ORIGINAL ARTICLE

Insomnia symptoms among Greek adolescent students with excessive computer use

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Abstract

Background: The aim of the present study is to assess the intensity of computer use and insomnia epidemiology among Greek adolescents, to examine any possible age and gender differences and to investigate whether excessive computer use is a risk factor for developing insomnia symptoms.

Patients and Methods: Cross-sectional study of a stratified sample of 2195 high school students. Demographic data were recorded and two specific questionnaires were used, the Adolescent Computer Addiction Test (ACAT) and the Athens Insomnia Scale (AIS).

Results: Females scored higher than males on insomnia complaints but lower on computer use and addiction. A dose-mediated effect of computer use on insomnia complaints was recorded. Computer use had a larger effect size than sex on insomnia complaints. Duration of computer use was longer for those adolescents classified as suffering from insomnia compared to those who were not.

Conclusions: Computer use can be a significant cause of insomnia complaints in an adolescent population regardless of whether the individual is classified as addicted or not. Hippokratia 2010; 14 (3): 203-207

Key words: insomnia, computer use, adolescent, case control, ACAT scale

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Recent advances in computer science have led to an increase in computer use worldwide. Estimated number of users has risen above 1.7 billion in 2009[1].

Computer use is widely spread among children and adolescents who use computers for studying, communicating, playing, searching information. Research findings have demonstrated the positive effects of computer use on cognitive skills, intelligence, school performance[2].

On the other hand, there is growing concern about the negative aspects of intensive computer use. There is substantial evidence that excessive computer use is associated with negative consequences on physical and psychological well-being of children and adolescents. Frequent computer related activities increase the risk of neck-shoulder and low back pain in adolescents[3]. Excessive computer use is related to obesity among adolescents[4].

Adequate sleep is crucial for mental health, normal growth and development in children. Insufficient sleep is associated with impairments such as decreased attention, impulsivity, behavioral problems and low school performance[5]. Insomnia has a negative impact on physical interpersonal and psychological functioning of adolescents[6]. More attention needs to be directed to identifying causal pathways of sleep disturbances.

Researchers have found that computer game playing is associated with reduced duration of sleep and early awakening on weekdays[7]. Extensive viewing of the computer screen can lead to eye discomfort, fatigue, blurred vision and headaches, factors which can affect sleep paterns[8]. Excessive computer game-playing resulted in significantly reduced amounts of slow wave sleep, prolonged sleep onset latency and more stage two sleep, in a polysomnographic study among school-aged children[9]. Another polysomnographic study held among adults demonstrated that playing computer games at night results in prolonged sleep latency and shorter REM sleep[10]. Several behavioural and psychophysiological mechanisms have been proposed to explain the effect of computer use on sleep variables. Access to 24-hours home entertainment is easily available thus predisposing to unhealthy sleeping habits[11]. Playing computer games late at night can cause a state of high arousal, excitement and alertness that interferes with onset of sleep[12]. It is possible that playing a computer game induces the secretion of catecholamines and thus affects sleep variables[13,14]. It is thought that an increase in sympathetic and aminergic tone after playing an exciting computer game decreases REM sleep in the first NREM–REM sleep cycle. A decrease in REM sleep has also been reported as one of the first night effects (FNE)[15,16]. The aim of the present study is to assess the intensity of computer use among Greek adolescents to examine age and gender differences and to investigate whether excessive computer use is a risk factor for developing insomnia symptoms.

Material and Methods

Sample

The sample consists of 2155 students (mean age 15.34 ± 1.66) recruited via randomized stratified sampling in the region of Thessaly, Greece.

High school in Greece is divided in Gymnasium (ages 12-14, mandatory schooling for all) and Lyceum (ages 15-18, non-mandatory). Stratified sampling thus employed a proportionate allocation strategy; a sampling fraction was determined with respect to the two stages of high school education and to size of the four provincial capitals of the region. The final sample was selected after randomization among high school classes and it consisted of 120 classes, which belong to 85 schools of the region, a 10% of the total number of Gymnasium classes and a 12% of the total number of Lyceum classes of those four cities. The aim of using stratified sampling was acquiring a representative sample of the target population. Determining sample size through power analysis was not an option since no previous data existed on computer usage or insomnia status for the target population. Sample characteristics are presented in Table 1.

