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Computer Use, Sleep Difficulties, and Psychological Symptoms Among School-Aged Children: The Mediating Role of Sleep Difficulties

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Abstract

Background: Previous studies have indicated that electronic media use may affect the health of school-aged children.
Objectives: This study aimed to examine the association between computer use and psychological symptoms among Italian adolescents, taking into account the mediating role of difficulty in getting to sleep.
Patients and Methods: This study used data from 23,941 15-year-old students participating in the health behavior in school-aged children survey (mean age, 15.7 years; 50.1% girls). Self-completed questionnaires were administered in classrooms. Measures included computer use, psychological symptoms, and difficulty in getting to sleep. Structural equation modeling was used to investigate the associations among variables.
Results: On average, students spent approximately 2 hours per day using computers and about one-third of the sample reported weekly psychological symptoms (feeling low, irritable, and nervous). Further, 15.8% of Italian adolescents reported experiencing difficulties in getting to sleep more often than once a week or almost daily over the last six months. The structural equation model showed that more frequent computer use was associated with a higher frequency of psychological symptoms in adolescents, and the difficulty in getting to sleep partly mediated this association.
Conclusions: Overall, these results indicate the role of computer use in influencing the sleep quality and health of adolescents. Educational programs are recommended to increase awareness among families and students of the effects of computer use and sleep habits on health.

Keywords: Computers, Sleep, Adolescent, Health

1. Background

Electronic media use is an important part of life for children and adolescents. In the US and Europe, studies have shown that the use of computers and other electronic devices is very frequent among adolescents, with screen time ranging from 2 - 8 hours per day (1). Electronic media use has been associated with negative physical outcomes among adolescents: obesity (2), less physical activity, neck and shoulder pain, and musculoskeletal symptoms (3). Moreover, psychological symptoms seem to be related to the use of technological devices among youth, such as stress, depression, anxiety and aggression (4); attention problems; and poor sleep quality, which are particularly important to school-aged children (5). Indeed, frequent computer use has been associated with later bedtimes (6), shorter total sleep duration (7), and higher levels of subjective insomnia. Sleep is a critical issue to child and adolescent development because of its essential restorative function for physical and mental health in these life periods (8). Previous studies have demonstrated that short sleep duration and poor sleep quality can negatively affect mental health in adolescents (e.g. mood/anxiety disorders and stress) (3) and lead to memory problems (9).

Many studies have documented the relationship between new media exposure and health consequences, but very few studies have investigated the possible processes underlying this link. Bartlett et al. have suggested that sleep duration may be a mediator in the association between computer use and psychological and somatic symptoms such as headache, stomachache, and backache (10). Computer use has also shown negative consequences in other aspects of sleep behaviors: excessive use of electronic devices can not only reduce the sleep duration, but may render it more difficult to fall asleep, thus reducing the quality of sleep and causing fatigue (11), which in turn might affect the psychological well-being of adolescents.

2. Objectives

The current study aimed to contribute to existing literature by examining an additional potential mechanism explaining the association between frequency of computer use and psychological symptoms in adolescents. More specifically, the mediating role of difficulties in falling asleep was tested.

3. Patients and Methods

This study used a large sample of Italian students drawn from the 2010 "Health behaviour in school-aged children" survey, a trans-national study conducted every four years and carried out in collaboration with the European office of the world health organization (12). Self-completed questionnaires were administered in classrooms during a regular school day. Three age-groups were included in the research protocol: 11, 13, and 15-year-olds corresponding to the sixth, eighth, and tenth grades. According to the HBSC protocol, cluster sampling was used. The schools were randomly selected from the national school office's database of all Italian public schools. Then, one class for each age group (11, 13, and 15) was randomly selected in each school and all students in the selected classes were included in the sample. This design ensures the sample to be representative of the schools' student populations. Parents had to give their consent for their children to participate in the survey. The ethics committee of the national institute of health, which approved the protocol, the use of an opt-out consent form, which implied that a child would be included by default unless his or her parents chose to "opt-out" by explicitly refusing consent. Only the data obtained by surveying the 15-year-old students were used in this study because of the increasing autonomy of middle adolescents in relation to sleep habits and computer use. The questionnaire was completed by a total of 23,941 Italian adolescents (mean age, 15.7 years; 50.1% girls). The self-reporting questionnaire was devised by the HBSC international group and focuses on the health behavior of adolescents. All questionnaire items were first developed in English and subsequently translated in Italian and back-translated to English, with careful checking for consistency at the international coordinating center. Further details of the study methods and development can be found elsewhere (12). In this study, we considered the following variables: computer use, difficulty in getting to sleep, and psychological symptoms.

