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Full Length Article

Mutual relations between sleep deprivation, sleep stealers and risk behaviours in adolescents

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ARTICLE INFO

Article history:
Received 27 February 2015
Received in revised form
25 January 2016
Accepted 16 February 2016
Available online 23 February 2016

Keywords:
Screen time
Substance use
Violence
Earlier sex
Sleep curtailment
Adolescence

ABSTRACT

Objectives: The aim is to evaluate the mutual influences between sleep duration/sleep deprivation (SD) and the sleep stealers/adolescent risk behaviours.

Methods: The national survey is a component of the Health Behaviour in School-Aged Children (HBSC) study, it is based on a school-based self-completed questionnaire; 3476 students were randomly selected from 139 randomly chosen Portuguese schools using as an unit the class, 53.8% were girls; 45.9% attended the 8th grade and 54.1% the 10th grade; the mean age was 14.9 years. The measured variables were: 1) gender and age; 2) sociodemographics; 3) sleep duration during the week and during weekends and computed SD; 4) screen time (computer use during the week and during the week end (PC use); watching TV and mobile phone use; 5) earlier sexual behaviour; 6) violent behaviours: fights, use of weapons; 7) use of tobacco, alcohol and drugs. The statistical analysis included Pearson chi-square tests and logistic regression.

Results: Excessive use of mobile phone, of computer use during weekdays, and internet facilities; substance use; violence and earlier sexual relations had significantly higher prevalence in sleep deprived adolescents. By logistic regression only using PC during weekdays, tobacco, drugs and weapons were associated to SD, while SD was associated to PC use during weekdays, tobacco use and drugs' use. Computer uses tend to be associated among themselves. Mobile phone is associated with computer practices and with alcohol and tobacco use. Tobacco is associated with most risk behaviours. Alcohol use is associated with other substance use, computer use and violent behaviours. Violence behaviours, earlier sex and drugs use tend to be associated among themselves.

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Peer review under responsibility of Brazilian Association of Sleep.

http://dx.doi.org/10.1016/j.slsci.2016.02.176

Conclusions: Sleep stealers use and risk behaviours are more prevalent in sleep deprived adolescents, but, in spite of significant individual associations, models of risk behaviours are still lacking.

1. Introduction

Adolescents sleep shows marked variation in duration and variability [1] and persistent circadian misalignments [2]. Two types of behaviours have major impact upon sleep: those that reduce sleep duration (the Sleep stealers: high tech media and gadgets) and those associated with health and survival risks (the Health risk behaviours) [3]. The Sleep stealers, i.e., gadgets or behaviours that reduce sleep duration, include TV, mobile phones and derivatives, computers and internet facilities, play stations, games, etc. Multiscreen viewing is a current practice [4]. In the EU Health Behaviours in School-aged Children (HBSC) study, 62% of the girls and 64% of the boys watch television two or more hours on week days [5]. Screen time, is an overweight [6] and diabetes risk factor [7], with high levels of emotional eating [8] and unhealthy food preferences [9–13]. Lower economic status [14–16], lower parental regulation and increased parental TV viewing are associated with increased screen times [17].

Risk behaviours are important threats during adolescence due to possible lifetime negative consequences. Their prevalence is high in the USA: the percentage of those who ever smoke, drunk, use marijuana and cocaine was respectively 44.7, 70.6, 39.9 and 18.2% in a national survey; the percentages of those carrying weapons to school (5.4%), involved in fights (12.0%), being bullied (18.2%) or having had sexual intercourse (47.4%) are impressive [18]. In Europe, smoking is decreasing, but alcohol consumption is high (31% of the girls and 36% of the boys have been drunk at least twice); 15% of the girls and 20% of the boys have ever used cannabis [5]. Alcohol consumption among Thai adolescents affects 14.8% (21.2% males and 9.3% females) [19].

In the USA 47.4% of the teens had already sexual intercourse, and some with violence (9.4%) or forced sexual intercourse (8%) [20]. Lower self-control or neurobehavioral disinhibition are possible substrates for sexual and other risk behaviours [21, 22], as well as exposure to traumatic life events [23], lower social/familiar protection [24–28], and alcohol [29] and drug consumption [30].

Violent behaviours have been associated with sleep disturbances, the observation of violence, use of alcohol, internalised anger [31], or with violent TV contents [32]. Many of these behaviours influence sleep and sleep duration, namely screen time [15,33,34] and risk taking behaviours [3,31,35]. Playing violent games had significant impact upon sleep [36,37].