Table 1: Sample characteristics.

School grade	Male (% within sex)	Female (% within sex)	Total (% within sex)
Gymnasium			
1st	233 (21.6%)	234 (20.9%)	467 (21.3%)
2nd	136 (12.6%)	111 (9.9%)	247 (11.3%)
3rd	219 (20.3%)	203 (18.2%)	422 (19.2%)
Lyceaum			
1st	203 (17.4%)	250 (20.6%)	453 (19%)
2nd	161 (16,4%)	180 (17.9%)	341 (17.2%)
3rd	125 (11.6%)	140 (12.5%)	265 (12.1%)
Total			
	1077 (100%)	1118 (100%)	2195 (100%)

Research instruments

Demographic data were recorded with a suitable questionnaire and two specific questionnaires were also administered.

- The Adolescent Computer Addiction Test
- The Athens Insomnia Scale (AIS)

The demographics questionnaire recorded information about sex, age, parents' educational level, family financial status, communication between family members, individual habits (smoking – alcohol consumption), physical training, television watching, school performance and questions about internet (use, frequency, activity and place of use).

The Adolescent Computer Addiction Test was formed by modifying the twenty-question Internet Addiction Test[17] for use in a manner corresponding to that followed by Chen et al[18]. The term "internet" was switched with the term "electronic computer" and the questionnaire was adapted for the Greek adolescent population. This new questionnaire is comprised of twenty questions, referring to the impact of personal computer usage on the adolescent's everyday life, social relations, sleep, emotional life and productivity, graded on a five-point Likert scale (1=not at all, 5=always) with the total score thus ranging from 20 to 100 points. A similar rating with the one followed by Yang was proposed, with users divided on three groups according to total ACAT score: 20-39 for minimal users, 40-59 moderate users, 60 and higher as excessive users. The validation study identified four factors, first factor identifying dependency on personal computers, the second factor measuring possible neglection of occupational duties, the third factor describing the impact on social relations, and the fourth factor conveying a degree of obsession with usage of personal computers. Internal consistency was high (Cronbach's alpha equaled 0,93 and the Rho index 0,95), test-retest reliability after one month was satisfactory. Structural validity was investigated with confirmatory factor analysis. The four factor model proved a good fit to the data at hand while the invariance of factor loadings and of measurement error variances-covariances was demonstrated when data from adolescent samples from separate cities were examined concurrently using equality constraints[19].

The Athens Insomnia Scale (AIS) is a self-administered psychometric instrument based on the International Classification of Diseases, 10th version, WHO, 1994, (ICD-10) insomnia criteria. It consists of eight items AIS and the total score ranges from 0 to 24. The original validation study demonstrated good internal, test-retest reliability and external validity[20]. A cut-off value of ten to determine those suffering form insomnia among the general population was chosen following the creators' recommendations since it provides us with the highest positive predictive value (PPV) of 90% while still offering a high negative predictive value of 94%[21].

Statistical analysis

The statistical package for the social sciences (SPSS) version 16.01 was used for all statistical analysis[22]. The student sample was categorized according to their scores in the ACAT scale in minimal, moderate and excessive

computer users so as to compare them as to their scores in the AIS insomnia scale. As expected, the dependent variables did not follow the normal distribution hence the comparisons between the different groups were made using the Mann-Whitney statistic rather than the Student's t-test. Since the relevant literature mentions significant differences between the sexes with regards to computer use, an analysis of covariance was used to assess whether females have more insomnia complaints than males after controlling for differences between males and females in computer usage. In this way we would be able to compare the relative effects of increased computer use in males versus a tendency for females to report more insomnia complaints.

An effort was made to ascertain possible effects of the other factors included in the demographics questionnaire (parents' educational level, family financial status, communication between family members, smoking, alcohol consumption, physical training and watching television) in the number of insomnia complaints. Since other factors can have an impact on insomnia (e.g hyperexcitability after cigarette or alcohol use, watching television) an attempt was made to include them into the analysis. However the sample size was dramatically reduced with the inclusion of only a few variables in the analysis since the percentage of the subjects that were smokers and alcohol users was relatively small. An effort to include some of those variables in the analysis is included in the results. Notice however that those characteristics were not standardized at baseline and this study does not claim to present a detailed picture as to the impact of those factors in insomnia in general.

