



Sleep duration and physical fighting involvement in late adolescence

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Abstract

Objective Violence behaviours are among the leading causes of mortality and morbidity among young people worldwide, and evidence has shown changes in sleep patterns seem to affect school attainment, behaviour, emotion and attention control, and social interactions and relate with a more aggressive behaviour. We assessed the association between sleep duration and physical fighting involvement among 17-year-old Portuguese school-going adolescents.

Subject and methods The analysis included 2426 Portuguese adolescents observed at wave 2 of the EPITeen cohort. Sleep duration was estimated by self-reported bed and wake-up times. Physical fighting involvement was based on the self-reported data regarding the year before the evaluation. Logistic regression models adjusted for potential confounders were used to calculate the odds ratio (OR) and 95% confidence intervals (95% CI).

Results In our sample, 34.2% of participants had been involved in a physical fight at least once during the previous year. In girls, shorter sleep duration was significantly associated with physical fighting (OR = 1.35; 95% CI: 1.01; 1.81) and remained statistically significant after adjustment for parents' education level (AOR = 1.36; 95% CI: 1.01; 1.83), although the association was attenuated after additional adjustment for tobacco use and depressive symptoms (AOR = 1.19; 95% CI: 0.86; 1.65). In boys, insufficient sleep was significantly associated with physical fighting (OR = 1.43; 95% CI: 1.12; 1.82) and remained statistically significant after adjustment for parents' education level (AOR = 1.42; 95% CI: 1.11; 1.82) and after additional adjustment for tobacco use (AOR = 1.28; 95% CI: 1.00; 1.66).

Conclusion Shorter duration of sleep seems to be associated with physical fighting involvement, although the relationship might be mediated by other behavioural factors.

Keywords Physical fighting · Sleep · Adolescents · Behaviours

Introduction

Violence behaviours are among the leading causes of mortality and morbidity among young people worldwide (World Health Organization 2014). Previous studies carried out through national- and international-level surveys (Elgar et al. 2015; Fraga et al. 2011; Pickett et al. 2013; Rajan et al. 2015; Rudatsikira et al. 2008) showed that the prevalence of youth violence varied between 12.0% (Rajan et al. 2015) and 40.7% (Rudatsikira et al. 2008). It can be manifested through varied

behaviours in which youngsters engage such as bullying, physical fighting, carrying weapons, etc. The involvement of young people in physical fighting may cause emotional and/or physical harm that can ultimately lead to serious injuries or even death.

Regarding previous research, there is a significant association between physical fighting involvement and other violent and unhealthy behaviours, such as carrying weapons (Swahn et al. 2013) and greater involvement in risk behaviours such as alcohol and drug use (Rudatsikira et al. 2008; Swahn et al. 2013), as well as media violence exposure (Coker et al. 2015; Demissie et al. 2014). Also, studies reported that those involved in physical fights are more likely to present negative health outcomes, such as sleep problems, appetite suppression and headaches (Fekkes et al. 2006; Walsh et al. 2013). A study examining the association between both the quantity and quality of sleep and aggression behaviour among male adolescents showed that hostility was associated with both reduced quantity and quality of sleep (Ireland and Culpin 2006).

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Conversely, lack of sleep is often a cause of excess mental stress, depressive symptoms and anxiety (Hasler et al. 2005; Strine and Chapman 2005), which might influence mental and physical abilities, modifying risk perception and awareness (Orzel-Gryglewska 2010). Previous studies showed that changes in sleep patterns seem to affect school attainment, behaviour, emotion and attention control, social interactions, substance use and psychiatric disorders (Dahl and Lewin 2002; Meldrum and Restivo 2014), and they relate to more aggressive behaviour, particularly in boys (Meijer et al. 2010).

This study hypothesizes that adolescents reporting shorter sleep duration might be more prone to engage in aggressive and violent behaviours. Thus, the purpose of this study is to assess how sleep duration on school nights relates to physical fighting involvement among 17-year-old Portuguese school-going adolescents.

Materials and methods

Participants

Briefly, the EPITeen study is a population-based cohort that was first assembled during the 2003–2004 school year, comprising adolescents born in 1990 and enrolled at public and private schools in Porto, Portugal. From the 2786 eligible adolescents identified, 2159 (77.5%) agreed to participate. In 2007–2008, the cohort included 2499 adolescents: 1716 who were part of the initially recruited sample and 783 additionally recruited students. These were included for being born in the same year and attending school at Porto during the second recruitment phase. Sampling procedures and detailed methods have been described elsewhere (Ramos and Barros 2007).