Short sleep duration and irregular schedules were significantly associated with all risky behaviours, and long sleep duration was significantly associated with all risky behaviours except for suicidality [35], school violent behaviours [38], bullying [39]; association between vexingness and aggression or antisocial behaviour was found [40].

This study aims the bidirectional influences between sleep deprivation, sleep stealers and risk behaviours in adolescents, while evaluating their predictive values.

2. Methods

2.1. Participants

This survey is a component of the Health Behaviours in School-Aged Children (HBSC) study [5,41]. The Portuguese HBSC survey included 3476 pupils, (53.8%, $n=1869$) were girls, in the 8th (45.9%) and 10th grades (54.1%) with a mean age being 14.9 years ($SD=1.26$, min 12.5, max 19.0) randomly chosen from 139 schools, in a national sample geographically stratified by Education Regional Divisions, using as a sampling unit the school and then the class. The school response rate was 89.9%. The overall procedure, concerning has been described elsewhere; briefly this study has the approval of a scientific committee of the involved institutions, an ethical national committee (Hospital S. João- Oporto-Portugal), the Ministry of Education (Directorate of Education) and the national commission for data protection and followed strictly all the guidelines for protection of human rights. Adolescents' participation in the survey and completion of the questionnaires was voluntary and anonymity was assured, all parents signed an informed consent.

2.2. Instrument

The questionnaire inquired about: 1) gender and age; 2) sociodemographics; 3) sleep duration during the week and weekends, sleep deprivation (SD) (difference in sleep duration equal/higher than 3 hours between weekdays and weekends) [42]; 4) screen time (computer use: standard; games, internet; social networks, emails,), 5) TV and mobile phone use; 6) earlier sexual behaviour; 7) violence: fights, use of weapons; 8) use of tobacco, alcohol and drugs. Answers were provided by Likert type scales inquiring if behaviours occurred and their frequency (e.g. how many hours a day do you sleep during the weekdays – or during the week end? how many times a month do you drink spirits? How many cigarettes do you smoke every month?), and for the purpose of the present study were dichotomised into a YES/NO behaviour occurrence basis.

2.3. Data analysis

The data were further transformed in dichotomic variables considering only: high frequency versus low/absent prevalence of a specific behaviour. The corresponding cut-offs are defined subsequently: High frequency of screen time (either PC or TV) was 3 h or more both during the week and weekends [16]. Sleep deprivation was set as the difference in sleep duration equal/higher than 3 h between weekdays and weekends [42].

Statistics with SPSS21 included descriptive analysis, Pearson chi-square for comparison between SD (Sleep deprived) and NoSD (Not sleep deprived). Binary logistic regression of all the variables with significant differences between SD/NoSD, used as dependent variable successively while the remaining were included in the logistic model. For all regression analysis the cut p value was set at 0.05; in all cases the beginning block defined the variables included in the equation model and computed the Wald statistics and the corresponding significance level. At block 1 with method "enter" the model likelihood was computed by the R^2 Cox and Snell and Nagelkerke coefficients; the goodness of the fit was evaluated by the Hosmer and Lemeshow test and the variables with predictive effect upon each dependent variable were computed; the accuracy of the model and the number of required iterations were taken into consideration.

3. Results

The mean sleep duration is 7.52 h in weekdays, (min=5; max=10 h) and 8.78 h in weekends; the mean difference weekends/week is 1.25 h±1.59 (min=5, max=5 h). SD occurred in 18.9% of the students with no significant gender differences (χ^2=.343; p=.558); it was however more prevalent in the 10th grade (24. 1%, versus12.7% in the 8th grade; χ^2=67.323, p<.001).

TV viewing during the week and the weekends was frequent (65.6% viewed TV 3 h or more during week days and 75.6% during weekends), but with no differences in SD (χ^2=9.048; p=.338 and χ^2=12.77; p=.12; respectively) (see Table 1).

Using computer for 3 h or more per day was practised by 31.2% of the students in weekdays and by 53.6% at weekends; but prevalence was higher in SD adolescents during weekdays (χ^2=29.571; p=<.001) but not in weekends (χ^2=14.448; p=.071).