Results

Differences between sexes and different age groups

Out of the 2155 students, 1077 were male and 1118 female. Of those male, 109 were classified as suffering from insomnia while the corresponding figure for females was 142. The gender difference was not statistically significant (chi-square=3.607, p=0.058) although the trend for females having more insomnia complaints was noticeable. There was however a statistically significant trend for older students to present with more insomnia complaints (Mann-Whitney Z=5.489, p<0.001).

Insomnia complaints among computer usage categories

There was no statistically significant difference between students with and without insomnia complaints when examined as to the age of computer use initiation, while frequency of computer use was statistically significantly correlated with insomnia complaints, with a small effect size (eta=.07). A statistically significant difference emerged between those two categories when examined as to the absolute number of years of using computers. Those with insomnia complaints tended to have used personal computers for a longer period than those without insomnia complaints (Mann-Whitney Z=3.243, p=.001).

Results from the ACAT scale have indicated statistically significant differences between the two sexes as to computer usage. Males were classified more frequently as heavier users compared to females, with the associated effect size deemed as medium (eta=.253). Relative percentages of males and females are presented in Table 2. Comparing the separate groups of computer users as measured in the ACAT scale, concerning their total AIS scores, we find statistically significant differences with higher use pointing to higher AIS scores in all comparisons but between those who do not use computers and minimal users. Relative percentages are presented in Table 2 while group comparisons are presented in Table 3. Differences between ACAT groups as to the absolute number of those classified as insomniacs based on their AIS scores are also revealing. In all comparisons, higher computer use was linked to a larger number of adolescents classified as insomniacs except for the comparison between non-users and moderate users. (Table 3). The effect size for computer usage on insomnia (eta) was approximately, 30 for the 'excessive computer usage' category and, 19 for the 'moderate computer usage' category versus the 'no computer usage' category, demonstrating a possible dose-effect relationship, i.e the higher level of computer usage for the adolescent, the more negative effect on his sleep patterns.

Table 2: Number of individuals classified in each ACAT group relative to gender and AIS classification. Vertical percentages are cumulative.

ACAT groups	Sex		Totals	AIS classification	
	Male	Female		Insomniac	Non-insomniac
No use	160 (14.85%)	309 (27,6%)	469(21.4%)	55 (21.9%)	414 (21.3%)
Minimal use	554 (51.4%)	663 (59,3%)	1217(55.4%)	89 (35.4%)	1128 (58%)
Moderate use	263 (24,4%)	114 (10,2%)	377(17.2%)	59 (23.5%)	318 (16.35%)
Excessive use	100 (9,35%)	32 (2,9%)	132(6.0%)	48 (19.2%)	84 (4.35%)
Totals	1077	1118	2195	251	1944

Comparison of gender versus computer usage effects

Since gender was an important variable in computer

Table 3: Between-group comparisons on total AIS scores with the Mann-Whitney statistic and on number of insomniacs with the chi-square statistic.

ACAT groups	No use	Minimal use	Moderate use	Excessive use
No use	—			
Minimal use	Z=-0.96, NS χ^2=8.444, p=.005	—		
Moderate use	Z=-5,62, p<.001 χ^2=2.758, NS	Z=-7.95, p<.001 χ^2=23.751, p<.001	—	
Excessive use	Z=-7.41, p<.001 χ^2=44.027,p<.001	Z=-8.84, p<.001 χ^2=110.14, p<.001	Z=-4.25, p<.001 χ^2=25.266, p<.001	—

usage it was worth exploring the possibility that gender effects were more substantial than computer usage per se. A gender effect was notable in the aforementioned comparison between those with and without insomnia as to the period of computer usage. The difference was statistically significant among females (Mann-Whitney Z=3.184, p=.001) but not among males (Mann-Whitney Z=1.68, p=.093). To explore this possibility an analysis of covariance was carried out. Results indicated that after controlling for the gender effect a significant difference between individuals of different use backgrounds persisted, F(1,1727) = 9.052, p=.003 with the difference in means between males and females actually increasing as shown in Table 4. Therefore although gender was an important factor, the effect of cumulative years of computer usage on insomnia complaints was significant and larger for all subjects, the respective effect sizes (etas) were 0.07 (a very small effect size) and 0.144 (a small to moderate effect size).