Computer use was assessed with two separate questions (investigating use on school days and during the weekend): "How many hours a day do you usually use a computer for chatting, surfing the internet, emailing, or doing your homework?" Responses ranged from 1 (never) to 9 (7 hours or more). Responses to questions concerning computer use on school days and during the weekend were averaged to obtain a single measure of computer use.

Difficulty in getting to sleep was assessed with a single item: "How often have you had difficulty in getting to sleep during the past six months?". Responses range from 1 (rarely or never) to 5 (every day).

Psychological symptoms were measured with three items included in the "Psychological symptoms" subscale of the symptom check list (HBSC-SCL; the reliability and validity of the instrument have been confirmed in previous studies) (13): "How often have you had the following symptoms during the past 6 months? a) Feeling low, b) irritability or bad temper, c) nervousness. Responses range from 1 (rarely or never) to 5 (every day). Cronbach's alpha for the current sample was 0.82.

Structural equation modeling was used to explore the association between computer use and psychological symptoms and the mediating role of the difficulty in getting to sleep. Data analyses were undertaken with the LISREL program.

4. Results

Descriptive statistics for the variables included in the study are presented in Table 1. On average, students spent approximately 2 hours per day using computers (mean, 3.85, i.e. 3 = about one hour a day and 4 = about two hours a day; SD, 1.89) and about one-third (36.1%) of the sample reported at least two psychological symptoms per week. In relation to sleeping, 15.8% of the adolescents included in the study reported to have experienced difficulties in getting to sleep more often than once a week or almost daily during the last six months. The structural equation model achieved fits in our group (the model explained 12% of the variance in psychological symptoms). A direct positive association between computer use and psychological symptoms was found ($\beta = 0.14$, $P < 0.001$; Figure 1). The association between computer use and psychological symptoms was partly mediated by difficulty in getting to sleep: more frequent computer use was associated with more difficulties in getting to sleep ($\beta = 0.08$, $P < 0.001$), which in turn were positively associated with psychological symptoms ($\beta = 0.31$, $P < 0.001$). An indirect association between computer use and psychological symptoms through difficulties in getting to sleep was also found ($\beta = 0.02$, $P < 0.001$). Considering the well-known gender differences in psychological symptoms (14), separate analyses were undertaken to test gender differences, and the results showed that the same model fitted for both gender groups with no differ-

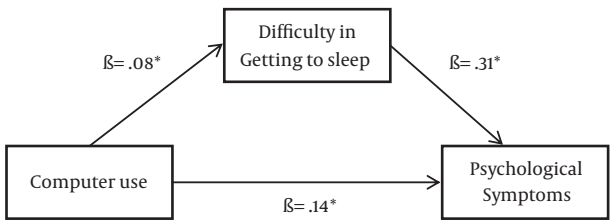
ence between boys and girls (all chi-square test p values > 0.10).

Table 1. Sample Characteristics[a]

Demographic	Values
Female[b]	50.1
Age, y	15.7
Difficulty in getting to sleep[b]	
Rarely or never	59.7
Monthly	14.5
Weekly	10.0
More often than weekly	9.3
Daily	6.5
Computer use, score[c]	3.85 ± 1.89
Psychological symptoms at least weekly[b]	
Feeling low	35.9
Irritability or bad temper	34.1
Feeling nervous	40.7

[a] N = 23,941.
[b] Values' unit is %.
[c] Value are expressed as mean ± SD

Figure 1. Associations Between Computer Use, Sleep Duration, and Psychological Symptoms Among 15-Year-Old Italian Students



Standardized regression weights, *P < 0.001.