Email, search engines, social networks and online games were used quite often (45.9; 52.7; 42.3 and 24% respectively), with significant higher prevalence in SD for email consultation (χ^2=16.392; p=.006); search engines (χ^2=17.694; p<.01); social networks (χ^2=24.899; p<.001).

About a quarter of the students would feel depressed without internet, would prefer internet to friends would have their sleep reduces and lower academic achievement. More than one third of the pupils would also have more frequently complaints concerning internet use. Finally more than half of them would feel their life empty without internet.

The impact of internet use upon students marks was also significantly higher in NoSD (χ^2=11.591; p<.05), while it did not influence sleep reduction (χ^2=4.625; p=.328) neither other people's complaints (χ^2=3.903; p=.419).

The use of mobile phones was frequent (81.0%), both significantly higher in SD adolescents (χ^2=19.202; p<.001).

The prevalence of risk behaviours (see Table 2) is worrying for chronic use of alcoholic beverages in the previous 30 days (13.5%), getting drunk (17.0%), and use of soft drugs (11.4%). All these behaviours are more prevalent in the sleep deprived adolescents (χ^2=54.566; p<.001; χ^2=62.116; p=.000; χ^2=25.878; p<.001; respectively); the same occurred for smoking (χ^2=29.936, p<.001).

Early sexual relations occurred in 21.3% of the students, with a significantly higher prevalence in SD teens (28.8% versus 19.6% in NoSD). The prevalence of carrying weapons to school (5.7%) or being involved in fights (13.3%) increased in SD adolescents (χ^2=14.484; p=.006 and χ^2=14.331; p<.01, respectively).

Table 1 – Comparison of screen time use (TV, mobile and computers) in adolescents with and without SD.

TV and high tech	N	Total %	% SD	% NoSD	Chi²	Degrees of freedom	Significance level
TV viewing weekdays >3 h	3476	65.6	62.5	66.2	9.048	8	.338
TV viewing weekends >3 h	3476	75.6	75.1	75.7	12.770	8	.120
Computer use weekdays	3476	**31.2**	**35.9**	**30.1**	**29.571**	8	**.000**
Computer use weekends	3476	53.6	57.1	52.8	14.448	8	.071
Computer games weekdays	3476	19.6	20.9	19.3	7.280	8	.507
Computer games weekends	3476	41.8	41.2	41.0	12.246	8	.141
Mobile phones							
EMedia communications with friends	**2887**	**81.0**	**86.6**	**79.7**	**19.202**	4	**.001**
Internet use							
Using search engines	**3041**	**52.5**	**57.1**	**51.4**	**17.694**	5	**.003**
Social networks	**3049**	**42.3**	**49.7**	**40.6**	**24.899**	5	**.000**
Multimedia contents	**3036**	**45.9**	**50.9**	**44.8**	**16.392**	5	**.006**
Online games	3032	24.0	26.0	23.5	3.536	5	.618
Internet use consequences							
Others complain about your time in the net	3014	36.6	37.4	36.4	3.903	4	.419
Your marks suffered from it	**3002**	**26.8**	**25.7**	**27.0**	**11.951**	4	**.018**
Your sleep is reduced due to late on line hours	3002	26.0	28.2	25.5	4.625	4	.328

Table 2 – Comparison of Risk behaviours (alcohol, tobacco, drugs, sex, violence, and physical inactivity) in adolescents with and without SD.

Alcohol	N	Total %	% SD	% NoSD	Chi^2	Degrees of freedom	Significance level
Alcoholic beverages in the last 30 days	3137	13.5	19.4	12.0	54.566	6	.000
Getting drunk in the last 30 days	3180	17.0	27.5	14.6	62.116	4	.000
Smoke							
Smoking habits	3157	15.3	21.7	13.8	29.936	1	.000
Drugs							
Drugs consumption in the last month	3093	11.4	19.1	9.6	25.877	3	.000
Sex							
Sexual relations	3146	21.3	28.8	19.6	24.582	1	.000
Violence							
How often in the last month did you carry a weapon to school	3143	5.7	8.6	5.0	14.484	4	.006
How often in the last 12 months were you involved in a fight	3154	13.3	14.8	12.9	14.331	4	.006

Table 3 – Model summary and goodness of fit of the Logistic regression analysis.

