

# Association between unhealthy behavior and sleep quality and duration in adolescents

## *Associação entre comportamento não saudável e qualidade e duração do sono em adolescentes*

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**Abstract** – Inadequate sleep has been associated with unhealthy behavior in adolescence. This study aimed to estimate the prevalence of negative sleep indicators (perceived poor-quality sleep and insufficient sleep duration) among students and to identify unhealthy behaviors associated with this outcome. This study is part of a school-based, cross-sectional survey conducted in 2011 in adolescents from Santa Catarina State, Brazil. High school students aged 15 to 19 years ( $n = 6,529$ ) and enrolled in state public schools participated in the study. The students responded to a questionnaire on the number of hours slept (insufficient:  $< 8$  h, sufficient:  $\geq 8$  h); perceived sleep quality (good or poor); and behavioral variables. Multinomial logistic regression was performed using reports of positive sleep indicators, and negative reports of one or two sleep indicators. Approximately 30% of adolescents reported a negative perception of sleep, indicating poor quality and insufficient duration. The use of computers/videogames ( $\geq 4$  h/d) and excessive consumption of alcoholic beverages, salty snacks or sweets were associated with negative sleep indicators. A high number of young people displayed one or two negative sleep indicators, and it was found an association between these indicators and a number of unhealthy behaviors.

**Key words:** Adolescent behavior; Brazil; Epidemiology; Sleep.

**Resumo** – O sono inadequado tem sido associado com o comportamento não saudável na adolescência. Este estudo teve como objetivo estimar a prevalência de indicadores negativos do sono (percepção da má qualidade e duração insuficiente do sono) entre os alunos e identificar comportamentos não saudáveis associados a este resultado. Este estudo é parte de uma pesquisa de base escolar, transversal, realizada em 2011, em adolescentes do Estado de Santa Catarina, Brasil. Estudantes do ensino médio com idades entre 15 a 19 anos ( $n = 6.529$ ) e matriculados em escolas públicas estaduais participaram do estudo. Os alunos responderam a um questionário sobre o número de horas dormidas (insuficiente:  $< 8$  h, suficiente:  $\geq 8$  h); qualidade do sono percebida (boa ou má); e variáveis comportamentais. Regressão logística multinomial foi realizada, utilizando os relatos de indicadores positivos do sono e relatos negativos de um ou dois indicadores do sono. Cerca de 30% dos adolescentes relataram uma percepção negativa do sono, indicando má qualidade e duração insuficiente. O uso de computadores / videogames ( $\geq 4$  h/d) e consumo excessivo de bebidas alcoólicas, salgadinhos ou doces foram associados a indicadores negativos do sono. Um elevado número de jovens apresentou um ou dois indicadores negativos do sono, e verificou-se uma associação entre estes indicadores e uma série de comportamentos não saudáveis.

**Palavras-chave:** Brasil; Comportamento do adolescente; Epidemiologia; Sono.

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## INTRODUCTION

The quality and duration of sleep are important indicators of health and well-being in adolescents<sup>1</sup>. Inadequate sleep has been associated with negative health perception, low physical aptitude, and obesity<sup>2</sup>. In addition, inadequate sleep represents signs of stress and a lifestyle that can compromise health<sup>3</sup>. In adolescence, there are increases in academic demands, exposure to social and extracurricular activities and the propensity to occupy part of the time with work. Adolescents sleep insufficiently due to these social, academic and work-related pressures and to biological changes in the sleep-wake cycle<sup>1</sup>. The consequences of insufficient and poor-quality sleep can have a negative impact on the behavioral and emotional control of adolescents, which may be associated with the adoption of unhealthy behaviors<sup>2</sup>, including smoking, alcohol and illicit drug use<sup>4,5</sup>, poor eating habits<sup>3</sup>, physical inactivity<sup>6,7</sup> and sedentary activities<sup>8</sup>.

In the last years, Brazil has experienced significant changes in factors related to deteriorated sleep patterns in adolescents, especially due to the purchasing power of internet access and electronic equipment. Between 2000 and 2010, the population census recorded an increase in permanent households with televisions (from 89.0% to 96.0%) and computers (12.6% to 35.1%)<sup>9</sup>. New technological inventions (iPhones and smartphones, for example) have reduced the duration of sleep in adolescent<sup>8,10,11</sup>. In addition, increased nighttime leisure options encourage teenagers to stay awake until later times and can promote alcohol consumption and harm the sleep<sup>12</sup>.

