Quality of sleep among university students

Effects of nighttime computer and television use

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ABSTRACT

This descriptive, cross-sectional study was based on subjective questionnaires that assessed nighttime habits of television viewing and Internet use during weekdays and perceived sleep quality among university students. Sleep perception was measured using the Pittsburgh Sleep Quality Index (PSQI). The study group comprised 710 university students aged 17-25 years. Analysis of sleep perception in relation to internet use revealed that 58.06% of subjects who accessed the internet between 19:00 and 21:00 slept poorly; 71.43% between 19:00 and 22:00; 73.33% between 19:00 and 24:00; and 52.38% between 19:00 and 03:00 (p=0.0251). Concerning the relationship between television exposure and perceived sleep, the groups did not differ from each other (p=0.9303). This study showed that internet use between 19:00 and 24:00 increases the risk of poor sleep among young adults, in comparison with television viewing times.

Key words: quality of sleep, internet, television, sleep disturbances.

Qualidade do sono entre universitários: os efeitos da utilização do computador e televisão no período da noite

RESUMO

Este estudo transversal descritivo com base em questionários subjetivos avalia o hábito de assistir TV e acessar a internet durante as noites nos dias de semana e a percepção da qualidade do sono entre universitários. Para avaliar a percepção do sono foi aplicado o Índice de Qualidade do Sono de Pittsburgh. O grupo estudado incluiu 710 universitários entre 17-25 anos. Para as análises da percepção do sono relacionado ao hábito de acessar o computador observou-se que acessam a internet e dormem mal: 58,06% entre as 19 e as 21h; 71,43% entre as 19 e as 22h; 73,33% entre as 19 e as 24h; 52,38% entre as 19 e as 3h (p=0,0251). Em relação aos horários de assistir TV e a percepção do sono os grupos não se diferenciaram entre si (p=0,9303). O estudo demonstra que acessar a internet durante os horários das 19 às 24h aumenta as chances dos jovens dormirem mal quando comparado aos horários de assistir TV.

Palavras-chave: qualidade do sono, internet, televisão, distúrbios do sono.

The effects of excessive use of electronic media, such as computers and television, have been identified as a health issue[1-3]. The implications of heavy nocturnal use of such media, particularly computers, remain largely unknown[4].

Evidence shows that many young individuals surf the internet or watch TV programs in a habitual manner, often leading to impaired sleep quality[2,5].

However, television programs and computers with internet access are clearly excellent means of communication and production. These technologies have had a radical effect on the social transformation process and have led to rapidly shift-

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Received 18 October 2009
Received in final form 9 March 2010
Accepted 16 March 2010

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ing paradigms that have had an impact on daily routines and habits[7,8].

Although television and computers are similar in terms of intensity of light displayed, they differ in how they are used. When in front of the television, viewers usually sit or lie down in a comfortable position around three meters from the screen, changing channels with a remote control. However, in front of a computer monitor, internet users sit between fifty and seventy centimeters away from the screen and interact more actively with the device, engaging both mental and physical faculties to operate the equipment.

The use of these devices at inappropriate times, coupled with the brightness of the light that they project onto the retina, are factors that are thought to trigger changes in sleep patterns[1,2,4]. In the case of computer displays, the light that they emitted is in close proximity to the retina. According to Guyton, light-stimulated retina cells transmit electrical signals to the hypothalamus[10]. In addition to controlling the glands of the body, the hypothalamus contains a small nucleus that houses the biological clock, which is essential for regulating sleep/wake cycles and rhythms[10]. The strength, variation and timing of light projected onto the retina by these devices disrupt the normal release of melatonin in the body (the hormone that controls sleep), resulting in changes in quality of sleep[11-13]. Given that sleep plays an essential role in restoring energies expended during the day, and in memorization, concentration and learning processes[14,15], the ramifications of sleep quality among young graduates undergoing academic and professional training are manifold.

Surveys have shown[16,17] that internet users spend excessive time at the computer, and have found that the population as a whole is sleeping less hours due to exposure to television programs and computers on the internet[1-3].