Dependent variables ⇩	% Correct	Block 0 wald degrees freedom=1 p=.000	Iterations	Cox and Snell R2	Nagelkerke R2	Hosmer and Lemeshow test degrees freedom=8	
						Chi^2	p
SD	81.1	904.368	5	.004	.064	6.064	.064
PCweek	69.0	380.097	4	.037	.052	8.060	.428
Mail	77.0	719.202	6	.356	.536	10.737	.217
Search engines	81.9	939.109	6	.310	.507	9.329	.315
Social networks	64.4	224.372	5	.267	.367	7.336	.501
Mobile	82.8	976.186	5	.089	.149	5.986	.649
Tobacco	61.7	149.741	5	.245	.333	12.646	.125
Alcohol	72.7	527.401	6	.165	.239	7.368	.498
Drugs	88.6	1178.986	7	.193	.379	10.636	.223
Sex	81.2	835.075	5	.167	.263	7.313	.503
Weapons	94.7	1159.846	7	.059	.174	10.489	.232
Fights	74.1	590.852	4	.109	.160	7.085	.528

Logistic regression results are shown in Tables 3 and 4. The percentages of correct classification are high ranging from 61.7 for tobacco use as dependent variable and 94.7 for carrying weapons to school. The global values for Wald coefficient are high for all the performed regressions and highly significant ($p<.001$ in all cases). In spite of this the Hosmer and Lemeshow values were never significant, implying a poor fit of the model, but the Cox and Snell and Nagelkerke coefficients varied: they are extremely low for SD, PCuse weekdays, mobile phone use, fights and carrying weapons to school; they are a bit higher for alcohol and earlier sexual relations and moderate for internet modalities use, tobacco and marijuana.

The individual predictors of each dependent variable, including the Wald coefficient and the significance level are shown in Table 4 and explained in following paragraphs in terms of Odds ratios.

SD predictors were PC use weekdays, tobacco, marijuana and weapons [OR were 1.243 (CI: 1.009–1.530); .723 (CI:.578–.905); .726 (CI: .541–.976); 1.505 (CI: 1.016–2.230), respectively].

PC use during weekdays was predicted by SD, search engines, social networks, mobile [OR were 1.238 (CI: 1.006–1.525); 1.556 (CI: 1.153–2.098); 1.490 (CI: 1.210–1.835); 1.531 (CI: 1.195–1.963), respectively].

Mail use was predicted by search engines, social networks, mobile [OR were 18.282 (CI: 13.684–24.108); 7.225 (CI: 5.990–9.338); 1.489 (CI: 1.210–1.835); 1.531 (CI: 1.098–2.019), respectively].

Search engine use was predicted by PC use during weekdays, mail, social networks and tobacco [OR were 1.578 (CI: 1.163–2.140); 18.337 (CI: 13.900–24.191); 3.150 (CI: 2.359–4.206); 1.514 (CI: 1.110–2.063), respectively].

Social networks use was predicted by PC use during weekdays, mail, search engines, mobile, tobacco and alcohol [OR were 1.492 (CI: 1.212–1.837); 7.279 (CI: 5.629–9.414); 3.232 (CI: 2.419–4.316); 1.959 (CI: 1.533–2.504); 0.696 (CI:.556–.873);.552 (CI: 444–.686), respectively].

Excessive mobile use was predicted by PC use during weekdays, mail, social networks, tobacco and alcohol [OR were 1.510 (CI: 1.177–1.937); 1.454 (CI: 1.071–1.973); 1.927 (CI: 1.508–2.461);.542 (CI: .412–.713), 1.510 (CI: .426–.670), respectively].

Tobacco was predicted by SD, search engines, social networks, mobile, alcohol, drugs and sex [OR were .714 (CI: .541 to.993); 1.502 (CI: 1.106–2.041);.695 (CI:.555–.870);.537

Table 4 – Individual predictors for the successive dependent variables: Wald statistics and significance levels.

