309)	
Menstruation Characteristics	**n (%)**
Menstruation pattern	
Regular	200 (64.7)
Irregular	109 (35.3)
Having bothersome problems during menstruation	
Yes	171 (55.3)
No	138 (44.7)
Taking medication during menstruation	
Yes	29 (17.0)
No	142 (83.0)
Sleep Characteristics	n (%)
Daytime sleep	
Yes	52 (16.8)
Sometimes	165 (53.4)
No	92 (29.8)
Taking medication to sleep	
Yes	9 (2.9)
No	300 (97.1)
Watching TV/ using phone before going to sleep	
Yes	265 (85.8)
No	44 (14.2)
Chronotype Characteristics	**n (%)**
Morning type (≤21)	94 (30.4)
Intermediate type (22-34)	206 (66.7)
Evening type (≥35)	9 (2.9)
SJL Characteristics	n (%)
SJL level (hours)	
<1 hour	26 (8.4)
≥1 hour and <2 hours	80 (25.9)
≥2 hours	203 (65.7)
	Min-Max (Mean±SD)
SJL time (hours)	0.17-5.75 (2.43±1.16)
Sleep time school days	21:00-03:50 (23:37±70.05 min)
Sleep time free days	21:00-04:50 (00:56±87.54 min)
Wake up time school days	05:00-11:00 (06:55±38.88 min)
Wake up time free days	06:00-14:50 (10:27±98.61 min)
Time to fall asleep (minutes)	1-60 (23.23±18.09)
School day sleep time (hours)	3.50-11.00 (7.29±1.22)
Free day sleep time (hours)	4.50-14.50 (9.52±1.59)
Mean sleep time (hours)	4.50-11.50 (8.40±1.15)
Scale Scores	Min-Max (Mean±SD)
MESC	10-54 (24.40±5.67)
PMSS	52-216 (128.52±35.33)

*Descriptive statistics (mean, standard deviation, number, percentage), MESC: Morningness-Eveningness Scale for Children, PMSS: Premenstrual Syndrome Scale, SJL: Social Jetlag

Table 3. Correlations between chronotype, SJL and premenstrual symptoms		
	MESC	**PMSS**
MESC	---	
PMSS	r=-0.342**	---
SJL	r=-0.457**	r=0.242**

**<0,01; r: Pearson correlation coefficient, MESC: Morningness-Eveningness Scale for Children, PMSS: Premenstrual Syndrome Scale, SJL:Social Jetlag

Table 4. The mediating role of premenstrual symptoms							
Dependent variable	**Independent variable**	**B**	**SE**	**t**	**P**	**95% CI Lower**	**95% CI Upper**
PMSS	MESC (a)	-0.342	0.054	-6.386	<0.001*	-0.447	-0,237
R=0.342. R-square=0.117. F=40.781. p<0.001*							
SJL	MESC (c)	-0.457	0.051	-9.007	<0.001*	-0.556	-0,358
R=0.457. R- square=0.209. F=81.133. p<0.001*							
SJL	MESC (c')	-0.424	0.054	-7.880	<0.001*	-0.529	-0,319
SJL	PMSS (b)	0.096	0.054	1.790	0.074	-0.009	0,201
R=0.466. R^2 =0.217. F=42.461. p<0.001*							
Total effect		-0.457	0.051	-9.007	<0.001*	-0.556	-0.358
Direct effect		-0.424	0.054	-7.880	<0.001*	-0.529	-0.319
Indirect effect		-0.033	0.020	-	-	-0.073	0.006

*p<0.001; SE: Standard error; β: Standardisation coefficient; R2: Determination coefficient, MESC: Morningness-Eveningness Scale for Children, PMSS: Premenstrual Syndrome Scale, SJL: Social Jetlag, Path a: MESC- PMSS, Path b: PMSS-SJL, Path c: MESC-SJL, Path c': Mediation effect

Discussion

This study analysed the relationship between chronotype and SJL and found that SJL duration decreased with higher chronotype scores. In other words, the morning chronotype tendency shortened the duration of SJL. This result is consistent with the literature. (Uslu et al. 2021, Magnusdottir et al, 2024). These findings highlights the importance of addressing sleep issues early on to enhance the long-term developmental outcomes for adolescents. At this point, health professionals can use this finding to guide interventions aimed at improving sleep habits in adolescents, particularly by promoting morning chronotype tendencies. However, most adolescents do not know how to regulate circadian rhythms to promote their mental and physical health (Crouse et al. 2021) which is why they should be supported by health professionals. By encouraging earlier sleep-wake cycles, health professionals can help reduce SJL duration, which may ultimately improve adolescents' overall health (Uslu et al, 2021). Information can be provided on the positive association of the circadian system with light exposure, physical activity and regular sleep-wake schedules and the negative association with factors such as sedentary life, irregular sleep and use of light-emitting devices at night (Crouse et al. 2021). Also school administrators, teachers, parents and students can be informed about this issue. Sleep education, including chronotype, can be included in health education programmes (Malone et al. 2016). Adolescents can be supported by tools such as personal digital technologies, social media, and podcasts (Crouse et al. 2021). Changing school start times or implementing school-based public policy interventions can also improve adolescent sleep (Crouse et al. 2021, Otsuka et al. 2021). By implementing these strategies, health professionals and educators can play a pivotal role in helping adolescents develop healthier sleep habits, ultimately supporting their physical, emotional, and cognitive development.