In this analysis we included participants with data available on sleep duration and physical fighting involvement, a total of 2426 17-year-old adolescents (1250 females, 51.5%).

Data collection

The evaluation included two self-administered questionnaires (one completed at home, another at school), comprising information on social, demographic and behavioural characteristics and individual and family history of disease. A physical examination was also performed at school by a team of experienced nurses, nutritionists and physicians.

Parental education level was measured as the number of successfully completed years of formal schooling, and a new variable was created considering the information of the parent with the highest education level. Physical fighting was assessed with the following question: “During the past 12 months, how many times were you involved in a physical fight?” Closed option answers ranged from never to 12 or more times. For the

analysis, physical fighting during the previous year was computed as “never” or “at least one time”. Depressive symptoms were evaluated using the Beck Depressive Inventory (BDI) II, and a score over 13 points defined the presence of depressive symptoms (Coelho et al. 2002). Regular practice of sports corresponds to the frequency of spending at least 20 consecutive minutes in sport activities beyond compulsory school activities. Tobacco smoking was assessed using the following question: “Do you smoke or have you ever smoked?” If the answer was yes, participants were asked to classify the type of experience: experienced but does not smoke, smokes but not every day and smokes at least one cigarette a day. The variable was then coded as: “never”, “experimenter” or “smoker” (includes occasional and daily smokers). Participants were asked if they have ever drunk alcohol, the frequency of the consumption of alcoholic beverages and if they have ever been drunk. The variable was coded into “never”, “experimenter”, “drinker, never drunk” and “drinker, ever drunk”. The use of cannabis was assessed asking participants if they have ever used this type of substance and the frequency of use. The variable was coded into “never”, “experimenter” and “smoker”.

Participants were asked to report usual bedtimes (“During weekdays, at what time do you go to bed?”) and wake-up times (“During weekdays, at what time do you get up?”) on weekdays. Sleep duration was estimated by the difference between self-reported bedtimes and wake-up times. Sleep duration was coded as ≥ 8 h (sufficient) vs. < 8 h (insufficient), as previously reported for this setting (Hildenbrand et al. 2013; McKnight-Eily et al. 2011) and according to national (Associação Portuguesa de Sono and Sociedade Portuguesa de Pediatria n.d.) and international recommendations (National Sleep Foundation 2006).

Statistical analysis

Data were analysed separately for female and male participants. The chi-square test was used to test the statistical associations between physical fighting and sleep duration with the covariates. Logistic regression models were used to estimate the magnitude of the association [odds ratios, with 95% confidence intervals (OR, 95% CI)] between sleep duration and physical fighting involvement. In girls, adjusted ORs with 95% CIs were calculated through two models: (1) adjusted for parents’ education level; (2) adjusted for parents’ education level, tobacco use and depressive symptoms. In boys, adjusted ORs with 95% CIs were calculated through two models: (1) adjusted for parents’ education level; (2) adjusted for parents’ education level and tobacco use. All analyses were performed using IBM SPSS Statistics, version 22, 2013.

Ethics

The Ethics Committee of Hospital S. João approved the study, and data confidentiality and protection were guaranteed in all procedures. Parents and adolescents received written and oral information explaining the purpose and design of the study and written informed consent was obtained from both.

Results

Overall, 34.2% of participants were involved in a physical fight at least once during the previous year, and 14.9% have fought at school at least once. In girls, 24.1% report insufficient sleep duration (< 8 h of sleep during weekdays) and involvement in physical fighting, while in boys the proportion is 54.7%.

In both female and male participants, involvement in fights was more frequent and statistically significant among those who lived with no parents or only with the mother, with history of grade retention, usual smokers (tobacco and cannabis) and drinkers (namely those who reported at least one episode of drunkenness) and those that have the TV on when sleeping and played videogames at night (Tables 1 and 2). Insufficient sleep duration (< 8 h of sleep per school night) was more frequent and statistically significant among those with a history of grade retention and usual smokers (tobacco and cannabis) and drinkers (namely those who reported at least one episode of drunkenness) for both girls and boys (Tables 1 and 2).

In girls, insufficient sleep was significantly associated with physical fighting (OR = 1.35; 95% CI: 1.01; 1.81) and remained statistically significant after adjustment for parents' education level (AOR = 1.36; 95% CI: 1.01; 1.83), although it lost significance after additional adjustment for tobacco use and depressive symptoms (AOR = 1.19; 95% CI: 0.86; 1.65) (Table 3).

