

Association of bullying/cyberbullying and Light/Deep Sleep in Young People from Southern Spain

Asociación del bullying y cyberbullying con el sueño ligero y profundo en jóvenes

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Abstract

Introduction: The present study analyzed the association between bullying and cyberbullying victimization and aggression, and the light and deep sleep in adolescents. Recent literature, exposes that bullying can negatively affect sleep quality, interfering with physiological processes essential for recovery and emotional well-being.

Method: A cross-sectional study was conducted with 985 Andalusian adolescents (10-16 years old), who wore Xiaomi Mi Band 4 bracelets for seven days to record the duration of sleep phases. Validated questionnaires were applied to measure bullying and cyberbullying, and data were collected on age, sex, BMI and moderate-vigorous physical activity level. Multiple linear regressions were used to analyze covariate-adjusted associations.

Results: Bullying victimization was significantly associated with worse sleep, both light ($\beta = -7.267$; $p = .049$) and deep ($\beta = -1.479$; $p = .048$). Likewise, greater cyberbullying victimization showed worse deep sleep ($\beta = -5.278$; $p = .018$). No significant associations were found between aggression behaviors in both bullying and cyberbullying and sleep phases.

Conclusions: The results indicate that young people who suffer bullying/cyberbullying show significant sleep disturbances. These findings underscore the need for preventive interventions focused on mitigating the consequences of bullying at a young age.

Keywords: Bullying, Cyberbullying, sleep, adolescents, physical activity.

Resumen

Introducción: El presente estudio analizó la asociación entre la victimización y agresión de bullying y cyberbullying, y el de sueño ligero y profundo en adolescentes. La literatura reciente, expone que el acoso puede afectar negativamente la calidad del sueño, interfiriendo en procesos fisiológicos esenciales para la recuperación y el bienestar emocional.

Método: Se realizó un estudio transversal con 985 adolescentes andaluces (10-16 años), quienes portaron pulseras Xiaomi Mi Band 4 durante siete días para registrar la duración de las fases de sueño. Se aplicaron cuestionarios validados para medir bullying y cyberbullying, y se recogieron datos sobre edad, sexo, IMC y nivel de actividad física moderada-vigorosa. Se emplearon regresiones lineales múltiples para analizar asociaciones ajustadas por dichas covariables.

Resultados: La victimización por bullying se asoció significativamente con peor sueño, tanto ligero ($\beta = -7.267$; $p = .049$) como profundo ($\beta = -1.479$; $p = .048$). Asimismo, una mayor victimización por cyberbullying mostró un peor sueño profundo ($\beta = -5.278$; $p = .018$). No se hallaron asociaciones significativas entre las conductas de agresión, tanto en bullying como en cyberbullying, y las fases del sueño.

Conclusiones: Los resultados indican que los jóvenes que sufren bullying/cyberbullying, muestran alteraciones significativas en el sueño. Estos hallazgos subrayan la necesidad de intervenciones preventivas centradas en mitigar las consecuencias del acoso desde la juventud.

Palabras clave: Bullying, Cyberbullying, sueño, adolescentes, actividad física.

Introduction

Peer violence in the school context, commonly referred to as bullying, is configured as a dynamic of systematic abuse that can take physical or psychological forms and that is prolonged over time (Armitage, 2021). This type of mistreatment is usually exercised from a position of power, individually or collectively, towards subjects with little capacity for response or defense (Armitage, 2021). In quantitative terms, the United Nations Educational, Scientific and Cultural Organization (2019) exposes that one in three adolescents has been a victim of bullying at least once a month. The implications derived from this experience include the intensification of anxiety symptoms, tendency to social isolation and a significant deterioration in academic motivation (Schlesier et al., 2023). In parallel, technological evolution and the expansion of digital environments have given rise to new forms of bullying, which are more difficult to control and potentially more harmful than traditional manifestations, due to their massive, constant and anonymous nature (Cretu & Morandau, 2022).

Cyberbullying is a contemporary form of digital violence characterized by the intentional, persistent and repeated use of virtual environments, such as social networks, messaging applications or websites, to inflict psychological harm through acts of intimidation, defamation, threats or humiliation (Zhang et al., 2022). Its global expansion in recent years has made cyberbullying a focus of special academic and social interest. One of its most relevant characteristics is its ability to overcome spatio-temporal barriers, making it easier for perpetrators to harass their victims constantly and from any location (Sánchez-Domínguez et al., 2022). This type of harassment usually represents actions such as the dissemination of false information, the non-consensual exposure of personal data or the creation of false profiles aimed at damaging the reputation of the affected person (Lareki et al., 2023; Maftai et al., 2022). In this type of harassment, different roles are observed among which where victims generally adopt passive attitudes, aggressors present high levels of self-confidence, and observers remain silent in the face of aggressions (Ferrás & Selman, 2014; González-González et al., 2017).