Dependent variable ⇓	Variables in the equation ⇒											
	SD	PCweek	Mail	Search engines	Social networks	Mobile	Tobacco	Alcohol	Drugs	Sex	Weapons	Fights
SD		4.189.041	-.364	-.309	-.625	-.112	8.009.005	-.503	4.502.034	-.562	4.167.041	-.126
PCweek	4.052.044		-.496	8.385.004	14.078.000	11.307.001	-.144	-.058	-.722	-.292	-.910	-.447
Mail	-.336	-.475		423.90.000	228.21.000	6.568.010	-.286	-.850	-.137	-.737	-.744	-.276
Search engines	-.323	8.594.003	423.43.000		60.536.000	-.466	6.877.009	-.905	-.226	-.260	-.420	-.688
Social networks	-.682	14.2.001	228.973.000	63.071.000		28.859.000	9.851.002	28.595.000	-.099	-.221	-.670	-.129
Mobile	-.135	10.540.001	5.759.016	-.452	27.250.000		19.174.000	29.365.000	-.926	-.216	-.688	-.572
Tobacco	8.605.003	-.176	-.273	6.771.009	10.043.002	19.458.000		80.950.000	117.29.000	97.198.000	-.212	.000
Alcohol	-.519	-.093	-.831	-.765	28.238.000	28.163.000	78.860.000		19.550.000	-.179	5.676.017	13.498.000
Drugs	4.027.045	-.319	-.299	-074	-.110	-.874	120.02.000	25.071.000		41.419.000	9.502.002	13.987.000
Sex	-.655	-.205	-.737	-.139	-.218	-.172	98.856.000	-.053	35.397.000		11.761.001	57.807.000
Weapons	-.058	-.933	-.699	-.424	-.783	-.680	-.255	6.663.010	8.985.003	11.233.001		70.651.000
Fights	-.131	-.404	-.260	-.698	-.115	-.667	15.620.000	12.878.000	11.241.001	56.494.000	71.253.000	

(CI:.408–.708), 2.958 (CI: 2.336–3.746), 7.780 (CI: 5.367–11.278), 3.319 (CI: 2.500–3.940), respectively].

Alcohol consumption was predicted by social networks, mobile, drugs, weapons and fights [OR were .554 CI: .570–.894); .542 CI: .432–.679); 4.448 CI: 2.295–8.620); .508 CI: .291–.887); .640 CI: .504–.812), respectively].

Drugs use was predicted by SD, tobacco, alcohol, weapons and fights [OR were .733 (CI: .541–.993); 7.953 (CI: 5.488–11.526); 5.579 (CI: 2.847–10.933); .477 (CI: .298–.764), .570 (CI: .424–.765), respectively].

Early sexual activity was predicted by tobacco, drugs, weapons and fights [OR were 3.178 (CI: 2.530–3.991); 2.341 (CI: 1.769–3.098); .500 (CI: .336–.543); .416 (CI: .332–.522), respectively].

Carrying weapons to school was predicted by alcohol, drugs, sex and fights [OR were .486 (CI: .281–.841); .491 (CI: .309–.782); .502 (CI: .336–.751); 5.032 (CI: 3.452–7.334), respectively].

Involvement in fights was predicted by tobacco, alcohol, drugs, sex, and weapons [OR were .655 (CI: .531–.808); .650 (CI: .514–.823); .612 (CI: .459–.815); .421 (CI: .336–.528); 5.080 (CI: 3.483–7.409), respectively].

The most relevant OR were between mail use search engines and social networks; between tobacco, alcohol, drugs and sex; SD and weapons use had mutual relevant odds.

4. Conclusions and discussion

Results discussion must be started by methodological issues. The weaknesses and limitations of the study relate to the use of self-reported sleep duration during week and weekends with no information concerning sleep schedules, nor information about parental monitoring and opinion, nor a proper definition of sleep deprivation with a measure of daytime consequences. Another limitation is the cross sectional nature of the study that does not allow a fully assumption of causality, and finally and the fact that because of using data from a broad previous study with a very specific design and methods, data collection was limited by data availability and used merely post hoc. However there are strong points that relate to the fact that it was a national study, integrated in a multinational WHO research project. Data were well stratified, randomized and representative, and the school response rate was very high, and this study was, at the authors' knowledge, the first ever carried out in Portugal, furthermore results will allow not only to raise a few recommendations to public policies, related to the importance of sleep quality and quantity for adolescents health and well-being, but also may raise a few recommendations to the national study, in order to fully understand sleep features, determinants and consequences, for the next HBSC wave.

The main results are: SD was present in 18.9% of the students with no gender differences but SD increased with age; SD/NoSD differences were not significant for TV viewing, but highly significant for computer and internet use (email, search engines, social networks and multimedia). Risk behaviours were relatively common, mostly in what concerned alcohol and drug consumption, hetero-aggressive and sexual behaviours; all these behaviours were significantly more

prevalent in sleep deprived adolescents, but only grade and tobacco, PCuse weekdays, soft drugs and carrying weapons to school contributed significantly to a model of sleep deprivation. SD was a predictor of PCuse weekdays, tobacco and drugs. In spite of the fact that from the used model clusters of interrelated predictors showed mainly three groups: high tech use, substance use, sex and violence emerged, tobacco use was by itself a predictor of most risk behaviours.