An analysis of covariance was used to assess whether females have more insomnia complaints than males after controlling for differences between males and females in computer usage (ACAT group classification). Results indicate that after controlling for computer usage, there remains a significant difference between males and females in insomnia complaints F (1,1723) = 49.814, p<.001, as expected. However, the effect of different levels of computer usage was itself significant with a higher effect size than gender (eta. 383 vs. 167 for gender). Table 4 presents the means and standard deviations for males and females on insomnia complaints, before and after controlling for computer use. As is evident from this table, the mean difference between males and females increases after differences in levels of computer use were controlled for. To conclude, both effects were significant and forcing the equation towards different outcomes but computer usage had a larger effect size than gender.

An analysis of covariance to determine whether scores on the AIS scale among the sexes were significantly affected by age, computer use, alcohol and cigarette use, viewing television had only 251 subjects in total, F(1,244)=11.038, p<.001. Nevertheless results indicated that the most significant effects on insomnia scores were those mediated by computer use (partial eta^2 = 0.130) followed by gender ((partial eta^2 = 0.043) and cigarette use (partial eta^2 = 0.023). Age, alcohol use and television viewing effects weren't statistically significant but observed power for those factors was significantly lower than 80 hence the results are not conclusive for those factors.

Discussion

Several patterns emerged from this study. Gender effects were noticeable with males being heavier computer users than females taking into account duration, frequency and starting point of use in their lifespan. Females however tended to present with more insomnia complaints in general and were affected to a larger degree from longer exposure to personal computer use, demonstrating a fixed effect for gender in this age bracket.

A direct dose-mediated effect of computer use on insomnia complaints was evident from the comparison of

Table 4: Adjusted and Unadjusted gender means and variability for insomnia complaints using computer experience in years as a covariate.

		Unadjusted		**Adjusted**	
	N	M	SD	M	SE
Males	919	4.59	3.841	4.531	.127
Females	811	5.02	3.903	5.089	.135

AIS scores between different usage groups. It is important to note that even minimal computer users fared significantly worse as to the number of sufferers from insomnia when compared to non-users. Differences among ACAT groups were all statistically significant with any rise in computer use linked to a rise in insomnia complaints and numbers of adolescents classified as insomniacs. Thus it appears that increases in computer usage carry a disproportionate weight of importance for insomnia-related complaints. The effects of lengthier and heavier computer use on insomnia complaints had larger effect sizes compared to the effect of gender, demonstrating that the acquired habit of computer use was potentially more clinically significant than the innate biological or otherwise psychosocial tendency for females to present more frequently with insomnia complaints than males. Furthermore, the heavier usage of computer leads to more pronounced effects on sleep paterns.

A clear limitation of this study is the inability to take into account all sociodemographic factors due to their complex interactions. Cigarette use had a noticeable effect onto the insomnia complaints but conclusions from other factors cannot be safely deduced – a very large sample would be required, rendering data collection impractical. Social factors were not included in the analysis due to the inherent limitations of a survey. We should note however but there are no literature data supporting a hypothesis that there are differences among the levels of computer use in adolescents according to their family status. This study is making limited claims regarding factors that are not explicitly linked with family problems, namely gender and level of computer use. A longitudinal study is clearly a more efficient way of exploring those parameters, yet the projected number of individuals which should be included is clearly in the several thousand category and costs are a limiting factor.

In conclusion, a direct link between excessive computer use and adolescent insomnia is ascertained. All adolescent mental health professionals should be alerted to those findings if we take into account the fact that today's adolescent student population are tomorrow's active citizens. Thus, understanding sleep disturbances linked to problematic use of new technologies is essential for combating a phenomenon which significantly affects sleep, mental and somatic health. Further studies of a longitudinal design are necessary in order to ascertain the long-term effects of computer use in the general psychological well-being of the adolescents, taking into account sociodemographic factors and making provisions to provide with support those who are identified as excessive computer users.

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