Currently, the distinction between traditional bullying and cyberbullying is relevant. While bullying is usually related to specific physical spaces such as the school environment and with a limited temporality, cyberbullying transcends spatio-temporal barriers by being executed through digital media that allow its continuous occurrence (Ramadan, 2023). This implies that this type of bullying increases the exposure of victims, who can be subjected to aggression at any time of the day, even during periods intended for nighttime rest (Ramadan, 2023). The anonymity offered by digital platforms can exponentially increase aggressive behavior by reducing the perception of responsibility, thus reinforcing the aggressor's behavior (Boichuk et al., 2023). In addition, the possibility of replication and viralization of offensive content amplifies the scope of the damage, prolonging its effects and hindering the emotional recovery of victims (Palade & Pascal, 2023). This intensification of the impact is manifested, among other aspects, in deeper emotional responses, characterized by feelings of helplessness, hopelessness and persistent isolation (Peebles, 2014).

In children and adolescents, exposure to bullying and cyberbullying has a significant detrimental impact on multiple dimensions of development. Several studies have documented its disruptive influence on mental health, showing an increase in depressive and anxious symptoms (Kirkbride et al., 2024), impairments in emotional maturation and social competence (Nasti et al., 2023) and affects the general well-being of ado-

lescents, affecting their psychological balance and perception of safety (Benítez-Sillero et al., 2021; Kirkbride et al., 2024). It is relevant to highlight that not only direct victims present negative consequences: aggressors and observers also experience significant alterations, contributing to the degradation of school climate and hindering social and academic adaptation processes (Al-Turif & Al-Sanad, 2023; Ganotz et al., 2023; Iñiguez-Berrozpe et al., 2021; Soto-García et al., 2024).

Among the multiple problems shown that can result from exposure to bullying and cyberbullying in adolescence is significant sleep disturbance, a key factor in the comprehensive development of students (Sampasa-Kayinga et al., 2022). Sleep is divided into several phases, including light sleep and deep sleep. Light sleep comprises the initial stages of rest and represents the transition between wakefulness and deep sleep (McConnell et al., 2022). In this stage, brain activity begins to slow down, muscles relax and the body prepares for more restorative phases, although it can still be easily awakened (McConnell et al., 2022). Deep sleep, on the other hand, is a critical stage of rest in which the body performs essential functions of physical recovery, immune system strengthening, cell growth, and memory consolidation (Geva-Sagiv et al., 2023). During this phase, the brain shows slow and synchronized waves, metabolic activity decreases and it is very difficult to wake up (Geva-Sagiv et al., 2023).

Based on this, evidence indicates that repeated victimization experiences generate a state of physiological and emotional hyperalertness that directly interferes with the processes of sleep reconciliation and maintenance (Wang et al., 2025). In particular, it has been observed that adolescents who suffer bullying or cyberbullying present a reduction in deep sleep, which is related to physical recovery, memory consolidation and stress regulation (Geva-Sagiv et al., 2023). Likewise, an increase in light sleep time is observed, characterized by frequent awakenings (McConnell et al., 2022).

The inclusion of covariates such as age, sex, body mass index (BMI) and moderate-vigorous physical activity level is essential to ensure the validity of findings in studies exploring the relationship between bullying and cyberbullying and adolescent sleep. Recent research has shown that these factors not only directly influence sleep quality and duration, but also affect exposure to bullying and its consequences. For example, age determines sleep architecture, with older adolescents being more vulnerable to sleep deprivation when faced with stressful situations such as bullying (Sampasa-Kanyinga et al., 2022). Gender also modulates this relationship, as systematic differences have been observed between boys and girls in both the prevalence of bullying and how these experiences affect nighttime rest and mental health (Islam et al., 2021). Likewise, elevated BMI has been linked to an increased risk of sleep disturbances, such as reduced deep sleep, as well as increased likelihood of victimization, especially in early adolescence (Ji et al., 2021). Finally, we chose to include only moderate to vigorous intensity physical activity, as recent studies show that this type of activity has the most consistent and significant associations with lower levels of bullying and cyberbullying, whereas light physical activity does not show clear protective effects or robust associations with these psychosocial variables (Rusillo-Magdaleno et al., 2024).

Therefore, the aim of the present study was to analyze the association between exposure to bullying and cyberbullying situations (victimization and aggression) and the deep and light sleep phases of students. Given that recent research has shown associations between bullying and various psychological and physiological alterations, it is relevant to explore this relationship from a cross-sectional approach, in order to provide descriptive evidence on how these experiences are linked to sleep architecture.

Method

Participants

A total of 985 Spanish youth (n = 523 girls; n = 462 boys) from educational centers in Andalusia, southern Spain, participated in this cross-sectional study. The students were between 10 and 16 years old (13.2 ± 1.65 years) and had a body mass index (BMI) of 20.33 ± 4.01 kg/m². Statistically significant gender differences were observed in weight ($p < .001$), height ($p < .001$), maternal education level ($p < .001$), and deep sleep ($p = .004$). Participants were selected through convenience sampling from the participating schools. Table 1 presents the anthropometric and sociodemographic characteristics of the sample.

