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Disruption of the biological clock: chronotypes and social jet lag in high school students

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ABSTRACT

Adolescent students generally experience variations in sleep that can lead to discrepancies between the biological rhythms of their daily lives and social demands such as school schedules, affecting not only their physical and mental health but also their learning process. Therefore, this study aims to investigate the relationship between chronotype types and the prevalence or absence of social jet lag among adolescents aged 13 to 17 years. A quantitative approach was adopted, utilizing a cross-sectional and descriptive-correlational design, with a participation of 524 secondary school students and a non-probabilistic sample of 267, to whom two questionnaires were administered. The findings indicated the absence of a significant correlation between chronotypes and social jet lag (p=0.916, VCramer=0.026). Moreover, the predominant chronotype was intermediate (81.27%), and 83.15% were likely experiencing jet lag. Additionally, 60% of adolescents aged 15 to 16 years have an evening chronotype, and 35.59% of those suffering from jet lag are 16 years old. In conclusion, although the correlation between chronotypes and jet lag was not demonstrated, the issue of biological clock disorders is present among school students, particularly among those aged 16.

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1. INTRODUCTION

The importance of sleep and its patterns has become an increasingly relevant topic in academic research, especially during adolescence. Chronotypes, defined as individual preferences for sleep and wake times, play a fundamental role in the health and well-being of young people [1], [2]. Chronotypes can vary according to the times of day when individuals feel most alert and active, categorized as intermediate, morning, and evening [3]. Typically, adolescents tend to have an evening or nocturnal preference, which is associated with poor sleep quality and mental [4] and biological [5] health issues. Social jet lag occurs when an individual's sleep schedule does not align with the activities they must perform (such as class schedules), emerging when there is a misalignment between social and biological times [6], [7]. It generally arises when individuals practice poor habits by changing their wake-up time during the week [8]. This misalignment could lead to inadequate sleep, weakening concentration, mood, and even academic success.

Adolescents who experience greater misalignment in their social schedule are typically evening-types, as they tend to have shorter sleep durations at night, particularly when attending morning classes [9]. Adolescents are particularly vulnerable to developing unhealthy sleep habits, which often leads them to prefer later class schedules [10]. This may result in metabolic and physical health implications for young people [11]. Generally, access to the internet or mobile devices contributes to daytime sleepiness, high levels of fatigue, and poor sleep quality among students [12]. These issues may intensify during university years, as they are compounded by factors such as depressive symptoms and academic pressure, which often reduce total sleep time [13]. Therefore, the presence of chronotypes among students represents an alarming condition influencing the prevalence or absence of social jet lag, as reflected in disrupted sleep patterns or inattentiveness during the learning process.

Research has addressed chronotypes and social jet lag in various settings from a descriptive perspective. Some of these studies suggest that as people age, their chronotypes tend to shift towards a more morning-oriented behavior, particularly between the ages of 25 and 29 [14]. However, adolescents aged 16 and 17 often identify with an evening chronotype and typically experience poor sleep quality, which could have repercussions on their health and daily performance [15]–[17]. This indicates that age is a parameter for evaluating the behavior of both biological and social clocks, suggesting that understanding these patterns may be fundamental to grasping the phenomenon. Generally, evening-oriented students suffer from social jet lag, sleep disorders, a higher body mass index, and elevated metabolic risk compared to their morning-oriented peers [5]. In India, it has been found that 81% of students attending school are morning-oriented and experience a misalignment in their social schedule, due to a mismatch between class hours and sleep times, resulting in greater suffering from social jet lag [18]. Coincidentally, one reason that could cause social jet lag in children is the morning schedule [19]. In Canada, it has been demonstrated that severe social jet lag is associated with a later chronotype and lower physical activity [20]. Additionally, various Asian studies have revealed that social jet lag is common among adolescents, causing symptoms such as irritability and daytime sleepiness, primarily in those with late chronotypes [21], [22]. This situation not only contributes to poor sleep quality but also negatively impacts academic performance, as cognitive functioning is affected, which in turn hinders the learning process [23]. Therefore, it is essential to address these issues to improve students' quality of life in their academic performance.