Against this background, the aim of the present study was to identify possible relationships between time spent using the computer or television, and sleep quality among young university students.

METHOD

A descriptive, cross-sectional study was conducted, in which data on sleep quality was collected from a sample of 1,978 university students at a pubic university in the south of the state of Minas Gerais, Brazil. The random sample comprised 710 subjects, containing both women (486) and men (224). Their mean age was 20.7 years (standard deviation of 1.8 years), with a minimum age of 17.01 years, median age of 21.0 years and maximum age of 25.0 years.

Instruments

The participants were asked to answer an objective self-assessment questionnaire on the use of television and the computer on weekdays during the following time periods: [A] 19:00 to 21:00; [B] 19:00 to 22:00; [C] 19:00 to 24:00; [D] 19:00 to 3:00.

Sleep perception was measured using the Pittsburgh Sleep Quality Index (PSQI). This scale is used to quantify the quality of sleep over the past month. It was devised to provide a standardized measurement of sleep quality[18]. The scale is straightforward and consists of 19 self-assessed items grouped into seven components weighted 0 to 3. The overall score ranges from 0 to 21, with lower scores indicating better quality of sleep. Individuals scoring less than five are considered good sleepers (GoodS), while those scoring more than five are rated as poor sleepers (PoorS). An overall score >5 on the PSQI indicates serious problems relating to at least two components, or moderate difficulties relating to more than three components. The PSQI instrument has been validated as reliable for use in Brazil[19], and has been used in a number of studies in other countries[20,21].

Inclusion criteria

Students drawn from the Federal University of Alfenas who were present in the classroom at the time of questionnaire application, and who agreed to take part on a voluntary basis by signing the informed consent form, were included in the study.

Procedures

Data were collected in groups from the classrooms between August and November 2007. Contact with students was brief. The participating students were informed of the purpose of the study and the methods to be used and signed an informed consent statement.

The project "Life Habits and Sleep Complaints among Young University Students", on which the present study was based, was approved and homologated at the General Meeting of the Research Ethics Committee of the School of Medical Sciences of UNICAMP on October 24, 2006, under CAAE file no. 0441.0.146.000-06.

Statistical methodology

The data obtained in the study were tabulated, organized and stored in an electronic Excel spreadsheet. The compiled data were submitted to statistical analysis by the Research Board of the School of Medical Sciences of UNICAMP, using version 9.1.3 of the SAS (Statistical Analysis System) for Windows Service Pack 3 (SAS Institute Inc, 2002-2003, Cary, NC, USA).

The descriptive analysis was performed based on position and dispersion measurements for continuous variables, and frequency tables for categorical variables.

The following tests were used in comparative analyses: chi-square (χ^2) and Fisher's tests to investigate associations

and compare proportions; Mann-Whitney test to compare continuous or ordinal measurements between pairs of groups, and the Kruskal-Wallis test for comparisons among three or more groups; and multiple logistic regression analysis to identify factors impacting on sleep quality[22]. The significance level used for the statistical tests was set at 5%.

RESULTS

The overall PSQI scores for the 710 participants were: mean 6.5; standard deviation 2.6; minimum 0.0; median 6.0; and maximum 6.0. A total of 39.72% of respondents were found to be good sleepers and 60.38% were poor sleepers. Computer use was significantly higher among women between 19:00 and 21:00, and among men between 19:00 and 3:00 ($p<0.0001$; χ^2). A significantly higher proportion of women reported watching TV between 19:00 and 21:00 than of men ($p<0.0001$; χ^2) (Table 1).

No difference was found in any of the items of the Pittsburgh Sleep Quality Index between the groups, in terms of gender or perceived sleep. On the scale, 60.91% of the women reported poor sleep versus 58.93% of the men. The chi-square test was used: χ^2 p=0.6169. A mean overall score of 6.5 was found for the women, and 6.3 for the men (p=0.2981; Mann-Whitney).