Regarding boys, insufficient sleep was significantly associated with physical fighting (OR = 1.43; 95% CI: 1.12; 1.82) and remained statistically significant after adjustment for parents' education level (AOR = 1.42; 95% CI: 1.11; 1.82) and after additional adjustment for tobacco use (AOR = 1.28; 95% CI: 1.00; 1.66) (Table 4).

Discussion

The present study showed that sleep duration was related to involvement in physical fighting, validating the hypothesis that insufficient sleep on an average school night was associated with physical fighting involvement among 17-year-old adolescents in both genders. Also, we found that boys report insufficient sleep and involvement in fights more frequently

than girls. Regarding involvement in fights, boys seem to use more direct forms of aggression, externalizing their behaviours and making it more visible, while girls use more indirect forms of aggression, not using violence as the first resource to solve conflicts (Craig and Harel 2004; World Health Organization 2016).

In fact, scientific literature reports some mechanisms that might explain the relationship between sleep and violent or aggressive behaviours. One is the prefrontal cortical functioning, i.e., sleep deprivation reduces the prefrontal cortical functioning and consequently the behavioural responses based on cognitive and social context declines (Dahl 1996), potentially leading to uncontrolled and impulsive aggressive responses. Another probable mechanism is the expected role of serotonin in aggressive behaviours. Selective serotonin reuptake inhibitors seem to decrease irritability and assault in violent offenders (Butler et al. 2010), and sleep deprivation is associated with higher serotonergic activity. Finally, another possible mechanism is the hypothalamic-pituitary-adrenal (HPA) axis once sleep has an inhibitory influence on HPA (Kamphuis et al. 2012).

Also, a previous review showed that the use of substances was associated with sleep problems and the magnitude of association increased with the increased frequency of substance use (Chaput et al. 2015). However, this seems to be a bi-directional association and it remains unclear how these factors relate. Regarding violence, it is well established that for instance acute intoxication, namely with alcohol, causes disinhibited behaviour and may lead to aggression in persons prone to violent behaviour (Boles and Miotto 2003). Still, our study showed that the consumption of alcohol, tobacco and cannabis was associated with both sleep and physical fighting in girls and boys, which may be due to common determinants or also because these behaviours are themselves promoters of violent situations (Swahn and Donovan 2004). Substance use is a common factor in both sleep disorders and violent behaviours, which might explain the attenuation of the association in the adjusted models, more evident in girls. We cannot discard the potential collinearity between the covariates included in the final models. In fact, during adolescence, it is expected to have a cluster effect on engagement in unhealthy behaviours (Fraga et al. 2011; Swahn and Donovan 2004).

Insufficient sleep is associated with decreased arousal, reduced visual and motor acuity, and cognitive deficits including slower and more variable response time, impaired memory and attention (Maquet 2001). In children, the lack of proper hours of sleep is one of the most common, important and potentially preventable health risks (Chen et al. 2006). The literature shows that adolescents are a population group where chronic sleep loss has increasingly become the standard (Eaton et al. 2006) and we found that approximately one third of the 17-year-old participants in this study reported sleeping < 8 h per night. Also, although it might not be expected that

Table 1 Association between girls' last 12 months' involvement in physical fighting and insufficient sleep (< 8 h on an average school night) and girls' social and behavioural characteristics