Other recent studies that have explored the relationship between these two phenomena suggest that higher social jet lag is significantly associated with an increased risk of circadian disruption in young adults, making it important to maintain coherence in behavioral cycles [24]. In Korean children, sleeping less than 6 hours, having an evening chronotype, and experiencing social jet lag of more than 2 hours may be associated with anxiety or depression [25], [26]. Prolonged exposure to daylight and nighttime light can delay preferred sleep times, making evening-oriented individuals more vulnerable to nighttime light and more likely to experience greater social schedule misalignment [27]. Having a biological misalignment in students' sleep can lead to mood changes and aberrant behaviors in the school environment. Therefore, by identifying the association between chronotype types and social jet lag, practical solutions can be explored and relevant aspects of students' physical and mental health can be anticipated [28]–[30].

The study gains further relevance as it makes a significant contribution to advances in chronobiology, providing valuable insights into sleep disorders. Discoveries related to circadian rhythms have enabled a better understanding of how students behave during their study sessions, as well as the regulatory mechanisms needed through chronotherapies that optimally adjust their biological clocks [31]. Furthermore, the study is grounded in the theory of zeitgebers, which explains habitual behaviors or "social zeitgebers" that may occur irregularly—for instance, having breakfast at different times each day instead of following a consistent routine [32]. By drawing on clinical and psychological advances, this approach provides a relevant framework for understanding chronotypes and social jet lag within an educational context. The article offers a novel contribution by examining chronotypes and social jet lag in school-aged students—a population potentially vulnerable to the desynchronization between their biological clocks and the demands imposed by society. Despite the increasing relevance of chronotypes and social jet lag, the reviewed literature reveals a scarcity of studies directly addressing the correlation between these two variables in secondary school students [18], [20], particularly in contexts where these phenomena are still relatively unfamiliar. Other studies have focused on young adults and university students in environments where educational schedules are more flexible and even aligned with individual chronotypes [5], [24], [25]. This study responds to the psychosocial needs of students in educational settings governed by outdated or obsolete policies, with rigid school timetables and full-day schedules that begin early in the morning, without taking into account students' biological rhythms. Addressing the relationship between these variables provides empirical evidence to identify the chronotypes of students who experience social jet lag and those who do not, thereby enabling the development of relevant strategies within the framework of student well-being.

Another important aspect of this study is that it considers students who are in the biological and psychological stages of puberty and adolescence. While some research has used age ranges as a basis for comparison [16], [17], the present study explores differences based on students' specific ages rather than broad ranges. With this evidence, the study aims to contribute to the strengthening of biological clock theories and social zeitgebers [32], which seek to explain, from a psychoclinical perspective, the behavior of these phenomena among schoolchildren. Identifying social jet lag and chronotype supports the provision of more personalized psycho-pedagogical care. Based on the arguments presented, this study primarily aims to establish the relationship between chronotypes and social jet lag in secondary school students. It also seeks to identify the predominant chronotype, the presence or absence of social jet lag, and to compare both variables according to the students' age.

2. THE COMPREHENSIVE THEORETICAL BASIS

2.1. Chronotype

Chronotype reflects how biological cycles impact an individual's sleep and wake behaviors and manifestations [33]. It refers to the individual patterns of sleep-wake cycles that are determined by the body's circadian rhythms, meaning the times of day when a person feels most awake and alert, as well as the times when they feel more drowsy and tired [3]. It is based on understanding how an individual's rhythms interact with their environment, such as light-dark cycles and social cues. This interaction is fundamental as it directly affects the synchronization of each individual's circadian rhythms with their surrounding environment [34]. Chronotypes can be classified as: i) morning types, where individuals prefer to wake up in the morning and tend to do so with agility and mental clarity. They feel more awake than in the afternoon but find it challenging to stay awake late into the night; ii) intermediate types, where individuals do not have an extreme inclination towards being "larks" (morning types) or "owls" (evening types); they do not show a clear preference for morning or afternoon and can easily adapt to any schedule, not requiring a specific time to sleep. People with this chronotype spend more time watching television and using computers compared to morning types; and iii) evening types, where individuals tend to display greater extroversion and creativity, as well as a higher capacity to interpret information subjectively and emotionally compared to other chronotypes [4].