Table 1
Sociodemographic characteristics and behaviors by sex

Variables	All		Boys		Girls		
	(n=985)		(n=462)		(n=523)		
	Mean	SD	Mean	SD	Mean	SD	<i>p</i>
Age (years)	13.2	1.65	13.25	1.8	13.15	1.5	.91
Weight (Kg)	51.6	12.5	53	14	50.2	11	< .001
Height (m)	1.59	.15	1.61	0.2	1.56	.1	< .001
BMI (Kg/m²)	20.36	4	20.50	3.92	20.22	4.08	.156
Mod-Vig PA (min/day)	73.06	71.04	69.38	49.89	76.16	84.78	.121
Bullying victimization	1.85	.80	1.87	.84	1.83	.77	.44
Bullying aggression	1.51	.61	1.58	.63	1.43	.57	< .001
Cyberbullying victimization	1.26	.44	1.27	.46	1.25	.42	.261
Cyberbullying aggression	1.18	.40	1.19	.39	1.18	.42	.585
Average of Min./day of Light Sleep	362.75	97.59	363.6	97.63	361.9	97.55	.7
Average of Min./day of Deep Sleep	97.6	53	92	50.18	103.2	55.9	.004

Note. Includes, experiences of school bullying and cyberbullying, average minutes of moderate/vigorous physical activity, and light/deep sleep duration. Data are presented as means for continuous variables and frequencies (%) for categorical variables. BMI = body mass index; SD = standard deviation; Mod-Vig PA = Moderated-vigorous Physical activity.

Measures

Independent Variables: Bullying and cyberbullying

To measure the level of bullying we used the “European Bullying Intervention Project Questionnaire”, in its Spanish version validated by Ortega-Ruiz et al. (2016), consisting of 14 items. For the assessment of cyberbullying, the Spanish version of the “European Cyberbullying Intervention Project Questionnaire” (ECIPQ) (Del Rey et al., 2015), consisting of 22 items, was used. Reliability scores are high for both bullying (Crombach's α victimization = .840 and Crombach's α aggression = .814) and cyberbullying (α cybervictimization = .872 and α cyberaggression = .877). The questionnaires were administered individually and use a 5-point Likert scale, where 1 corresponds to “Never” and 5 to “More than once a week”. The items analyze the frequency of occurrence of bullying behaviors in the last two months, and the estimated time to complete both questionnaires is approximately 15 minutes.

Dependent Variables: Light and Deep Sleep

For the analysis of deep and light sleep, the Xiaomi Mi Band 4 smart bracelet was used. This activity monitoring device has demonstrated adequate levels of validity and reliability in previous research (De la Casa-Pérez et al., 2022). For the present study, data corresponding to the daily duration of sleep in its deep and light phases were collected, and the average daily minutes of each of these phases was used as the analysis variable. The choice of this device responds to its ease of use in school contexts, its accessibility and its ability to provide differentiated information on sleep architecture.

Confounding Variables: BMI, sex, age and Physical Activity.

Previous studies have identified age, sex, and BMI as variables that influence both bullying and cyberbullying (Rusillo-Magdaleno et al., 2024) and sleep patterns in adolescents (Keyes et al., 2015). Therefore, these variables were considered covariates in the present study. Body weight and height were measured using an ASIMED® Type B Class III digital scale (Barcelona, Spain) and a SECA® 214 portable stadiometer (SECA Ltd., Hamburg, Germany). All measurements were performed with participants dressed in light clothing and without footwear. BMI was calculated as weight (kg)/height² (m). Minutes and intensity of physical activity practice were extracted from the Xiaomi Mi Band 4 smart wristband. A previous study validated the use of this device for daily monitoring of heart rate data (De la Casa-Pérez et al., 2022). For the identification of moderate to vigorous intensity, the classification criteria established by the American Heart Association (2024) were used, defining moderate intensity as 50-70 % of maximum heart rate; and vigorous intensity as 70-85 % of maximum heart rate. Sociodemographic information was collected by means of a structured questionnaire, which included questions on the age and family history of the participants.

Procedure

To carry out this study, both the directors and teachers of the participating centers were informed and informed consent was obtained from the parents or legal guard-

ians. A verbal and written description of the nature and purpose of the study was given to students, parents and legal guardians. To guarantee the anonymity and confidentiality of the participants, the researchers provided a unique anonymous code. Data collection was recollected during the school hours assigned to the research. The process was divided into two main phases. In the first phase, participants' sleep and heart rate data were collected using Xiaomi Mi Band 4 smartbands for seven consecutive days. Each participant was required to continuously wear this device on their left wrist for nine days. These activity wristbands had been previously configured with the individual anthropometric data. For the analysis, only data from 7 days were taken into account, i.e., days 2 to 8, excluding the first and the last day, since data from complete days were not obtained. In the second phase, sociodemographic data were collected by means of structured questionnaires. The study was approved by the Bioethics Commission of the University of Jaén (Spain), reference NOV.22/2.PRY. The design took into account the current Spanish legal regulations governing clinical research in humans (Royal Decree 561/1993 on clinical trials), as well as the fundamental principles established in the Declaration of Helsinki (2013, Brazil).