5. Discussion

This study showed that frequent computer use among Italian adolescents was associated with more frequent psychological symptoms and that the difficulty in getting to sleep was partly responsible for this association. This finding is in line with results from previous studies with European adolescents (1, 10), and it reinforces the idea that intensive computer use can negatively influence adolescents' health by affecting sleep quality and consequently their psychological well-being. This link could be explained in several ways. Electronic media use may make it difficult to fall asleep by increasing the physiological and mental arousal and suppressing the melatonin secretion due to the bright light of the screen (15, 16). According to previous findings from Do et al. (17), sleeping disturbances may affect adolescents' feelings of nervousness and irritably. The lack of sleep might interfere with cognitive functions, making it more difficult to concentrate and focus on daily tasks, leading to tiredness, anxiety, and even depression (2). The positive correlation between frequent computer use and psychological symptoms demonstrates that excessive computer use and sleep disturbances could represent a relevant public health concern considering the widespread use of technology devices in human life (3). This study has some limitations. First, the total variance explained with the model is modest, even though it is in line with common effect sizes in the epidemiological field. Second, the HBSC protocol only includes difficulties in getting to sleep as a measure of sleep disturbances; studying additional indicators of sleeping behavior such as sleep duration would have enabled the comparison of our findings with those reported in previous research on sleep disturbances and psychological well-being. Moreover, the cross-sectional design of this study did not allow us to draw strong conclusions on the direction of the effects: anxiety symptoms might also make it more difficult to fall asleep (18); at the same time, adolescents might use computers as a strategy to relax and reduce feelings of nervousness. Although several studies (1) support the idea that high computer use and short sleep duration are causally related to psychological and somatic symptoms, future longitudinal research is needed to clarify this relation (for example, by evaluating their potential reciprocal association). These limitations notwithstanding, the strength of this study lies in the use of a large representative sample of Italian adolescents and in the evaluation of the mechanism that is potentially responsible for the association between computer use and psychological symptoms. In conclusion, this study pointed out that intensive computer use might influence the quality of sleep among adolescents, which might in turn lead to negative psychological symptoms. Given the significant role of computer use in influencing adolescents' health and given the widespread use of technological devices among adolescents worldwide, educational programs should account for these aspects of adolescents' lives. Prevention programs that promote responsible computer use among adolescents and those that teach parents how to monitor their kids' electronic equipment and habits are recommended (1); these programs can help reduce the risk of developing psychological symptoms and sleeping difficulties.

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Footnote

Authors' Contribution: Study concept and design: Alessio Vieno and Claudia Marino; analysis and interpretation of data: Claudia Marino and Alessio Vieno; drafting of the manuscript: Claudia Marino; critical revision of the manuscript for important intellectual content: Michela Lenzi, Alberto Borraccino, Giacomo Lazzeri, and Patrizia Lemma.