The comparison with the HBSC study shows that Portuguese adolescents use TV and screen time too many hours per day, being situated in a 17th place among HBSC countries, and within the HBSC average value, at the age of 15 [5]. When compared with the USA data [20] TV for more than 3 h/day was more prevalent in Portugal (56.2% versus 33.3%), while computer use was quite similar in both countries (31.6% versus 31.1%, respectively).

Data do not show significant increase of SD with TV viewing and computer use, but demonstrate highly significant results for mobile phones, computer use on week days, use of search engines, participations in social networks and use of multimedia contents.

In the HBSC study, [5] smoking at least once a week had an average prevalence of 18%; in Portugal it was around 10%, but significantly higher in SD adolescents. In the USA-CDC report [20] smoking is more prevalent (44.7%).

Alcohol consumption increases with age and drunkenness episodes are becoming frequent among European youngsters [5]; having had 2 or more episodes has a prevalence of 32% (29% for girls and 34% for boys). Usually it occurs mostly in boys, but girl prevalence is increasing and it is already higher in some countries. In the USA drunkenness prevalence is very low, around 14%, in Portugal around 21% and in Canada around 34%.

Cannabis use varies tremendously among countries; the perceived availability of Cannabis increases the rate of use [5].

In the present study, all the substance use behaviours were higher in SD adolescents. A USA study proved the bidirectional associations between sleep and substance use, namely: cigarette use and weekend sleep and marijuana use and total sleep; alcohol use could predict shorter weekend oversleep while marijuana use predicted increased weekend sleep and weekend oversleep [43].

Fights tend to decrease with age, for boys in all countries and for girls in most countries [5]; at the age of 15 the prevalence is 10%; it was lower in Portugal by 2% of the girls and 9% of the boys. Unexpectedly, carrying a weapon to school and being involved in fights had exactly the same percentages as those found in the USA by the CDC 2010 [20]; the correlation of fights and carrying a weapon and sleep deprivation was also observed, with increased odds for boys [38].

The prevalence of earlier sexual activity, intercourse (before 15 years), varies across countries; the average prevalence was 26% (23 for girls and 29% for boys); but the gender gap might vary; in Portugal it was 18/27% close to the average values. In our data early sexual relations were more prevalent in SD adolescents. Logistic regression analysis aiming to find predictors of SD only explains very low percentages of the variance; the same holds for SD as a predictor of risk behaviours; variance (R^2) coefficients only explained significant amounts of the variance in multimedia use, search engines, social networks and tobacco, but the goodness of the fit was never present.

Whenever taking these data as an all, it becomes clear that behaviours have complex relations with sleep deprivation, with multidirectional interactions, both between sleep deprivation and risk behaviours and between sleep deprivation and the sleep stealers use, and among behaviours themselves. The approach needed for a more comprehensive understanding of the role of sleep in stabilizing and improving deleterious behaviours in youngsters worldwide requires robust measures and complex statistical models. The obtained data are relevant but preliminary, and much work is still required in order to improve worldwide health and global quality of life in adolescents, because and ultimate consequence of fully understand sleep deprivation determinants and consequences is to be able to influence public policies in this area and provide educational and health professionals and policy makers with evidence based guidelines that may help to decrease sleep deprivation and thus contribute to adolescents health and wellbeing promotion.

Conflict of interest

For all authors – No financial support, no conflict of interests.