Statistical Analysis

Data were expressed as means and standard deviations for continuous variables and as percentages for categorical variables. Differences between sexes in continuous variables were assessed using t-tests for independent samples. To explore the association between bullying and cyberbullying victims and aggressors and sleep duration (deep and light sleep), multiple linear regression tests were performed. In this design, sleep variables were set as dependent, and levels of exposure to bullying and cyberbullying as independent variables. Age, sex, BMI, and moderate- and vigorous-intensity physical activity were considered as covariates. All statistical analyses were performed using SPSS software, version 25.0 (IBM Corp., Armonk, NY, USA). A 95% confidence level ($p < .05$) was used for all results. The study was approved by the Bioethics Commission of the University of Jaén (Spain), reference NOV.22/2.PRY. The design took into account the current Spanish legal regulations governing clinical research in humans (Royal Decree 561/1993 on clinical trials), as well as the fundamental principles established in the Declaration of Helsinki (2013, Brazil).

Results

Association Between bullying victimization and Light/Deep Sleep, adjusted for BMI, sex, age and Physical Activity.

Table 2 presents the associations between bullying victimization and sleep outcomes, adjusted by physical activity, BMI, sex and age. Higher levels of bullying victimization were significantly associated with less light sleep ($\beta = -0.267$; standard error (SE) = 3.649; $p = .049$) and less deep sleep ($\beta = 1.479$; SE = 2.099; $p = .048$).

Table 2
Association between bullying victimization and light/deep sleep

Variables	Light Sleep			Deep Sleep		
	β	SE	<i>p</i>	β	SE	<i>p</i>
Age (years)	-19.184	1.666	.000	1.382	.945	.144
Sex	-4.767	5.713	.404	6.679	3.248	.040
BMI (Kg/m ²)	-.208	.756	.784	-.684	.428	.111
Mod-Vig PA (min/day)	-.106	.049	.031	.089	.023	<.001
Bullying victimization	-7.267	3.694	.049	-1.479	2.099	.048

Note. These results are adjusted for physical activity, BMI, sex, and age. *Non-standardized Beta* (β), standard error (SE), BMI = body mass index (kg/m²). Mod-Vig PA = Moderated-vigorous Physical activity.

Association Between bullying agression and Light/Deep Sleep, adjusted for BMI, sex, age and Physical Activity.

Table 3 presents the associations between bullying aggression and sleep outcomes, adjusted by physical activity, BMI, sex and age. Bullying aggression were not associated with light nor deep sleep (*p* < 0.05).

Table 3
Association between bullying agression and light/deep sleep

Variables	Light Sleep			Deep Sleep		
	β	SE	<i>p</i>	β	SE	<i>p</i>
Age (years)	-18.690	1.647	.000	1.242	.933	.183
Sex	-5.281	5.731	.357	6.591	3.253	.043
BMI (Kg/m ²)	-.292	.756	.700	-.646	.427	.131
Mod-Vig PA (min/day)	-.101	.049	.041	.087	.022	<.001
Bullying agression	-3.864	4.824	.423	-2.074	2.738	.449

Note. These results are adjusted for physical activity, BMI, sex, and age. *Non-standardized Beta* (β), standard error (SE), BMI = body mass index (kg/m²). Mod-Vig PA = Moderated-vigorous Physical activity.

Association Between cyberbullying victimization and Light/Deep Sleep, adjusted for BMI, sex, age and Physical Activity.

Table 4 presents the associations between cyberbullying victimization and sleep outcomes, adjusted by physical activity, BMI, sex and age. Higher levels of cyberbullying

victimization were significantly associated with less deep sleep ($\beta = -5.278$; standard error (SE) = 3.939; $p = .018$).

Table 4
Association between cyberbullying victimization and light/deep sleep

Variables	Light Sleep			Deep Sleep		
	β	SE	p	β	SE	p
Age (years)	-18.615	1.643	.000	1.280	.932	.170
Sex	-4.647	5.717	.416	6.884	3.247	.034
BMI (Kg/m ²)	-.249	.755	.742	-.632	.427	.139
Mod-Vig PA (min/day)	-.100	.049	.042	.088	.022	<.001
Cyberbullying victimization	-12.874	6.934	.064	-5.278	3.939	.018

Note. These results are adjusted for physical activity, BMI, sex, and age. *Non-standardized Beta* (β), standard error (SE), BMI = body mass index (kg/m²). Mod-Vig PA = Moderated-vigorous Physical activity.

Association Between cyberbullying aggression and Light/Deep Sleep, adjusted for BMI, sex, age and Physical Activity.

Table 5 shows the associations between cyberbullying aggression and sleep outcomes, adjusted by physical activity, BMI, sex and age. Cyberbullying aggression were not associated with light nor deep sleep ($p < 0.05$).

Table 5
Association between cyberbullying aggression and light/deep sleep

Variables	Light Sleep			Deep Sleep		
	β	SE	p	β	SE	p
Age (years)	-18.575	1.645	.000	1.309	.0932	.160
Sex	-4.699	5.725	.412	6.935	3.248	.033
BMI (Kg/m ²)	-.316	.755	.676	-.657	.427	.124
Mod-Vig PA (min/day)	-.098	.049	.046	.088	.088	<.001
Cyberbullying aggression	-9.103	7.325	.214	-5.860	4.156	.159

Note. These results are adjusted for physical activity, BMI, sex, and age. *Non-standardized Beta* (β), standard error (SE), BMI = body mass index (kg/m²). Mod-Vig PA = Moderated-vigorous Physical activity.