2.2. Social jet lag

It refers to the discrepancy between a person's internal biological rhythms and the social demands imposed by their environment, such as work or school schedules. This misalignment has been associated with metabolic anomalies and a higher risk of adiposity, suggesting that the lack of synchronization between biological rhythms and social activities can have negative health implications [35]. "Social jet lag" refers to the misalignment between an individual's social and biological timing, occurring when there is a discrepancy between sleep patterns on workdays and free days. This reflects a conflict between internal circadian rhythms and external social obligations [36], [37]. The measurement of social jet lag is based on the difference between the midpoint of sleep on workdays and days off [38].

3. METHOD

This research is framed within a descriptive-correlational study. According to previous study [39], it presents a non-experimental and cross-sectional design, as the data were collected at a single point in time without any intervention or follow-up over time. Thus, the research design allows for the analysis of the association between the study variables in a specific context and at a given moment. To carry out the study, a population of 524 secondary school students from a military-managed educational institution located in the city of Tacna, aged between 11 and 17 years, was considered. The sample chosen for the research through non-probabilistic sampling consists of 267 students. Parents provided informed consent for minors to participate in the study. The morningness eveningness scale for children (MESC) [34] was used, which is a tool that assesses time preferences in children and adolescents. The MESC consists of 10 questions that measure time preferences for various activities, with multiple-choice response options; scores range from 10 to 43 points. According to the established methodology, the 25th and 75th percentiles were considered to identify chronotypes: morning (scores>29), evening (scores<22), and intermediate (scores between 23 and 28). The reliability of the instrument was evaluated through an analysis of internal consistency, obtaining a Cronbach's alpha of 0.73, indicating that the instrument is reliable. Previous studies have also reported adequate internal consistency (between 0.70 and 0.80) in adolescent samples from different countries. Additionally, a 7-item survey on sleep habits, adapted from Randler and Schaal [40], was used to assess social jet lag. These questions allow for the calculation of the midpoint of sleep on weekends (MSF), the midpoint of sleep during the week (MSW), and the total midpoint of sleep (TMS) to determine social jet lag.

The instruments were administered over four consecutive days in June 2024; before each session, informed consent was provided to the parents of the students. Subsequently, coordination was made with the teachers for the application of the tests at flexible times within their class schedule. The average time for each participant was approximately 15 minutes, and the student's showed openness and willingness to complete the instruments without any issues. With the obtained data, a statistical processing was carried out using strategies that allowed for hypothesis testing through tables, graphs, and the Chi-square independence test and Cramer's V to determine the degree of association. For this purpose, SPSS version 25 was used.

In the development of this research, various ethical aspects were considered to ensure the well-being and safeguard the rights of the participants. First, informed consent was obtained from each of the students before administering the instruments. This involved clearly and comprehensively informing them about the research objectives, the procedures to be followed, any potential risks and benefits, and the voluntary nature of their participation, making it clear that they could withdraw from the study at any time without repercussions. Additionally, the anonymity and confidentiality of the information provided by the participants were protected, ensuring that their personal data would not be disclosed or used for purposes unrelated to the research. Finally, the necessary permissions were obtained from the academic and administrative authorities of the institution, ensuring that the study would not cause any harm or disadvantage to the students.

4. RESULTS AND DISCUSSION

4.1. Results

According to the results, the predominant chronotype among students in the third, fourth, and fifth grades is the intermediate chronotype, with 81.27%, followed by the morning chronotype at 14.98%, and the evening chronotype at 3.75%. Additionally, 83.15% of students in these grades are likely experiencing social jet lag, while 16.85% do not exhibit social jet lag. The strength of the association between chronotypes and social jet lag is weak among secondary school students, as shown in Table 1.

Table 1. Chronotypes and social jet lag of basic education students

Variables	f	%
Chronotype		
Morning	40	14.98
Intermediate	217	81.27
Evening	10	3.75
Social jet lag		
No social jet lag	45	16.85
Probable social jet lag	222	83.15

Chronotype and social jet lag do not show a significant correlation ($p>0.05$, V Cramer<0.3). Among the students who are likely to have social jet lag, 81.08% have an intermediate chronotype, meaning they do not lean towards either of the established chronotypes. However, 15.32% have demonstrated a morning chronotype, as presented in Table 2.