References

1. Nuutinen T, Roos E, Ray C, Villberg J, Valimaa R, Rasmussen M, et al. Computer use, sleep duration and health symptoms: a cross-sectional study of 15-year olds in three countries. *Int J Public Health.* 2014;**59**(4):619–28. doi: 10.1007/s00038-014-0561-y. [PubMed: 24848704].
2. Rosen LD, Lim AF, Felt J, Carrier LM, Cheever NA, Lara-Ruiz JM, et al. Media and technology use predicts ill-being among children, preteens and teenagers independent of the negative health impacts of exercise and eating habits. *Comput Human Behav.* 2014;**35**:364–75. doi: 10.1016/j.chb.2014.01.036. [PubMed: 25717216].
3. Thomee S, Harenstam A, Hagberg M. Computer use and stress, sleep disturbances, and symptoms of depression among young adults–a prospective cohort study. *BMC Psychiatry.* 2012;**12**:176. doi: 10.1186/1471-244X-12-176. [PubMed: 23088719].
4. Messias E, Castro J, Saini A, Usman M, Peeples D. Sadness, suicide, and their association with video game and internet overuse among teens: results from the youth risk behavior survey 2007 and 2009. *Suicide Life Threat Behav.* 2011;**41**(3):307–15. doi: 10.1111/j.1943-278X.2011.00030.x. [PubMed: 21463355].
5. Cain N, Gradisar M. Electronic media use and sleep in school-aged children and adolescents: A review. *Sleep Med.* 2010;**11**(8):735–42. doi: 10.1016/j.sleep.2010.02.006. [PubMed: 20673649].
6. Li S, Jin X, Wu S, Jiang F, Yan C, Shen X. The impact of media use on sleep patterns and sleep disorders among school-aged children in China. *Sleep.* 2007;**30**(3):361–7. [PubMed: 17425233].
7. Yen CF, Ko CH, Yen JY, Cheng CP. The multidimensional correlates associated with short nocturnal sleep duration and subjective insomnia among Taiwanese adolescents. *Sleep.* 2008;**31**(11):1515–25. [PubMed: 19014071].
8. Alexandru G, Michikazu S, Shimako H, Xiaoli C, Hitomi K, Takashi Y, et al. Epidemiological aspects of self-reported sleep onset latency in Japanese junior high school children. *J Sleep Res.* 2006;**15**(3):266–75. doi: 10.1111/j.1365-2869.2006.00530.x. [PubMed: 16911029].
9. Dewald JF, Meijer AM, Oort FJ, Kerkhof GA, Bogels SM. The influence of sleep quality, sleep duration and sleepiness on school performance in children and adolescents: A meta-analytic review. *Sleep Med Rev.* 2010;**14**(3):179–89. doi: 10.1016/j.smrv.2009.10.004. [PubMed: 20093054].
10. Barlett ND, Gentile DA, Barlett CP, Eisenmann JC, Walsh DA. Sleep as a Mediator of Screen Time Effects on US Children's Health Outcomes. *J Child Media.* 2012;**6**(1):37–50. doi: 10.1080/17482798.2011.633404.
11. Owens J, Maxim R, McGuinn M, Nobile C, Msall M, Alario A. Television-viewing habits and sleep disturbance in school children. *Pediatrics.* 1999;**104**(3):ee27. [PubMed: 10469810].
12. Lazzeri G, Giacchi MV, Dalmasso P, Vieno A, Nardone P, Lamberti A, et al. The methodology of the Italian HBSC 2010 study (Health Behaviour in School-aged Children). *Ann Ig.* 2013;**25**(3):225–33. doi: 10.7416/ai.2013.1925. [PubMed: 23598806].
13. Haugland S, Wold B. Subjective health complaints in adolescence–reliability and validity of survey methods. *J Adolesc.* 2001;**24**(5):611–24. doi: 10.1006/jado.2000.0393. [PubMed: 11676508].
14. Cavallo F, Zambon A, Borraccino A, Raven-Sieberer U, Torsheim T, Lemma P. Girls growing through adolescence have a higher risk of poor health. *Qual Life Res.* 2006;**15**(10):1577–85. doi: 10.1007/s11136-006-0037-5. [PubMed: 17033911].
15. Dworak M, Schierl T, Bruns T, Struder HK. Impact of singular excessive computer game and television exposure on sleep patterns and memory performance of school-aged children. *Pediatrics.* 2007;**120**(5):978–85. doi: 10.1542/peds.2007-0476. [PubMed: 17974734].
16. Magee CA, Lee JK, Vella SA. Bidirectional relationships between sleep duration and screen time in early childhood. *JAMA Pediatr.* 2014;**168**(5):465–70. doi: 10.1001/jamapediatrics.2013.4183. [PubMed: 24589672].
17. Do YK, Shin E, Bautista MA, Foo K. The associations between self-reported sleep duration and adolescent health outcomes: what is the role of time spent on Internet use?. *Sleep Med.* 2013;**14**(2):195–200. doi: 10.1016/j.sleep.2012.09.004. [PubMed: 23068781].
18. Alvaro PK, Roberts RM, Harris JK. The independent relationships between insomnia, depression, subtypes of anxiety, and chronotype during adolescence. *Sleep Med.* 2014;**15**(8):934–41. doi: 10.1016/j.sleep.2014.03.019. [PubMed: 24958244].