Discussion

The aim of the present study was to analyze the association between exposure to bullying and cyberbullying situations (victimization and aggression) and the deep and light sleep phases of students. Given that recent research has shown associations between bullying and various psychological and physiological alterations, it is relevant to explore this relationship from a cross-sectional approach, in order to provide descriptive evidence on how these experiences are linked to sleep architecture. The results obtained show that experiences of bullying and cyberbullying are significantly associated with sleep duration and quality in adolescents. Specifically, victimization—both in traditional and digital forms—is associated with shorter duration and poorer quality of sleep, affecting both light and deep phases. Conversely, aggression, whether in bullying or cyberbullying contexts, did not show significant associations with the duration or quality of these sleep phases.

The association found between bullying victimization and worst sleep is consistent with that reported by multiple previous studies. For example, Hasan et al. (2022) identified that adolescent victims of bullying are up to 2.65 times more likely to suffer severe sleep loss due to worry. Similarly, another study found that young victims have greater sleep disturbances, such as insomnia and nighttime fears (Donoghue & Meltzer, 2018). However, studies such as Chen and Wu (2023) suggest a reverse direction: exposing that sleep problems may precede victimization. These effects may be because victimization generates a state of emotional hypervigilance, anticipatory anxiety, and heightened negative affect, which hinders the processes of deep sleep reconciliation and maintenance (Chen & Wu, 2023).

The association between cyberbullying victimization and poorer deep sleep quality is well supported in the literature. A recent study by Wang et al. (2025) showed that both traditional and digital victimization predict, at the daily level, poorer sleep quality and greater negative affect the following day. Similarly, Sampasa-Kanyinga et al. (2018) found that online victimization is associated with shorter sleep duration, mediated by elevated levels of psychological distress. However, other authors caution that, under certain levels of social support, the relationship between cyberbullying and sleep may be attenuated (Mang et al., 2023). These results underline the mediating role of variables such as anxiety or emotional support in the association between digital victimization and sleep disturbances.

Notably, the observed associations between bullying and cyberbullying victimization with significantly reduced time and quality of light and deep sleep are maintained after adjustment for confounding variables. This pattern has been corroborated by recent empirical evidence demonstrating that the relationship between victimization and sleep dysfunction persists independently of these sociodemographic and behavioral factors (Mang et al., 2023; Nagata et al., 2022; Sampasa-Kanyinga et al., 2022; Wang et al., 2025). This may be explained as sustained victimization may induce an alteration characterized by an overactivation of the sympathetic nervous system during nighttime rest (Kwon et al., 2020). However, this process is not substantially modulated by age or BMI, as neuroendocrine and emotional dysregulation resulting from victimization can affect individuals of different physiological profiles (Hasan et al., 2022). On the other hand, some covariates, such as gender and physical activity, may have a partial modulatory effect. Studies have shown that girls are more vulnerable to insom-

nia and physiological hyperarousal to stressful events, which could amplify the impact of bullying on sleep in this population (Sarabadani & Morovati, 2022). Likewise, high levels of physical activity have been related to a greater regulation of the autonomic nervous system, which could exert a protective effect by partially attenuating the negative effects of victimization on sleep (Lins-Filho et al., 2022).

The results of the present study showed no statistically significant associations between aggression behaviors, both in traditional bullying and cyberbullying contexts, and the sleep variables assessed. This finding is consistent with studies such as Chen and Wu (2023), who found no relationship between aggression and sleep problems in a longitudinal analysis, which could be explained by individual and contextual factors such as the type of aggression (physical, verbal, or digital), cultural differences, or the lower immediate emotional burden experienced by aggressors (Broekhof et al., 2018). However, other works, such as those by Hysing et al. (2021) and Donoghue and Meltzer (2018), have indeed documented that adolescents with aggressive behaviors present higher prevalence of insomnia and parasomnias. One possible explanation for this discrepancy is that, in certain cases, aggressors may develop delayed emotional effects such as guilt that alter sleep in the medium term (Nagata et al., 2023).

Conclusions

The results obtained allow us to conclude that involvement in bullying phenomena, especially in the role of victim, both in bullying and cyberbullying, is significantly associated with sleep disturbances during adolescence. In contrast, aggression, particularly in face-to-face contexts, does not show a consistent relationship with sleep variables. These findings highlight the need to address the different forms of victimization in school and clinical interventions, considering their potential impact on the physical and emotional well-being of young people. All this, considering the control of relevant covariates such as age, sex, BMI and the practice of physical activity with moderate and vigorous intensity.