However, despite evidence of an association between negative sleep indicators and undesirable health behaviors<sup>3</sup>, review studies indicate a lack of information on South American teenagers<sup>13-15</sup>. Furthermore, a literature review revealed no studies that investigated the relationship between unhealthy behaviors and sleep quality and duration in a representative sample of schools in a Brazilian state.

The present study identified risk behaviors that are associated with insufficient and poor-quality sleep. Such information is important when trying to minimize the negative effects of economic and psychosocial factors on sleep and of biological changes in the sleep-wake cycle in adolescents. Thus, this study sought to estimate the prevalence of negative sleep indicators (perceived poor-quality and insufficient sleep duration) on school days among high school students from Santa Catarina state, Brazil, and to identify unhealthy behaviors associated with this outcome.

## METHODS

### Sampling design

This study is part of school-based epidemiological survey entitled “Lifestyle and behaviors of risk of young people from Santa Catarina – COMPAC project” that was performed in 2011. The population included public high school students between the ages of 15 and 19 years. The following statistical

parameter was used to calculate the sample size: the unknown prevalence of the phenomenon, estimated at 50%; a confidence interval of 95%; and a maximum error of 2 percentage points, achieving a minimum sample size of 2,373 students. This study used a design effect of two ( $n = 4,746$ ) and added 25% for possible losses or refusals during collection, with a final sample of 5,932 students.

The geographical regions ( $n = 6$ ), comprised the sampling strata. The selection of sample units occurred in two stages: (1) schools were stratified by size (large:  $\geq 500$  students; middle: 200 to 499 students; and small:  $< 200$  students), and (2) specific classes were drawn by shift and grade. A total of 90 schools were selected from the 725 available schools, and 344 classes were selected. Detailed sampling procedures have been published elsewhere<sup>16</sup>. The questionnaire was tested for face and content validity, and values of reproducibility ranging from 0.51 to 0.96 were obtained (unpublished data).

The survey was approved by the Ethics Committee on Human Research of the Federal University of Santa Catarina (Process N<sup>o</sup>: 1029/2010) and the Education Department of the state of Santa Catarina.

### Descriptive variables

The duration and quality of sleep were based on self-reported data. These variables have shown good test-retest reproducibility<sup>17</sup>, as it was found in the COMPAC project ( $r = 0.51$  to  $0.96$ ). In this study, sleep duration on school days was examined, and students were instructed to disregard daytime naps and sleep quality, which is the frequency with which they slept well. For classification, cutoff recommended by the National Sleep Foundation<sup>6</sup> and other studies<sup>3,18,19</sup>. Detailed information can be found in box 1, which also contains the variables' respective collection methods and analysis categories.

### Statistical analysis

Relative frequency distribution of the outcomes under study and the outcomes' combination was used. Because no inter-sex differences were found, this stratum was disregarded in the analyses. Next, crude and adjusted multinomial logistic regression was performed using reports of positive sleep indicators (sufficient duration + good quality) as a reference against negative reports of one indicator (insufficient duration + good quality + sufficient duration + poor quality) or two (insufficient duration + poor quality). Each behavioral variable was adjusted for the other independent variables. Four control variables were used to divide the hierarchical model into four levels: (1) demographic (sex, age and residential area), (2) socioeconomic (occupation, monthly family income and schooling level of the mother and adolescent), (3) psychological (perception of health, stress level, perception of sadness and loneliness), and (4) nutritional status (body mass index). All adjustment variables were self-reported by the students on a standardized questionnaire. Variables with a critical level  $\leq 0.20$  remained in the model. Finally, a significance level of 5% was adopted.