	Physical fighting			Sleep duration	
	Total <i>n</i>	Yes <i>n</i> (%)	<i>p</i> value*	< 8 h <i>n</i> (%)	<i>p</i> value*
Household^a					
Father and mother	883	156 (17.7)	< 0.001	282 (31.9)	0.037
Only mother	231	68 (29.4)		61 (26.4)	
Only father	39	5 (12.8)		11 (28.2)	
No parents	48	15 (31.3)		7 (14.6)	
Parents' education level^b					
≤ 9th grade	574	147 (25.6)	< 0.001	168 (29.3)	0.910
10th to 12th grade	323	59 (18.3)		99 (30.7)	
> 12th grade	330	41 (12.4)		98 (29.7)	
Grade retention					
Never	790	108 (13.7)	< 0.001	215 (27.2)	0.009
Once	239	56 (23.4)		89 (37.2)	
Twice or more	204	91 (44.6)		66 (32.4)	
TV on when sleeping					
No	876	159 (18.2)	0.006	247 (28.2)	0.075
Yes	352	89 (25.3)		118 (33.5)	
Depressive symptoms					
BDI score ≤ 13	914	175 (19.1)	0.004	267 (29.2)	0.002
BDI score > 13	200	57 (28.5)		81 (40.5)	
Plays games at night					
No	1174	227 (19.3)	0.001	343 (29.2)	0.083
Yes	59	23 (39.0)		24 (40.7)	
Tobacco use^c					
Never	667	97 (14.5)	< 0.001	172 (25.8)	0.003
Experimenter	392	93 (23.7)		130 (33.2)	
Smoker	179	61 (34.1)		66 (36.9)	
Alcohol use^d					
Never	208	20 (9.6)	< 0.001	54 (26.0)	0.015
Experimenter	476	98 (20.6)		131 (27.5)	
Drinker, never drunk	331	64 (19.3)		99 (29.9)	
Drinker, ever drunk	204	66 (32.4)		79 (38.7)	
Cannabis use[§]					
Never	1112	200 (18.0)	< 0.001	315 (28.3)	< 0.001
Experimenter	42	16 (38.1)		12 (28.6)	
Smoker	96	41 (42.7)		46 (47.9)	
Practice of sports (at least 20 min)					
Until once a week	706	130 (18.4)	< 0.001	201 (28.5)	0.148
Two to three times a week	355	64 (18.0)		104 (29.3)	
Four or more times a week	157	51 (32.5)		57 (36.3)	

**p* value obtained for the crude comparison of physical fighting and insufficient sleep prevalence across strata of exposure using the chi-square test

^a With whom the adolescent was living

^b Adolescents were classified based on the parent with the higher educational level

^c Smoker category includes both occasional or daily smokers

^d Drinkers included those who consumed alcoholic beverages occasionally or daily, considering separately those who never got drunk and those who reported episodes of drunkenness

Table 2 Association between boys' last 12 months' involvement in physical fighting and insufficient sleep (<8 h on an average school night) and boys' social and behavioural characteristics

	Physical fighting			Sleep duration	
	Total <i>n</i>	Yes <i>n</i> (%)	<i>p</i> value*	< 8 h <i>n</i> (%)	<i>p</i> value*
Household^a					
Father and mother	859	396 (46.1)	0.025	264 (30.7)	0.416
Only mother	199	115 (57.8)		73 (36.7)	
Only father	28	13 (46.4)		10 (35.7)	
No parents	39	21 (53.8)		10 (35.7)	
Parents' education^b					
≤ 9th grade	488	245 (50.2)	0.536	179 (36.7)	0.001
10th to 12th grade	312	152 (48.7)		110 (35.3)	
> 12th grade	352	163 (46.3)		88 (25.0)	
Grade retention					
Never	661	291 (44.0)	< 0.001	198 (30.0)	0.050
Once	267	132 (49.4)		99 (37.1)	
Twice or more	228	144 (63.2)		83 (36.4)	
TV on when sleeping					
No	844	388 (46.0)	0.004	256 (30.3)	0.005
Yes	308	171 (55.5)		121 (39.3)	
Depressive symptoms					
BDI score ≤ 13	910	426 (46.8)	0.129	323 (35.5)	0.423
BDI score > 13	67	38 (56.7)		20 (29.9)	
Plays games at night					
No	669	303 (45.3)	0.007	206 (30.8)	0.131
Yes	486	259 (53.3)		171 (35.2)	
Tobacco use^c					
Never	672	271 (40.3)	< 0.001	184 (27.4)	< 0.001
Experimenter	319	185 (58.0)		122 (38.2)	
Smoker	165	106 (64.2)		71 (43.0)	
Alcohol use[¶]					
Never	192	73 (38.0)	< 0.001	54 (28.1)	0.029
Experimenter	316	142 (44.9)		93 (29.4)	
Drinker, never drunk	338	152 (45.0)		117 (34.6)	
Drinker, ever drunk	295	185 (62.7)		115 (39.0)	
Cannabis use^d					
Never	987	453 (45.9)	< 0.001	307 (31.1)	0.001
Experimenter	51	27 (52.9)		15 (29.4)	
Smoker	138	93 (67.4)		64 (46.4)	
Practice of sports (at least 20 min)					
Until once a week	346	159 (46.0)	0.132	118 (34.1)	0.042
Two to three times a week	393	181 (46.1)		110 (28.0)	
Four or more times a week	402	210 (52.2)		145 (36.1)	

**p* value obtained for the crude comparison of physical fighting and insufficient sleep prevalence across strata of exposure using the chi-square test