Practical recommendations

The relationship between bullying and cyberbullying victimization and sleep quality in young people underscores the urgent need for action at home and school. The emotional impact of these experiences can alter both deep and light sleep, directly affecting physical and mental well-being. To mitigate these effects, it is key to promote safe and trusting environments where students can talk without fear, while establishing family routines that favor good rest: regular bedtimes, digital disconnection before bedtime and relaxing activities. These actions should be adapted taking into account factors such as age, since sleep changes as the nervous system and school demands develop; gender, because boys and girls may experience and process bullying in different ways, which affects their rest; body mass index, since a high BMI is associated with respiratory disorders such as sleep apnea, which fragments rest and reduces its quality; and levels of moderate to vigorous physical activity, which favor a more restful sleep and help manage daily stress.

Limitations

This study also has significant strengths that reinforce the robustness of the data collected. These included the implementation of coding procedures that guaranteed the anonymity and confidentiality of the information, the use of validated instruments with high levels of reliability, as well as rigorous data collection and strict adherence to the established protocols. Finally, the inclusion of covariates such as age, sex, BMI and average moderate/vigorous physical activity has made it possible to generate relevant and original findings in the field of educational research. However, this study presents a series of methodological and procedural limitations that should be pointed out with precision. One of the most relevant is the cross-sectional nature of the design, which prevents the establishment of causal relationships between the variables analyzed and whose validity is conditioned by the honesty and precision of the answers provided by the participants. Likewise, the convenience sampling used limits the generalizability of the results to the Spanish youth population as a whole. Additionally, the Xiaomi Mi Band 4 smart wristband presents some limitations due to the tendency to slightly overlap light HR data with resting, leading to an estimated overestimation of ~5% (De la Casa et al., 2022). In addition, the device performance does not identify possible sleep problems or sleep disorders. Therefore, caution is advised when interpreting the sleep data provided by these devices.

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Institutional Review Board Statement

The study was performed in accordance with the Declaration of Helsinki, and was approved by the Ethics Committee of the University of Jaén (Spain) (protocol code: NOV.22/2.PRY approved on January 13, April 2023) for studies involving human subjects. Informed consent was obtained from all subjects and their guardians involved in the study.

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Conflict of Interest

The authors declare no conflict of interest

References

- Al-Turif, G. A., & Al-Sanad, H. A. (2023). The repercussions of digital bullying on social media users. *Frontiers in psychology, 14*(1). 1280757. <https://doi.org/10.3389%2Ff-psyg.2023.1280757>
- American Heart Association. (2024). *Target heart rates*. <https://www.heart.org/en/healthy-living/fitness/fitness-basics/target-heart-rates>

- Armitage, R. (2021). Bullying in children: impact on child health. *BMJ paediatrics open*, 5(1). <https://doi.org/10.1136%2Fbmjpo-2020-000939>
- Benítez-Sillero, J. D. D., Corredor-Corredor, D., Ortega-Ruiz, R., & Córdoba-Alcaide, F. (2021). Behaviours involved in the role of victim and aggressor in bullying: Relationship with physical fitness in adolescents. *PLoS one*, 16(11), e0259087. <https://doi.org/10.1371/journal.pone.0259087>
- Boichuk, O., Lyebiedyeva, Y., Stadnyk, M., Mishchuk, A., & Shcherbin, L. (2023). Effectiveness of virtual space in the socialization process of teenagers (under martial law). *Amazonia Investiga*, 12(63), 266-276. <https://doi.org/10.34069/AI/2023.63.03.25>
- Broekhof, E., Bos, M. G., Camodeca, M., & Rieffe, C. (2018). Longitudinal associations between bullying and emotions in deaf and hard of hearing adolescents. *The Journal of Deaf Studies and Deaf Education*, 23(1), 17-27. <https://doi.org/10.1093/deafed/enx036>
- Chen, J. K., & Wu, W. C. (2023). Associations of sleep problems with non-physical bullying perpetration and victimization among adolescents: A cross-lagged panel study. *Sleep health*, 9(2), 144-150. <https://doi.org/10.1016/j.sleh.2022.10.007>
- Cretu, D. M., & Morandau, F. (2022). Bullying and cyberbullying: a bibliometric analysis of three decades of research in education. *Educational Review*, 1-34. <https://doi.org/10.1080/00131911.2022.2034749>
- De la Casa-Pérez, A., Latorre-Román, P. Á., Muñoz-Jiménez, M., Lucena-Zurita, M., Laredo-Aguilera, J. A., Párraga-Montilla, J. A., Cabrera-Linares, J.C. (2022). ¿Es la Xiaomi mi Band 4 una herramienta de precisión para medir parámetros relacionados con la salud en adultos y personas mayores? Un estudio de validación original. *International Journal of Environmental Research and Public Health*, 19, 1593. <https://doi.org/10.3390/ijerph19031593>
- Del Rey, R., Casas, J. A., Ortega-Ruiz, R., Schultze-Krumbholz, A., Scheithauer, H., Smith, P., Thompson, F., Barkoukis, V., Tsorbatzoudis, H., Brighi, A., Guarini, A., Pyzalski, J., & Plichta, P. (2015). Structural validation and cross-cultural robustness of the European Cyberbullying Intervention Project Questionnaire. *Computers in Human Behavior*, 50(1), 141-147. <https://doi.org/10.1016/j.chb.2015.03.065>
- Donoghue, C., & Meltzer, L. J. (2018). Sleep it off: Bullying and sleep disturbances in adolescents. *Journal of Adolescence*, 68, 87-93. <https://doi.org/10.1016/j.adolescence.2018.07.012>
- Ferrás, S. D., & Selman, R. (2014). How students' perceptions of the school climate influence their choice to upstand, bystand, or join perpetrators of bullying. *Harvard Educational Review*, 84(2), 162-187. <https://doi.org/10.17763/haer.84.2.h488313410l651mm>
- Ganotz, T., Schwab, S., & Lehofer, M. (2023). Bullying among primary school-aged students: which factors could strengthen their tendency towards resilience? *International Journal of Inclusive Education*, 27(8), 890-903. <https://doi.org/10.1080/13603116.2021.1879949>
- Geva-Sagiv, M., Mankin, E. A., Eliashiv, D., Epstein, S., Cherry, N., Kalender, G., ... & Fried, I. (2023). Augmenting hippocampal–prefrontal neuronal synchrony during sleep enhances memory consolidation in humans. *Nature neuroscience*, 26(6), 1100-1110. <https://doi.org/10.1038/s41593-023-01324-5>