References

[1] Fredriksen K, Rhodes J, Reddy R, Way N. Tracking the effects of adolescent sleep loss during the middle school years. Child Dev 2004;75(1):84–95.
[2] Hasler BP, Clark DB. Circadian misalignment, reward-related brain function, and adolescent alcohol involvement. Alcohol Clin Exp Res 2013;37(4):558–65 April.
[3] O'Brien E, Mindell J. Sleep and risk-taking behavior in adolescents. Behav Sleep Med 2005;3:113–33.
[4] Jago R, Sebire SJ, Gorely T, Cillero IH, Biddle SJ. "I'm on it 24/7 at the moment": a qualitative examination of multi-screen viewing behaviours among UK 10-11 year olds. Int J Behav Nutr Phys Act 2011;8:85 3.
[5] Currie, C, Zanotti, C, Morgan, A, et al. Social determinants of health and well-being among young people. Health Behaviour in School-aged Children (HBSC) study: International Report From the 2009/2010 survey. WHO Regional Office for Europe, (Health Policy for Children and Adolescents, No. 6), Copenhagen; 2012.
[6] Staiano AE, Harrington DM, Broyles ST, Gupta AK, Katzmarzyk PT. Television, adiposity, and cardiometabolic risk in children and adolescents. Am J Prev Med 2013;44(1):40–7.
[7] Goldfield GS, Saunders TJ, Kenny GP, Hadjiyannakis S, Phillips P, Alberga AS, Tremblay MS, Sigal RJ. Screen viewing and diabetes risk factors in overweight and obese adolescents. Am J Prev Med 2013;44(4 Suppl. 4):S364–70.
[8] Ouwens MA, Cebolla A, van Strien T. Eating style, television viewing and snacking in pre-adolescent children. Nutr Hosp 2012;27(4):1072–8.
[9] Hare-Bruun H, Nielsen BM, Kristensen PL, Møller NC, Togo P, Heitmann BL. Television viewing, food preferences, and food habits among children: a prospective epidemiological study. BMC Public Health 2011;11:311 13.
[10] Pearson N, Salmon J, Crawford D, Campbell K, Timperio A. Are parental concerns for child TV viewing associated with