^a With whom the adolescent was living

^b Adolescents were classified based on the parent with the higher educational level

^c Smoker category includes both occasional or daily smokers

^d Drinkers included those who consumed alcoholic beverages occasionally or daily, considering separately those who never got drunk and those who reported episodes of drunkenness

Table 3 Association of sleep duration and physical fighting involvement in girls

Sleep	Physical fighting involvement			Odds ratio (95% confidence interval)		
	Total <i>n</i>	Yes <i>n</i> (%)	p value	Crude OR	Model 1	Model 2
≥ 8 h	877	167 (19.0)	0.047	Ref	Ref	Ref
< 8 h	373	90 (24.1)		1.35 (1.01; 1.81)	1.36 (1.01; 1.83)	1.19 (0.86; 1.65)

Model 1: adjusted for parents' education level

Model 2: adjusted for parents' education level, tobacco use and depressive symptoms

older adolescents use fighting to solve problems, we found that more than one third of the adolescents in our sample was involved in a physical fight at least once in the previous year. According to the literature, engaging in physical fighting is a relatively common behaviour at this age (Elgar et al. 2015; Fraga et al. 2011; Pickett et al. 2013).

Although our results corroborate the effect of lack of sleep on arising mood disturbances, violence and involvement in physical fighting, we cannot disregard the fact that this is a cross-sectional study design; the temporality of associations cannot be determined and therefore the direction of this association remains unclear. Also, there is a large set of evidence supporting the effect of physical fighting on sleep patterns (Fekkes et al. 2006; Meijer et al. 2000; Walsh et al. 2013). This is consistent with results obtained in other settings, such as the involvement in intimate partner violence and the increased odds of poor sleep quality (Sanchez et al. 2016; Walker et al. 2011), children exposed to violence (Spilsbury et al. 2014) and bullying, with victimization contributing with odds of 3.61 to having sleeping disturbances and 2.28 to having nightmares (Kshirsagar et al. 2007). Also, the way we assessed physical fighting does not allow us to characterize who initiated the fight and so we cannot determine who is a victim or a perpetrator. We cannot discard the possible differences regarding the association of sleep duration and proactive and reactive involvement in fighting.

To our knowledge, the association of sleep duration with physical fighting involvement, one of the most assessed behaviours to characterize youth violence and a reliable indicator of the violence magnitude that people are exposed to in a

given society, has not been described previously. However, some strengths, limitations and methodological options should be pointed out. Adolescents in this study were previously evaluated by the same research team (EPITeen study), which enhances a climate of trust and confidentiality. Moreover, our decision to analyse a single question to assess physical fighting involvement can be considered broad because it covers a set of behaviours and no specific victims or perpetrators are identified. Nonetheless, it is a widely used and easy question for the assessment, which tends to work well among young people, and it allows the characterization of young people's behaviour. Also, data on usual bedtimes and wake-up times on weekdays were based on self-reported information; however, no bias is expected since reporting wake-up and bedtimes is not likely to cause embarrassment or discomfort. To overcome the self-report of wake-up and bedtimes, sleep quantity and quality could have been assessed by using other sophisticated methods; however, using actigraphy and/or lengthier measures of sleep quality assessment was not possible for the EPITeen cohort evaluations. Apart from the limitations, the study was conducted on a large sample of population-based adolescents, with a high proportion of participation at baseline and at follow-up, which supports the external validity of our results.

In conclusion, we found that shorter duration of sleep was associated with physical fighting involvement during adolescence in both girls and boys. A multidisciplinary approach should empower adolescents with healthier lifestyles and sleep routines that may have potential effects on the prevention of violent behaviour among this age group.

Table 4 Association of sleep duration and physical fighting involvement in boys

Sleep	Physical fighting involvement			Odds ratio (95% confidence interval)		
	Total <i>n</i>	Yes <i>n</i> (%)	p value	Crude	Model 1	Model 2
≥ 8 h	790	362 (45.8)	0.005	1	1	1
< 8 h	386	211 (54.7)		1.43 (1.12; 1.82)	1.42 (1.11; 1.82)	1.28 (1.00; 1.66)

Model 1: adjusted for parents' education level

Model 2: adjusted for parents' education level and tobacco use

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Compliance with ethical standards

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with 1964 Helsinki Declaration and its later amendments.

Informed consent Informed consent was obtained from all individual participants included in the study.

Conflict of interest The authors have no conflicts of interest to declare.

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