- González-González, E. N., Peña-Ramos, M. O., & Vera-Noriega, J. Á. (2017). Validación de una escala de roles de víctimas y agresores asociados al acoso escolar. *Electronic Journal of Research in Educational Psychology*, 15(1), 224-239. <http://www.redalyc.org/articulo.oa?id=293150349010>
- Hasan, M. M., Fatima, Y., Smith, S. S., Tariqujjaman, M., Jatrana, S., & Mamun, A. A. (2022). Geographical variations in the association between bullying victimization and sleep loss among adolescents: a population-based study of 91 countries. *Sleep Medicine*, 90, 1-8. <https://doi.org/10.1016/j.sleep.2021.12.014>
- Hysing, M., Askeland, K. G., La Greca, A. M., Solberg, M. E., Breivik, K., & Sivertsen, B. (2021). Bullying involvement in adolescence: implications for sleep, mental health, and academic outcomes. *Journal of interpersonal violence*, 36(17-18), NP8992-NP9014. <https://doi.org/10.1177/0886260519853409>
- Iñiguez-Berrozpe, T., Orejudo-Hernández, S., Ruiz-Eugenio, L., & Elboj-Saso, C. (2021). School networks of positive relationships, attitudes against violence, and prevention of relational bullying in victim, bystander, and aggressor agents. *Journal of School Violence*, 20(2), 212-227. <https://doi.org/10.1080/15388220.2021.1875842>
- Islam, M. I., Yunus, F. M., Kabir, E., & Khanam, R. (2022). Evaluating risk and protective factors for suicidality and self-harm in Australian adolescents with traditional bullying and cyberbullying victimizations. *American journal of health promotion*, 36(1), 73-83. <https://doi.org/10.1177/08901171211034105>
- Ji, X., Covington, L., & Brownlow, J. (2021). 636 Associations among sleep, physical activity and high body mass index in youth: Age differences. *Sleep*, 44(2), A249-A249. <https://doi.org/10.1093/SLEEP/ZSAB072.634>
- Keyes, K. M., Maslowsky, J., Hamilton, A., & Schulenberg, J. (2015). The great sleep recession: changes in sleep duration among US adolescents, 1991–2012. *Pediatrics*, 135(3), 460-468. <https://doi.org/10.1542/peds.2014-2707>
- Kirkbride, J. B., Anglin, D. M., Colman, I., Dykxhoorn, J., Jones, P. B., Patalay, P., Pitman, A., Sonesson, E., Steare, T., Wright, T., & Griffiths, S. L. (2024). The social determinants of mental health and disorder: evidence, prevention and recommendations. *World psychiatry*, 23(1), 58. <https://doi.org/10.1002/wps.21160>
- Kwon, M., Seo, Y. S., Nickerson, A. B., Dickerson, S. S., Park, E., & Livingston, J. A. (2020). Sleep quality as a mediator of the relationship between cyber victimization and depression. *Journal of nursing scholarship*, 52(4), 416-425. <https://doi.org/10.1111/jnu.12569>
- Lareki, A., Altuna, J., & Martínez-de-Morentin, J. I. (2023). Fake digital identity and cyberbullying. *Media, Culture & Society*, 45(2), 338-353. <https://doi.org/10.1177/01634437221126081>
- Lins-Filho, O., Andrade-Lima, A., Torres, A. D., Oliveira, L. M., do-Prado, W. L., Ritti-Dias, R., ... & Farah, B. Q. (2023). Association between sleep quality and cardiac autonomic modulation in adolescents: a cross sectional study. *Sleep Science*, 16(04), e462-e467. <https://doi.org/10.1055/s-0043-1776750>
- Maftai, A., Holman, A. C. & Merlici, I. A. (2022). Using fake news as means of cyber-bullying: The link with compulsive internet use and online moral disengagement. *Computers in Human Behavior*, 127(1), 107032. <https://doi.org/10.1016/j.chb.2021.107032>
- Mang, L., Huang, N., Liu, X., Zhen, C., & Guo, J. (2023). The interaction effects of social support and four types of bullying on sleep quality in Chinese adolescents. *Journal of affective disorders*, 341, 119-127. <https://doi.org/10.1016/j.jad.2023.08.092>