The mean perceived sleep scores for the different time periods of computer use were 6.3 (19:00 to 21:00); 6.6 (19:00 to 22:00); 7.0 (19:00 to 24:00) and 6.4 (19:00 to 3:00) (Table 2). Application of the Kruskal-Wallis test (p=0.3257) showed that there were no differences between the groups relating to time period.

The mean perceived sleep scores in relation to television viewing periods were 6.7 (19:00 to 21:00); 6.6 (19:00 to 22:00); 6.3 (19:00 to 24:00); and 6.7 (19:00 to 03:00) (Table 3). Application of the Kruskal-Wallis test (p=0.3257) showed that there were no differences between the groups (Table 4).

DISCUSSION

The findings from this study revealed that there were significantly higher numbers of poor sleepers among individuals using computers between 19:00 and 22:00 or between 19:00 and 24:00 (Table 2). In contrast, no significant differences in the numbers of poor sleepers were seen among television users between the different time periods (Table 3). This result is of particular relevance given that computer use at these times is prevalent not only in the student population but also among children, adolescents, adults and the elderly[1-4,16,17].

To our knowledge, only seven studies investigating the impact of computer use on sleep patterns have been published in the worldwide literature[1-4,16,17,23]. All of these studies except one[23] found that computer use disturbed sleep patterns.

In the present study, significant numbers of complaints of reduced sleeping times and increased sleep disturbances (Sleep Duration and Sleep Disorders components of Tables 2 and 3) were associated with media use, thus corroborating the results of previous studies[1-3,23].

Our analysis showed that computer use (Table 2) was connected with a significantly higher risk of perceiving poor sleep quality among these university students, in contrast to the habit of watching television (Table 3). Our results are similar to those of Dworak[17] and Van Den[3], who reported a significantly higher risk of impaired sleep patterns following internet use before going to sleep than in relation to television use, among children and adolescents.

Furthermore, a study by Suganuma[1] on the use of electronic media (television and computers) in relation to perceived sleep found a significant difference between light users (29.0%) and heavy users (53.5%) (p=0.02) regarding perceptions of insufficient sleep. According to this author[1], "attention should be given to media use before sleep as a cause of perceived insufficient sleep".

An earlier study by the present authors[2] found that adolescents who used the computer during the night perceived poorer sleep quality (74.04%) to a significantly greater extent than non-users did. Nevertheless, we did not expect internet use between 19:00 and 24:00 to be the greatest risk factor for poor sleep among university students.

Studies that might explain our findings have explored the effect of light exposure on circadian rhythms and have demonstrated that exposure to light before 24:00 leads to delays in the circadian phase, whereas exposure after 24:00 induces phase advances, thereby changing sleep cycles. Studies involving strong light showed a more significant impact on the circadian clock than did those with weak light. These studies concluded that the sensitivity

Table 1 Analysis and comparison of computer and television use (hours), according to gender.

	19:00-21:00	19:00-22:00	19:00-24:00	19:00-3:00
Women (Computer)	71 (35.86%)	64 (32.32%)	39 (19.7%)	24 (12.12%)
Men (Computer)	22 (2.57%)	20 (19.70%)	21 (20.59%)	39 (38.24%)
Women (TV)	60 (16.1%)	172 (46.3%)	78 (21.0%)	61 (16.4%)
Men (TV)	10 (5.8%)	52 (30.2%)	56 (32.5%)	54 (31.4%)

Table 2. Comparative analysis of computer use (hours) and perceived sleep, using the Pittsburgh Sleep Quality Index.