**Box 1.** Description of variables, categories and collection method.

Type	Variable	Question	Response options	Analysis categories	
Dependent	Clustering of duration and quality of sleep (weekdays)	How often do you think you sleep well?	Always; almost always; sometimes; almost never; never	0 = $\geq 8$ h (sufficient duration + good quality) 1 = $\geq 8$ h (sufficient duration + poor quality) or $< 8$ h (insufficient duration + good quality) 2 = $< 8$ h (insufficient duration + poor quality)	
		On average, how many hours do you sleep per day?	$< 6$ h; 6 h; 7 h; 8 h; 9 h; 10 h; $> 10$ h		
Independent	Physical activity (min/d)	During a normal (typical) week, how much time do you spend on moderate to vigorous physical activities (leisure, work or commuting)?	None; $< 30$ min; 30 to 59 min; $\geq 60$ min	None; $< 30$ min; 30 to 59 min; $\geq 60$ min	
	TV watching (h/d) (weekdays)	How many hours per day do you watch TV?	None; $< 1$ h; 1 h; 2 h; 3 h; $\geq 4$ h	$\leq 1$ h; 2; 3; $\geq 4$ h	
	Computer/videogames (h/d) (weekdays)	How many hours per day do you spend on the computer and/or play videogames?	None; $< 1$ h; 1 h; 2 h; 3 h; $\geq 4$ h	$\leq 1$ ; 2; 3; $\geq 4$	
	Food intake	How many days in a normal week (days/week)...			
		Do you eat fruits?		0 d; 1; 2; 3; 4; 5; 6; 7	$\geq 5$ ; $< 5$
		Do you eat vegetables?		0 d; 1; 2; 3; 4; 5; 6; 7	$\geq 5$ ; $< 5$
		Do you eat salty snacks?		0 d; 1; 2; 3; 4; 5; 6; 7	$\geq 5$ ; $< 5$
		Do you eat sweets?		0 d; 1; 2; 3; 4; 5; 6; 7	$\geq 5$ ; $< 5$
Do you drink soda?		0 d; 1; 2; 3; 4; 5; 6; 7	$\geq 5$ ; $< 5$		
Alcohol (drinks/occasion)	During a normal week, on occasions that you consume alcohol, how many drinks do you have?	Never consume; $< 1$ drink/occasion; 1; 2; 3; 4; $\geq 5$ drinks/occasion	None; 1-2; $\geq 3$		

## RESULTS

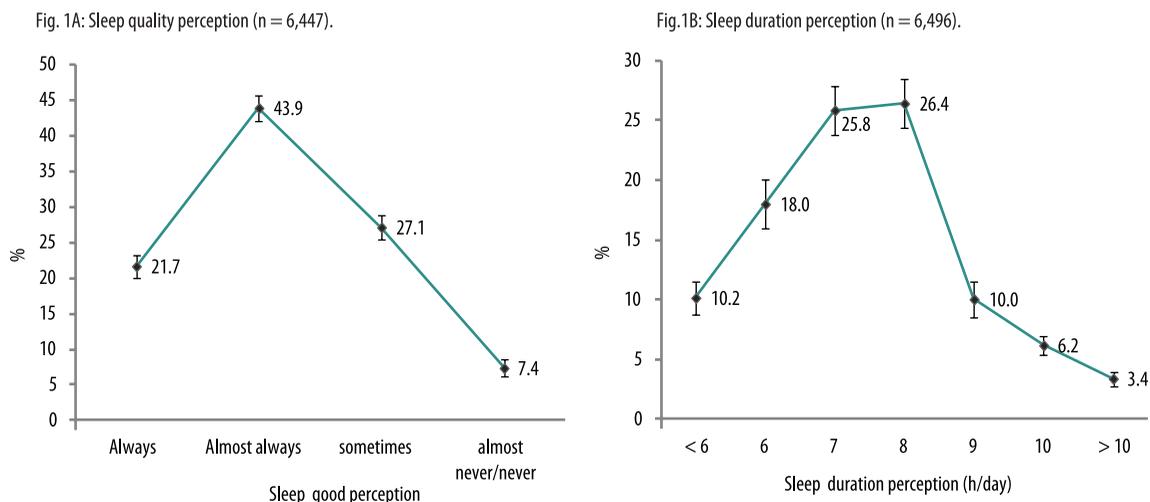
The final sample was 6,529 students. There was sample losses in range of until 2% to sleep variables, like sleep quality perception ( $n = 6,447$ ; missing: 1.9%); sleep duration perception ( $n = 6,496$ ; missing: 1.1%), and their combination ( $n = 6,419$ ; missing: 2.3%).

More than one-third of the students reported a negative perception of sleep quality during the week (figure 1. 1A). Regarding sleep duration, the highest proportion of teenagers reported sleeping 7 (25.8%) and 8 (26.4%) h/d. A high prevalence of students reported insufficient sleep duration ( $\leq 7$  h), representing approximately 50% of the total (figure 1. 1B).