Table 2. Correlation between chronotype and social jet lag

Social jet lag	Chronotype						Total		χ^2	p	V_{Cramer}
	Morning		Intermediate		Evening						
	f	%	f	%	f	%	f	%			
No social jet lag	6	13.33	37	82.22	2	4.44	45	100.00			
Probable social jet lag	34	15.32	180	81.08	8	3.60	222	100.00	0.175	0.916	0.026
Total	40	14.98	217	81.27	10	3.75	267	100.00			

A total of 45% students with a morning chronotype are between 16 and 17 years old, while 60% of those with an evening chronotype are between 15 and 16 years old. Regarding the intermediate chronotype, 88.01% are aged between 14 and 16 years, as seen in Table 3, indicating that they do not show a specific orientation and can easily adapt to the context. Regarding the prevalence of social jet lag, 40% of students who do not experience social jet lag are 16 years old. Similarly, 35.59% of students who are likely experiencing social jet lag are of the same age, as shown in Table 4.

Table 3. Prevalence of chronotype by age

Chronotype	Ages 13		14		15		16		17		Total	
	f	%	f	%	f	%	f	%	f	%	f	%
Morning	2	5.00	11	27.50	9	22.50	17	42.50	1	2.50	40	100.00
Intermediate	17	7.83	76	35.02	39	17.97	76	35.02	9	4.15	217	100.00
Evening	0	0.00	4	40.00	2	20.00	4	40.00	0	0.00	10	100.00
Total	19	7.12	91	34.08	50	18.73	97	36.33	10	3.75	267	100.00

Table 4. Prevalence of chronotype by age

Social jet lag	Ages 13		14		15		16		17		Total	
	f	%	f	%	f	%	f	%	f	%	f	%
No social jet lag	4	8.89	14	31.11	8	17.78	18	40.00	1	2.22	45	100.00
Probable social jet lag	15	6.76	77	34.68	42	18.92	79	35.59	9	4.05	222	100.00
Total	19	7.12	91	34.08	50	18.73	97	36.33	10	3.75	267	100.00

4.2. Discussion

The initial objective of the study was to identify the correlation between chronotypes and social jet lag among students. The results indicated that no significant correlation was found between the study variables. These findings differ from those reported in the literature [18], [20], [24], [25], where the prevalence of an evening chronotype could pose a high risk of social jet lag in individuals. It appears that regardless of the chronotype students may present, they experience difficulties with their schedules and suffer from jet lag during classes. In this study, 81.08% of students experiencing social jet lag have an intermediate chronotype. This means that even though they may have greater flexibility to work in the morning or afternoon, if the schedules are significantly different from their natural rhythms, it can lead to this desynchronization. Pre-adolescent and adolescent students may not be aware of their social jet lag during their academic tenure, as they are in a stage filled with energy and adaptability. Meanwhile, those with more extreme chronotypes can easily recognize fatigue. This may cause students with an intermediate jet lag to underestimate the effects of physical and mental fatigue they experience. Additionally, there may be some external variables not included in the study, such as academic pressure, depression, or extracurricular activities [28], that could mediate this correlation. Therefore, there is still a need to continue exploring this association while considering other factors.

Regarding the second objective of the study, the majority of students express having an intermediate chronotype, meaning they consider themselves individuals who do not require a specific time to sleep [4]. This finding are consistent with some previous research [41], [42], as schoolchildren often engage in active social activities, such as spending time with friends or hobbies, where they may even stay up later through digital communications. This suggests that these findings may be associated with the modern lifestyle they lead. However, most studies found indicated the prevalence of morning [14] or evening chronotypes [15]–[17], [20]. It is important to note that these studies were conducted with individuals over the age of 16, including university students and young adults who work. In our study, since the participants are school students who generally have only academic and extracurricular activities and are still without social pressure, they exhibit greater energy to adapt to schedules. Some studies have also identified the prevalence of the intermediate chronotype [41], [42].

In the third objective, regarding social jet lag, it has been identified that the majority of students likely experience social jet lag. This means that their biological clock typically does not align with the social schedule of the school they attend. This aligns with previous research [18], [21], which found that at least 67% of students suffer from sleepiness during class time, indicating the presence of jet lag. Students who spend extended hours in front of screens before going to bed typically experience around two hours of sleep deprivation, which they sometimes attempt to recover during class time [43], [44]. Class schedules usually do not align with adolescents' natural sleep rhythms, as many of them stay awake very late. Furthermore, academic loads and assignments may cause students to sleep less, especially if these involve digital activities that require them to be connected to their phones or computers, as prolonged use of electronic devices interferes with sleep.