	19:00-21:00		19:00-22:00		19:00-24:00		19:00-3:00		
Computer use (hours)	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**p value**
Sleep perception									
Very good	11	11.83	7	8.33	4	6.67	12	19.05	0.3552
Good	57	61.29	50	59.52	35	58.33	33	52.38	(χ^2)
Poor + very poor	25	26.88	27	32.14	21	35	18	28.57	
Sleep latency									
≤ 15 m	19	20.43	14	16.67	11	18.33	20	31.75	0.2664
16 m to 30 m	46	49.46	34	40.48	28	46.67	19	30.96	(χ^2)
31 m to 60 m	21	22.58	26	30.95	15	25	15	23.81	
>60 m	7	7.53	10	11.90	6	10	9	14.29	
Sleep duration									
>7h	25	26.88	21	25	14	23.33	26	41.27	0.0904
6h to 7h	59	63.44	54	64.29	35	58.33	27	42.86	(χ^2)
< 6h	9	9.68	9	10.71	11	18.33	10	15.87	
Sleep efficiency									
>85%	78	83.87	71	84.52	49	81.67	53	84.13	0.9720
65% to 84%	15	16.13	13	15.48	11	18.33	10	15.87	(χ^2)
< 65%									
Sleep disorders									
None	1	1.08	2	2.38	4	6.67	6	9.52	0.0692
Occasional	74	79.57	65	77.38	40	66.67	49	77.78	(Fisher)
Persistent	18	29.24	17	20.24	16	26.67	8	12.70	
Hypnotic use									
None	88	94.62	80	95.24	57	95	55	87.30	0.2534
<1-3 or more times per week	5	5.38	4	4.76	3	5	8	12.70	(Fisher)
Daytime sleepiness									
None + mild	44	47.31	38	45.24	21	35	26	41.27	0.5469
Moderate	39	13	32	38.10	27	45	24	38.10	(χ^2)
Excessive	10	3.33	14	16.67	12	16.67	13	20.63	
Classification									
Good sleepers	39	41.94	24	28.57	16	26.67	30	47.62	***0.0251**
Bad sleepers	54	58.06	60	71.43	44	73.33	33	52.38	(χ^2)
Total	**93**	100	**84**	100	**60**	100	**63**	100	300

of circadian rhythms to the effects of light exposure on the retina varies according to the circadian phase within which light exposure takes place[11-13,24-27].

Based on our findings, we posit that proximity to the computer screen between 19:00 and 24:00 induced a significant light effect that changed the participants' sleep cycles and contributed towards poorer quality sleep. Another factor may be related to the interactivity patterns of computer use, in which computer users tend not to interrupt their use. In contrast, TV viewing is less contiguous or intense, such that users more readily discontinue the activity temporarily. Exploring these hypotheses was beyond the scope of the present study and could be the topic of future investigations.

Takahashi and Arito[29] showed that performing mental tasks before sleep can curtail the duration of slow wave sleep within the first cycle.

However, a study by Higuchi et al.[4] on the display light of electronic games between 23:00 and 01:45 among a group of young adults, found no effect on the physiological variables of sleep. According to these authors, the combination of the compelling nature of the game and the display brightness may change the perception of sleep quality.

Our results indicate that the fact that these young adults watched television (Table 3) was not linked to any significant risk of a perception of poor quality sleep, although an earlier study had shown that watching TV for three or more hours consecutively contributed towards a significantly higher risk of frequent sleep problems[5].

Correlation analysis (Table 4) between non-use of the computer at any time and use during the nighttime periods studied showed that computer use between 19:00 and 22:00 or between 19:00 and 24:00 was associated with higher frequency of poor sleepers.

Table 3. Comparative analysis of television viewing (hours) and perceived sleep, using the Pittsburgh Sleep Quality Index.