child TV viewing and the home sedentary environment? Int J Behav Nutr Phys Act 2011;8:102 27.
[11] Ramos E, Costa A, Araújo J, Severo M, Lopes C. Effect of television viewing on food and nutrient intake among adolescents. Nutrition 2013;29(11–12):1362–7.
[12] Santaliestra-Pasías AM, Mouratidou T, Huybrechts I, et al. Increased sedentary behaviour is associated with unhealthy dietary patterns in European adolescents participating in the HELENA study. Eur J Clin Nutr 2013;68:300–8.
[13] Shi L, Mao Y. Excessive recreational computer use and food consumption behaviour among adolescents. Ital J Pediatr 2010;36:52 5.
[14] Coombs N, Shelton N, Rowlands A, Stamatakis E. Children's and adolescents' sedentary behaviour in relation to socio-economic position. J Epidemiol Community Health 2013;67 (10):868–74.
[15] Padez C, Mourao I, Moreira P, Rosado V. Long sleep duration and childhood overweight/obesity and body fat. Am J Hum Biol 2009;21(3):371–6.
[16] Sisson SB, Broyles ST. Social-ecological correlates of excessive TV viewing: difference by race and sex. J Phys Act Health 2012;9(3):449–55.
[17] Totland TH, Bjelland M, Lien N, et al. Adolescents' prospective screen time by gender and parental education, the mediation of parental influences. Int J Behav Nutr Phys Act 2013;10:89 6.
[18] Eaton, DK, Kann, L, Kinchen, S, et al. Centers for disease control and prevention (CDC). Youth risk behavior surveillance - United States, 2011. MMWR surveill summit. 8. 2012;61(4):1–162.
[19] Pengpid S, Peltzer K. Alcohol use and associated factors among adolescent students in Thailand. West Indian Med J 2012;61(9):890–6.
[20] CDC 2010. Cigarette use among high school students – United States, 1991—2009. Weekly July 9. 2010;59(26):797–1.
[21] Baams L, Overbeek G, Semon Dubas J, van Aken MA. On early starters and late bloomers: the development of sexual behavior in adolescence across personality types. J Sex Res 2014;51(7):754–64.
[22] Riggs NR, Tate EB, Ridenour TA, et al. Longitudinal associations from neurobehavioral disinhibition to adolescent risky sexual behavior in boys: direct and mediated effects through moderate alcohol consumption. J Adolesc Health 2013;53 (4):465–70.
[23] Murry VM, Simons RL, Simons LG, Gibbons FX. Contributions of family environment and parenting processes to sexual risk and substance use of rural African American males: a 4-year longitudinal analysis. Am J Orthopsychiatry 2013;83(2 Pt 3):299–309.
[24] Caruthers AS, Van Ryzin MJ, Dishion TJ. Preventing high-risk sexual behavior in early adulthood with family interventions in adolescence: outcomes and developmental processes. Prev Sci 2014;15(Suppl. 1):S59–69 February.
[25] Lyerly JE, Brunner Huber LR. The role of family conflict on risky sexual behavior in adolescents aged 15 to 21. Ann Epidemiol 2013;23(4):233–5.
[26] Netto LR, Cavalcanti-Ribeiro P, Pereira JL, et al. Clinical and socio-demographic characteristics of college students exposed to traumatic experiences: a census of seven college institutions in northeastern Brazil 3. PLoS One 2013;8(11): e78677.
[27] Oliveira-Campos M, Giatti L, Malta D, Barreto SM. Contextual factors associated with sexual behavior among Brazilian adolescents. Ann Epidemiol 2013;23(10):629–35.
[28] Parkes A, Wight D, Hunt K, Henderson M, Sargent J. Are sexual media exposure, parental restrictions on media use and co-viewing TV and DVDs with parents and friends associated with teenagers' early sexual behaviour? J Adolesc 2013;36(6):1121–33.
[29] Muchimba M, Haberstick BC, Corley RP, McQueen MB. Frequency of alcohol use in adolescence as a marker for subsequent sexual risk behavior in adulthood. J Adolesc Health 2013;53(2):215–21.
[30] Schuster RM, Mermelstein R, Wakschlag L. Gender-specific relationships between depressive symptoms, marijuana use, parental communication and risky sexual behavior in adolescence. J Youth Adolesc 2013;42(8):1194–209.
[31] Umlauf MG, Bolland JM, Lian BE. Sleep disturbance and risk behaviors among inner-city African-American adolescents. J Urban Health 2011;88(6):1130–42.
[32] Matos AP, Ferreira JA, Haase RF. Television and aggression: a test of a mediated model with a sample of Portuguese students January. J Soc Psychol 2012;152(1):75–91.
[33] Al-Hazzaa HM, Musaiger AO, Abahussain NA, Al-Sobayel HI, Qahwaji DM. Lifestyle correlates of self-reported sleep duration among Saudi adolescents: a multicenter school-based cross-sectional study. Child. Care Health Dev 2013;22.
[34] Arora T, Hussain S, Hubert Lam KB, Lily Yao G, Neil Thomas G, Taheri S. Exploring the complex pathways among specific types of technology, self-reported sleep duration and body mass index in UK adolescents. Int J Obes 2013;37(9):1254–60.
[35] Yen CF, King BH, Tang TC. The association between short and long nocturnal sleep durations and risky behaviours and the moderating factors in Taiwanese adolescents 30. Psychiatry Res. 2010;179(1):69–74.
[36] Ivarsson M, Anderson M, Åkerstedt T, Lindblad F. The effect of violent and nonviolent video games on heart rate variability, sleep, and emotions in adolescents with different violent gaming habits. Psychosom Med 2013;75(4):390–6.
[37] King DL, Gradisar M, Drummond A, et al. The impact of prolonged violent video-gaming on adolescent sleep: an experimental study. J Sleep Res 2013;22(2):137–43.
[38] Hildenbrand AK, Daly BP, Nicholls E, Brooks-Holliday S, Kloss JD. Increased risk for school violence-related behaviors among adolescents with insufficient sleep. J Sch Health 2013;83(6):408–14.
[39] Tochigi M, Nishida A, Shimodera S, et al. Irregular bedtime and nocturnal cellular phone usage as risk factors for being involved in bullying: a cross-sectional survey of Japanese adolescents. PLoS One 2013;7(9):e45736.
[40] Schlarb AA, Sopp R, Ambiel D, Grünwald J. Chronotype-related differences in childhood and adolescent aggression and antisocial behavior – a review of the literature. Chronobiol Int 2014;31(1):1–16.
[41] Matos MG, Simões C, Tomé G, et al. In: Portuguese adolescents' health today and in eight years: HBSC 2006. Lisboa: FMH & CMDT; 2006.
[42] Paiva T, Gaspar T, Matos MG. Sleep deprivation in adolescents: correlations with health complaints and health related quality of life. Sleep Med. in press; 2015.
[43] Pasch KE, Latimer LA, Cance JD, Moe SG, Lytle LA. Longitudinal bi-directional relationships between sleep and youth substance use. J Youth Adolesc 2012;41(9):1184–96.