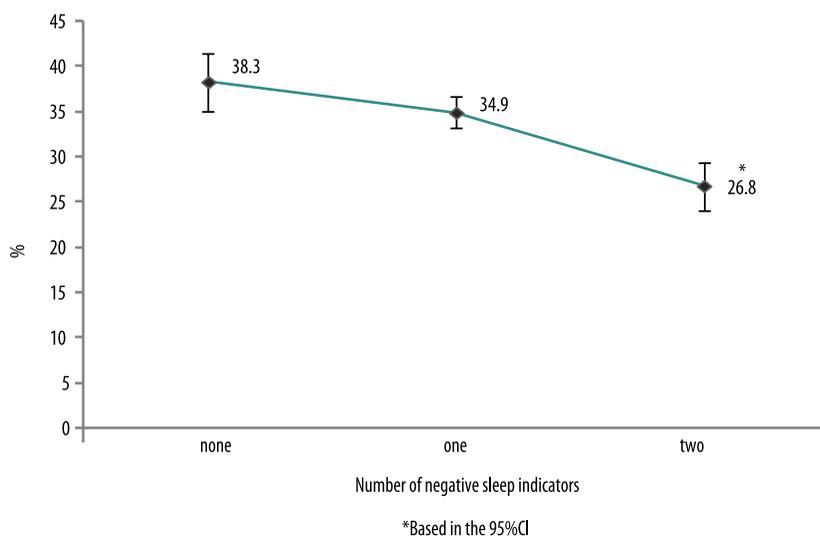
The proportion of students with one negative sleep indicator (poor quality or insufficient duration) did not significantly differ from those with no negative indicators (good quality + sufficient duration). Approximately 30% of adolescents reported a negative perception of sleep, indicating poor quality and insufficient duration (fig. 2).

In the presence of one negative sleep indicator, compared with none, engaging in  $< 30$  min of physical activity per day was a protective factor in a crude analysis. For two negative factors, 30 to 59 min and  $< 30$  min

were associated, but these associations did not persist after adjustments. Watching TV, irrespective of the number of hours per day, was a protective factor against reporting one or two negative sleep factors. The likelihood of those individuals who used a computer/videogames  $\geq 4$  h/d reporting one or two negative indicators was 1.31 to 1.80 times higher, respectively, after adjustments. All food components were associated with two negative sleep indicators in a sleep analysis, but after adjustments, an inadequate intake of salty snacks and sweets ( $\geq 5$  d/wk) remained associated with this outcome. Those individuals who consumed excessive amounts of alcohol ( $\geq 3$  drinks/occasion) were 1.24 times more likely to report a negative indicator and 1.59 times more likely to report two negative sleep indicators than those individuals who reported not drinking, after adjustments (table 2).



**Figure 1.** Distribution of sleep quality (A) and duration (B) perception on weekdays among adolescents. Santa Catarina, Brazil, 2011.



**Figure 2.** Percentage of negative sleep indicators on weekdays (n = 6,419). Santa Catarina, Brazil, 2011.

**Table 1.** Multinomial logistic regression (crude and adjusted odds ratios) for the behavior variables associated with sleep indicator clustering. Santa Catarina, Brazil, 2011.