	19:00-21:00		19:00-22:00		19:00-24:00		19:00-3:00		
TV viewing	N	%	N	%	N	%	N	%	p value
Sleep perception									
Very good	10	14.29	19	8.48	12	8.96	17	14.78	0.0724
Good	40	57.14	135	60.27	77	57.46	49	42.61	(χ^2)
Poor	16	22.86	63	28.13	42	31.34	41	35.65	
Very poor	4	5.71	7	3.13	3	2.13	8	6.96	
Sleep latency									
≤ 15m	15	21.43	38	15.96	27	20.15	28	24.35	0.3980
16m to 30m	30	42.86	98	43.75	57	42.54	38	33.04	(χ^2)
31m to 60m	14	20	64	28.57	35	2612	29	25.22	
>60m	11	15.71	24	10.71	15	11.19	20	17.39	
Sleep duration									
>7h	18	25.71	72	32.14	42	31.34	45	39.12	0.1681
6h to 7h	46	65.71	125	55.80	72	53.73	51	44.35	(χ^2)
< 6h	6	8.57	27	12.05	20	3.68	19	16.52	
Sleep efficiency									
>85%	55	78.57	181	80.80	111	82.84	93	80.87	0.9035
65% to 84%	15	21.43	43	19.20	23	17.16	22	19.13	(χ^2)
Sleep disorders									
None	3	4.29	6	2.68	8	5.97	11	9.57	0.1701
Occasional	51	72.86	177	79.02	104	77.61	82	71.30	(χ^2)
Persistent	16	22.86	41	18.30	22	16.42	22	19.13	
Hypnotic use									
None	65	92.86	209	93.30	127	94.78	104	90.43	0.6050
<1-3 or more times per week	5	7.14	15	6.7	7	5.22	11	9.57	(χ^2)
Daytime sleepiness									
None	1	1.43	12	5.36	5	3.73	9	7.83	0.4095
Mild	25	5.71	91	40.63	65	48.51	46	40.40	(χ^2)
Moderate	31	44.29	93	41.52	49	36.57	46	40.40	
Excessive	13	18.57	28	12.50	15	11.19	14	12.17	
Classification									
Good sleepers	27	38.57	89	39.73	54	40.30	42	36.52	0.9303
Bad sleepers	43	61.43	135	60.27	80	59.70	73	63.48	(χ^2)
Total	70	100	224	100	134	100	115	100	543

Table 4. Results from multiple logistic regression analysis on sleep quality (poor sleepers versus good sleeper).

Times of computer use and non-use	p=value	95% CI
19:00-21:00 vs. non-use	0.87	0.64 ; 1.67
19:00-22:00 vs. non-use	0.01	1.04 ; 3.65
19:00-24:00 vs. non-use	0.03	1.12 ; 3.33
19:00-03:00 vs. non-use	0.27	0.42 ; 1.27

Students using the computer during weekdays between 19:00 and 22:00 or between 19:00 and 24:00 presented a greater likelihood of being bad sleepers, compared with non-users.

Despite the large sample size used in this study and the valuable data pooled, causal relationships could not be fully examined here because this was a field study among students from only one university.

In conclusion, the data on computer use between 19:00 and 21:00 or between 19:00 to 24:00 that we collected allowed us to conclude that computer use increases the risk of poor sleep among university students. However, perceptions of sleep relating to TV viewing during the same periods did not present the same risk.

REFERENCES

1. Suganuma N, Kikuchi T, Yanagi K, et al. Using electronic media before sleep can curtail sleep time and result in self-perceived insufficient sleep. Sleep Biol Rhythms 2007;5:159-165.
2. Mesquita G, Reimão R. Nightly use of computer by adolescents: its effects on quality of sleep. Arq Neuropsiquiatr 2007;65:428-432.
3. Van Den BJ. Television viewing, computer game playing, and internet use and self-reported time to bed and time out of bed in secondary-school children. Sleep 2004;27:101-104.
4. Higuchi S, Motohashi Y, Liu Y, et al. Effects of playing a computer game using a bright display on presleep physiological variables, sleep latency, slow wave and REM sleep. J Sleep Res 2005;14:267-273.
5. Johnson JG, Cohen P, Kasen S, et al. Association between television viewing