- McConnell, B. V., Kronberg, E., Medenblik, L. M., Kheyfets, V. O., Ramos, A. R., Sillau, S. H., ... & Bettcher, B. M. (2022). The rise and fall of slow wave tides: vacillations in coupled slow wave/spindle pairing shift the composition of slow wave activity in accordance with depth of sleep. *Frontiers in neuroscience*, 16, 915934. <https://doi.org/10.3389/fnins.2022.915934>
- Nagata, J. M., Yang, J. H., Singh, G., Kiss, O., Ganson, K. T., Testa, A., ... & Baker, F. C. (2023). Cyberbullying and sleep disturbance among early adolescents in the US. *Academic pediatrics*, 23(6), 1220-1225. <https://doi.org/10.1016/j.acap.2022.12.007>
- Nasti, C., Intra, F. S., Palmiero, M., & Brighi, A. (2023). The relationship between personality and bullying among primary school children: the mediation role of trait emotion intelligence and empathy. *International journal of clinical and health psychology*, 23(2), 100359. <https://doi.org/10.1016/j.ijchp.2022.100359>
- Palade, T., & Pascal, E. (2023). Reducing Bullying through Empathy Training: The Effect of Teacher's Passive Presence. *Behavioral Sciences*, 13(3), 216. <https://doi.org/10.3390/bs13030216>
- Peebles, E. (2014). Cyberbullying: Hiding behind the screen. *Paediatrics & child health*, 19(10), 527-528. <https://doi.org/10.1093/pch/19.10.527>
- Ramadan, A.R. (2023). The Relationship between Social Media use and Depression Symptoms in Jazan region In the Point of View of the Social Work Profession. *Egyptian Journal of Social Work*, 15(1), 39-56. <https://dx.doi.org/10.21608/ejsw.2023.185791.1175>
- Rusillo-Magdaleno, A., Moral-García, J. E., Brandão-Loureiro, V., & Martínez-López, E. J. (2024). Influence and Relationship of Physical Activity before, during and after the School Day on Bullying and Cyberbullying in Young People: A Systematic Review. *Education Sciences*, 14(10). <https://doi.org/10.3390/educsci14101094>
- Sampasa-Kanyinga, H., Chaput, J. P., Hamilton, H. A., & Colman, I. (2018). Bullying involvement, psychological distress, and short sleep duration among adolescents. *Social psychiatry and psychiatric epidemiology*, 53, 1371-1380. <https://doi.org/10.1007/s00127-018-1590-2>
- Sampasa-Kanyinga, H., Lien, A., Hamilton, H., & Chaput, J. (2022). Cyberbullying involvement and short sleep duration among adolescents. *Sleep health*, 675(2), 183-190. <https://doi.org/10.1016/j.sleh.2021.11.009>
- Sánchez-Domínguez, J. P., Raymundo, L. M., & Terrero, J.Y.T. (2022). Características de ciberbullying en adolescentes escolarizados. *Dilemas contemporáneos: Educación, Política y Valores*, 92(2). <https://doi.org/10.46377/dilemas.v9i2.3140>
- Sarabadani, E., & Morovati, Z. (2022). Comparison of psychological problems and sleep quality in two groups of cyberbullying victims and normal people. *Iranian Evolutionary Educational Psychology Journal*, 4(1), 103-114. <https://dor.isc.ac/dor/20.10.01.1.25884395.2022.4.1.12.2>
- Schlesier, J., Vierbuchen, M. C. & Matzner, M. (2023) anxious and skipping school? The interplay of school bullying, school anxiety and school absenteeism considering gender and grade level. *Frontiers in Education*, 8(1), 951216. <https://doi.org/10.3389/feduc.2023.951216>
- Soto-García, O. H., Sainz, V., Maldonado, A., & Calmaestra, J. (2024). The TEI Program for Peer Tutoring and the Prevention of Bullying: Its Influence on Social Skills and Empathy among Secondary School Students. *Social Sciences*, 13(1), 51. <https://doi.org/10.3390/socsci13010051>

- Wang, W., Xie, M., Liu, Z., Chen, H., Wu, X., & Lin, D. (2025). Linking Daily Victimization to Daily Affect Among Adolescents: The Mediating Role of Sleep Quality and Disturbance. *Journal of Youth and Adolescence*, 54(2), 354-367. <https://doi.org/10.1007/s10964-024-02076-6>
- Zhang, W., Huang, S., Lam, L., Evans, R., & Zhu, C. (2022). Cyberbullying definitions and measurements in children and adolescents: summarizing 20 years of global efforts. *Frontiers in public health*, 10(1), 1000504. <https://doi.org/10.3389/fpubh.2022.1000504>