Variables	1 versus 0			2 versus 0		
	n (%)	ORc† (95% CI)	ORa† (95% CI)	n (%)	ORc† (95% CI)	ORa† (95% CI)
<b>Physical activity (min/d)</b>						
≥ 60	922 (34.6)	1.00	1.00	764 (29.6)	1.00	1.00
30-59	569 (34.9)	0.91 (0.76; 1.09)	1.07 (0.87; 1.33)	412 (25.2)	0.77 (0.63; 0.93)	0.96 (0.75; 1.24)
< 30	436 (34.0)	0.83 (0.72; 0.96)	1.01 (0.83; 1.21)	304 (23.5)	0.67 (0.54; 0.82)	0.86 (0.71; 1.03)
None	259 (37.1)	1.06 (0.82; 1.37)	1.14 (0.83; 1.55)	183 (26.5)	0.88 (0.70; 1.11)	0.91 (0.69; 1.21)
<b>TV watching (h/d)</b>						
≤ 1	1.167 (35.7)	1.00	1.00	1.071 (34.4)	1.00	1.00
2	431 (35.0)	0.68 (0.57; 0.82)	0.68 (0.56; 0.82)	260 (21.9)	0.44 (0.36; 0.55)	0.43 (0.33; 0.56)
3	294 (32.2)	0.54 (0.43; 0.67)	0.58 (0.46; 0.73)	163 (17.6)	0.30 (0.23; 0.40)	0.35 (0.26; 0.48)
≥ 4	291 (35.1)	0.65 (0.52; 0.80)	0.73 (0.60; 0.90)	163 (19.7)	0.38 (0.29; 0.50)	0.45 (0.32; 0.63)
<b>Computer/videogames (h/d)</b>						
≤ 1	1.128 (34.4)	1.00	1.00	800 (24.3)	1.00	1.00
2	347 (33.9)	1.01 (0.85; 1.21)	0.98 (0.81; 1.18)	239 (25.9)	1.09 (0.88; 1.35)	1.14 (0.87; 1.49)
3	254 (37.1)	1.15 (0.89; 1.49)	1.05 (0.80; 1.39)	192 (24.2)	1.07 (0.82; 1.39)	0.94 (0.69; 1.29)
≥ 4	444 (35.0)	1.37 (1.12; 1.67)	1.31 (1.04; 1.67)	424 (34.2)	1.89 (1.57; 2.27)	1.80 (1.38; 2.35)
<b>Fruits (d/wk)</b>						
≥ 5	717 (35.1)	1.00	1.00	516 (24.7)	1.00	1.00
< 5	1.454 (35.0)	1.08 (0.90; 1.28)	1.13 (0.93; 1.36)	1.128 (27.7)	1.21 (1.01; 1.44)	1.22 (1.00; 1.48)
<b>Vegetables (d/wk)</b>						
≥ 5	827 (34.5)	1.00	1.00	568 (25.1)	1.00	1.00
< 5	1.307 (34.8)	1.10 (0.93; 1.29)	1.06 (0.87; 1.29)	1.056 (28.0)	1.21 (1.05; 1.40)	1.06 (0.90; 1.25)
<b>Salty snacks (d/wk)</b>						
< 5	1.854 (34.3)	1.00	1.00	1.338 (35.5)	1.00	1.00
≥ 5	260 (34.8)	1.19 (1.00; 1.66)	1.30 (0.99; 1.72)	281 (25.6)	1.82 (1.43; 2.32)	1.67 (1.19; 2.34)
<b>Sweets (d/wk)</b>						
< 5	1.748 (33.4)	1.00	1.00	1.271 (32.4)	1.00	1.00
≥ 5	387 (35.4)	1.08 (0.92; 1.26)	1.10 (0.91; 1.34)	353 (25.6)	1.45 (1.17; 1.79)	1.36 (1.03; 1.80)
<b>Soda (d/wk)</b>						
< 5	1.658 (33.1)	1.00	1.00	1.157 (33.9)	1.00	1.00
≥ 5	469 (35.4)	1.13 (0.98; 1.31)	0.91 (0.76; 1.09)	462 (24.6)	1.66 (1.35; 2.05)	1.14 (0.86; 1.51)
<b>Alcohol (drinks/occasion)</b>						
None	1.016 (34.8)	1.00	1.00	682 (23.3)	1.00	1.00
1-2	823 (35.3)	1.14 (0.96; 1.34)	1.04 (0.86; 1.24)	607 (27.2)	1.30 (1.08; 1.57)	1.08 (0.86; 1.35)
≥ 3	348 (34.8)	1.52 (1.24; 1.87)	1.25 (1.01; 1.54)	367 (37.6)	2.45 (2.03; 2.96)	1.64 (1.28; 2.09)

Note: 0 = sufficient duration + good quality; 1 = sufficient duration + poor quality or insufficient duration + good quality; 2 = insufficient duration + poor quality. Bold: difference, with  $p \leq .05$ . Each independent variable was adjusted to other independent variables and between the control variables at three levels: (1) demographic (sex, age and area), (2) socioeconomic (occupation, income and level of schooling of the mother and adolescent); (3) and psychological (perceived health, stress level, sadness and loneliness and overweight status).