and sleep problems during adolescence and early adulthood. Arch Pediatr Adolesc Med 2004;158:562-568.
6. Asaoka S, Fukuda K, Tsutsui Y, et al. Does television viewing cause delayed and/or irregular sleep-wake patterns? Sleep Biol Rhythms 2007;5: 23-27.
7. Kumar K. Da sociedade pós-industrial à pós-moderna: novas teorias sobre o mundo contemporâneo. Tradução de Ruy Jungmann. Rio de Janeiro: Jorge Zahar 1997:252-258 .
8. Lima FO. Tecnologia e sociedade. In: Lima FO (Ed). A Sociedade digital, o impacto da tecnologia na sociedade, na cultura, na educação e nas organizações. Rio de Janeiro: Qualitymark 2000:9-35.
9. Guyton MD. Mecanismo comportamentais e motivacionais do cérebro: sistema límbico e o hipotálamo. In: Guyton MD (Ed). Tratado de fisiologia médica. Tradução de Mira de C. Engelhardt. 9ª Ed. Rio de Janeiro: Guanabara Koogan 1997: 684-692.
10. Marques N, Menna-Barreto L. Cronobiologia: princípios e aplicações. 3ª Ed. São Paulo: Edusp; Rio de Janeiro: Fiocruz 2003:10-204.
11. Czeisler CA. The effect of light on the human circadian pacemaker. Ciba Found Symp 1995;183:254-290.
12. Khalsa SBS, Jewett ME, Cajochen C, et al. A phase response curve to single bright light pulses in human subjects. J Physiol 2003;549:945-952.
13. Yokoi M, Aoki K, Shimomura Y, et al. Exposure to bright light modifies HRV responses to mental tasks during nocturnal sleep deprivation. J Physiol Anthropol 2006;25:153-161.
14. Genzel L, Desler M, Wehrle R, et al. Slow wave sleep na REM sleep awakenings do not affect sleep dependent consolidation. Sleep 2009;32:295-301.
15. Payne JD, Stickgold R, Swanberg K, et al. Sleep preferentially enhances memory for emotional components of scenes association for Scenes. Psychol Sci 2008;19:781-788.
16. National Sleep Foundation. Sleep in Americans poll highights key findings. Teens and Sleep [on-line] 2006 Acesso em: 20 jun 2006. Disponível em: <www.sleepfoundation.org>.
17. Dworak M, Schierl T, Bruns T, et al. Impact of singular excessive computer game and television exposure on sleep patterns and memory performance of school-aged children. Pediatrics 2007;120:978-985.
18. Buysse DJ, Reynolds CF, Monk TH, et al. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res 1989; 28:193-213.
19. Doi Y, Minowa M, Uchiyama M, et al. Psychometric assessment of subjective sleep quality using the Japanese version of the Pittsburgh Sleep Quality Index (PSQI-J) in psychiatric disordered and control subjects. Psychiatry Res 2000; 97:165-172.
20. Buysse DJ, Reynolds CF, Monk TH, et al. Quantification of subjective sleep quality in healthy elderly men and women using the Pittsburgh Sleep Quality Index (PSQI). Sleep 1991;14:331-338.
21. Bertolazi NA. Tradução, adaptação cultural e validação de dois instrumentos de avaliação do sono: Escala de Sonolência de Epworth e Índice de qualidade do Sono de Pittsburgh. [Dissertação]. Porto Alegre: Universidade Federal do Rio Grande do Sul; 2008.
22. Conover WJ. Practical nonparametric statistics. New York: John Wiley & Sons; 1971.
23. Li S, Jin X, Wu S, et al. The impact of media use on sleep patterns and sleep disorders among school-aged children in China. Sleep 2007;30:361-367.
24. Kubota T, Uchiyama M, Suzuki H, et al. Effects of nocturnal bright light on saliva melatonin, core body temperature and sleep propensity rhythms in human subjects Neurosci Res 2002;42:115-122.
25. Van Cauter E, Sturis J, Byrne MM, et al. Demonstration of rapid light-induced advances and delays of the human circadian clock using hormonal phase markers. Am J Physiol Endocrinol Metab 1994;266:953-963.
26. Gordijn MC, Beersma DG, Korte HJ, et al. Effects of light exposure and sleep displacement on dim light melatonin onset. J Sleep Res 1999;8:163-174.
27. Shanahan TL, Czeisler CA. Physiological effects of light on the human circadian pacemaker. Semin Perinatol 2000;24:299-320.
28. Takahashi M, Arito H. Suppression of electroencephalogram delta power density during non-rapid eye movement sleep as a result of a prolonged cognitive task prior to sleep onset. Eur J Appl Physiol Occup Physiol 1994;68: 274-280.