Within the scope of this study, the relationship between chronotype and premenstrual symptoms were analysed, demonstrating that premenstrual symptoms decreased when adolescents' morning chronotype scores increased. This result is supported by previous reports (Lee et al. 2016, Kim et al. 2022, Jeong et al. 2023, Jung et al. 2023). Strong evidence of circadian rhythm changes during the premenstrual period suggests an interaction between sleep patterns and the menstrual cycle (Komada et al. 2019, Meers and Nowakowski 2020). This could be due to the impact of hormone level variations across different stages of the menstrual cycle on adolescents' sleep patterns and chronotypes (Michels et al. 2020), with particular emphasis on changes in melatonin secretion (Meers and Nowakowski 2020). Also, in the luteal phase, progesterone levels rise while allopregnanolone levels fall. A decrease in allopregnanolone may lead to increased dopamine levels, which can in turn induce anxiety (Jehan et al. 2016). With this perspective, the importance of sleep hygiene and quality in the management of premenstrual symptoms in adolescents has been emphasised (Jeong et al. 2023) because investing in adolescent health and well-being will bear rewarding fruit for decades and generations to come (Patton et al. 2016). The fact that menstrual health is not only the absence of disease or disability, but also a state of complete physical, mental and social well-being (Hennegan et al. 2021) points to the need to evaluate adolescents in terms of premenstrual symptoms.

The absence of a relationship between premenstrual symptoms and SJL was a striking finding of this study. In contrast, a study with university students concluded that SJL exacerbated menstrual symptoms such as pain, breast tenderness, and reduced daytime functioning (Komada et al. 2019). Additionally, a systematic review found that women with premenstrual symptoms tend to have lower melatonin levels, and report poorer sleep quality (Nexha et al. 2024). Furthermore, a study with a sample of nurses identified a relationship between social

jetlag (SJL) levels in evening shift workers and premenstrual symptoms (Kim and Jang 2022). The differences in the results of the studies may stem from factors such as how participants' sleep patterns and premenstrual symptoms were measured, the criteria used to define premenstrual symptoms, and the methods used to assess sleep quality (Jeong et al. 2023). Therefore, more targeted research focusing on these variables is needed to better understand the complex relationship between premenstrual symptoms and SJL.

Several hormones involved in reproductive function are modulated by sleep or the circadian system. Their secretion can, therefore, be altered directly or indirectly by sleep problems or circadian misalignment, especially when accompanied by stress (Kloss et al. 2015). Furthermore, women's sleep patterns are more frequently disrupted than men's, often due to hormonal fluctuations tied to menstruation, a hallmark of premenstrual symptoms (Jehan et al. 2016). For this reason, the evaluation of menstrual health is also an effective way to achieve gender equality and sustainable development goals (Sommer et al. 2021). In light of this information, the balance between chronotype representing circadian rhythm, SJL representing sleep problems and premenstrual symptoms representing stress was evaluated in this study. The mediating effect of premenstrual symptoms on the relationship between chronotype and SJL was analysed. It was observed that the increase in the chronotype score of adolescents, in other words, the morning chronotype tendency decreased premenstrual symptoms (path a) and SJL duration (path c). When premenstrual symptoms, which was thought to be a mediator variable in the relationship between chronotype and SJL, was added to the model, the effect of premenstrual symptoms on SJL was found to be insignificant (path b). The insignificance of this effect has shown that there is no mediating role of premenstrual symptoms in the relationship between chronotype and SJL. This striking finding, although beyond expectations, is important because it serves as a reminder that menstrual health remains a public health issue that should be prioritized and given more attention (Wilbur et al. 2022). Additionally, since the relationship between these two variables has not been previously examined within the context of premenstrual symptoms in adolescents, the initial findings may serve as a guide for other researchers. Considering the quantitative limitations in the literature, it would be important to conduct similar studies in different regions with varying cultural, sociodemographic, and governmental factors. These studies could provide a more comprehensive understanding and help address the question more effectively: Are premenstrual symptoms a mediator in the relationship between chronotype and SJL?

To the best of our knowledge, this is the first study to evaluate the mediating effect of premenstrual symptoms in the relationship between chronotype and SJL. Therefore, we believe the results will contribute to the literature. This study has several limitations that must be considered. First, the findings are based on data from only one school, which limits their generalizability. Future research including multiple schools across various geographical and cultural contexts would provide a broader understanding and strengthen the robustness of the results. Additionally, the study did not account for several factors that could influence adolescents' sleep patterns, such as physical activity, caffeine, and alcohol consumption. Incorporating these variables in future studies would offer a more comprehensive insight into the relationship between chronotype, social jetlag, and premenstrual symptoms. Another limitation is the reliance on self-report questionnaires to collect data for all variables, which can introduce potential biases. These questionnaires serve as screening tools, not diagnostic instruments, and may not fully capture the complexity of the constructs measured. To address this, future studies could benefit from more objective and reliable assessment methods, such as physiological measurements or behavioral data. Finally, the cross-sectional design of the study only captures relationships at a single point in time, limiting the ability to establish causal links between variables. However, the findings from this study provide valuable preliminary data and lay the groundwork for future longitudinal or experimental research, which could more effectively explore causality and the long-term effects of these relationships.

Conclusion

Based on the study findings, hypotheses H1-1 and H1-3 were supported, whereas H1-2 and H1-4 were not. Accordingly, a morning chronotype was associated with reduced premenstrual symptoms and shorter SJL duration among adolescents, but premenstrual symptoms have no effect on SJL. Furthermore, no mediating role of premenstrual symptoms was found in the chronotype–SJL relationship. Future studies should investigate the potential mediating role of premenstrual symptoms and other related variables in the relationship between chronotype and SJL. In addition, to effectively answer the question "Is premenstrual symptoms a mediator?", it is recommended that similar studies be conducted in various regions by taking into account different cultural and sociodemographic characteristics and mental/cultural/governmental policies.

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