The fourth objective states that 60% of those with an evening chronotype are between 15 and 16 years old. This finding is consistent with previous research indicating that the transition to an evening chronotype typically occurs around the ages of 16 and 17, during which individuals often experience health-related consequences [15]–[17]. This phenomenon can be explained by the fact that adolescents in this age group tend to go to bed later, resulting in shorter sleep duration [9]. Changes in sleep patterns occur when

adolescents prioritize other activities over sleep, thereby exacerbating the negative effects that predispose them to an evening chronotype.

In response to the fifth objective, it is observed that 35.59% of secondary school students who likely suffer from jet lag are 16 years old. The results coincide with existing literature, which indicates that 53.9% of students aged 13 to 15 experience social jet lag, attributable to irregular sleep habits, excessive texting, and wake-up times on school days and weekends [45]. Generally, students who are 16 years old are in their final stage of schooling, and in addition to school assignments, they must also prepare for university, leading to an increase in study hours and a decrease in sleep. Moreover, the use of electronic devices among adolescents is also an influencing factor, and the disruption of sleep cycles highlights the need to address the impact of social jet lag in this age group.

The theoretical implications of our study open a new debate regarding the lack of correlation between social jet lag and chronotypes in schoolchildren and challenge conventional notions about the relationship between biological rhythms and social demands. While, according to chronobiology theory, they should be correlated [31], it seems that students' adaptation to school schedules may be more complex than previously assumed. From the theory of zeitgebers [32], irregular behaviors in students' activities at different times each day are attributed to factors such as light, temperature, or social routines. Therefore, the experiences of social jet lag among schoolchildren may be influenced not only by academic activities but also by the time they spend connected to electronic devices or engaging in extracurricular tasks. Although they report having an intermediate chronotype, this does not necessarily imply that they have flexibility in managing their study times. Thus, future research could explore theoretical models that consider other study variables.

5. CONCLUSION

The findings show no association between chronotypes and social jet lag among secondary school students, suggesting a more complex interaction than initially hypothesized. The intermediate chronotype was the most common, and most students showed signs of possible social jet lag. Notably, 60% of evening-type students were aged 15–16, and 35.59% of those with social jet lag were 16 years old. The study encourages further research in this area.

This study employed a correlational, cross-sectional design, which limits the ability to infer causality or track changes over time, as data were collected at a single point and may reflect psychosocial influences. Although the sample was representative, it was drawn from only one public school. The use of self-reported quantitative data also introduces potential social desirability bias. Additionally, no moderating or mediating variables were considered to further control the relationships examined.

Future research should consider longitudinal designs to assess changes over time and establish causal relationships. It is also recommended to include larger, more representative samples from both urban and rural areas for a broader understanding of the phenomenon. To address the limitations of quantitative data, qualitative approaches may be incorporated for deeper insight. Additionally, structural equation modeling could be used to include mediating and moderating variables, allowing for more robust theoretical explanations.

The practical implications of this study suggest that the absence of a significant correlation calls for a reconsideration of psychoeducational intervention strategies in schools. These should not focus solely on adjusting school schedules or sleep routines based on students' chronotypes. Other influencing factors—such as excessive device use, academic demands, and sociocultural attitudes toward rest—must also be addressed. Researchers, school leaders, and psychologists could implement programs that promote healthy sleep habits through reflection, time management, and responsible technology use. Such initiatives would support students in making informed decisions about the importance of adequate sleep for academic engagement. The evidence presented serves as a valuable foundation for educational management decisions, highlighting the need for comprehensive, contextual, and multisystemic interventions that address not only biological, but also social and emotional dimensions.

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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

INFORMED CONSENT

We have obtained informed consent from all individuals included in this study.

ETHICAL APPROVAL

The research related to human use has been complied with all the relevant national regulations and institutional policies in accordance with the tenets of the Helsinki Declaration and has been approved by the authors' institutional review board or equivalent committee (Letter N°004-2025-DIN-EPN).

DATA AVAILABILITY

Derived data supporting the findings of this study are available from the corresponding author [GC-Q], on request.

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