## DISCUSSION

In our study, 34.5% of teenagers reported poor sleep quality, and 54% reported insufficient sleep duration. In Finland, 26% of boys and 23% of girls were found to sleep satisfactorily, quite poorly or very poorly<sup>7</sup>. In the United States, it was found that 10% seldom or never had a good night's sleep and that 36% slept well<sup>6</sup>, and approximately 70% reported insufficient sleep duration<sup>3,18</sup>. In Brazil, 39% were found to sleep  $\leq 8$  h in the city of São Paulo<sup>20</sup>, compared with 54.8% in a city in southern Brazil<sup>21</sup>.

In this study, using a computer/videogames  $\geq 4$  h/d and consuming  $\geq 3$  alcoholic drinks/occasion were associated with one or two negative sleep indicators, whereas an inverse relationship was observed with TV watching. Salty snacks and sweets intake  $\geq 5$  d/wk remained associated with the perception of two negative indicators.

Insufficient sleep duration on school days was associated with 10 of the 11 health-related risk behaviors in North American students, such as drinking sodas, not following physical activity recommendations and using a computer  $\geq 3$  h/d. The only non-association was between insufficient sleep and watching TV  $\geq 3$  h/d<sup>3</sup>. The result obtained in another American study was similar to the present study, but only sleep duration was analyzed. Those individuals who watched TV  $\geq 4$  h/d were more likely to sleep a sufficient number of hours compared with non-watchers. In contrast, those individuals who used a computer  $\geq 2$  h/d were less likely to sleep for an adequate number of hours<sup>18</sup>.

The effect of using a computer had a greater impact on what time adolescents went to sleep compared with other activities, including watching TV<sup>22</sup>. Using a computer/videogames has been associated with poor sleep quality and insufficient sleep in adolescents<sup>8,11</sup>. Nevertheless, given that only using a computer/videogames  $\geq 4$  h/d was associated with sleep in teenagers from Santa Catarina, more extensive investigations of these activities are needed because it has been recommended that the use of these two technologies be limited. However, there is a lack of guidelines related to the frequency and duration of use.

Associations between TV and sleep are still controversial<sup>3,8,19,23</sup>. Foti et al.<sup>18</sup> suggest future research to determine whether the TV is in teenagers' bedrooms and whether those teenagers reporting watching TV are actually doing so or if the set is left on during other activities. Moreover, if teenagers sleep with the TV on, they may add these hours to both the number of hours watched and sleep duration. The National Sleep Foundation (2006)<sup>6</sup> found that 57% of adolescents have a TV in their bedrooms and that 76% watch TV for 1 h before going to sleep. Sisson et al.<sup>24</sup> found association between having a TV in the bedroom and a lower prevalence of regular sufficient sleep.

In addition to the different ways of measuring the duration and quality of sleep, which could interfere with results, the fact that many teenagers consider TV to be both a sleep impediment and a sleep aide may be an

explanation for such conflicting findings. The strategy most widely reported by teenagers for falling or staying asleep was watching TV (46.2%)<sup>25</sup>. Watching TV was also the third most cited reason (39.4%) for teenagers' not sleeping sufficiently. It was observed that 11% of students watched TV to fall asleep, in addition to considering watching TV to be a barrier to a good night's sleep<sup>26</sup>.

Engaging in physical activity was a protective factor against sleep negative indicators, only crude analysis. Physical activity has been consistently associated with better sleep quality and longer duration<sup>3,6,7,18</sup>. Among the benefits of regular exercise for sleep<sup>27</sup>, physical activity can help to establish regular sleep times<sup>28</sup>. However, Tynjala et al.<sup>7</sup> observed an association between physical activity and perceived sleep quality in girls, and Ortega et al.<sup>19</sup> found slight evidence that boys who do not obtain a sufficient amount of sleep are less likely to engage in physical activity. In a city in southern Brazil, teenagers who slept less were more active<sup>23</sup>.

A number of strategies that adolescents use to help them sleep may have the opposite effect, stimulating rather than relaxing. In a study conducted by Noland et al.<sup>25</sup>, in addition to watching TV, engaging in physical exercise before going to bed was also one of the strategies used by teenagers to fall asleep. In the United States, 32% of adolescents engaged in physical exercise 1 h before retiring to bed<sup>6</sup>. These activities may have a stimulating effect and should be avoided near bedtime. The fact that the time of day of physical activities has not been widely investigated in studies seeking to find relationships between this behavior and sleep may partially explain the conflicting results that have been found.

In our study, fruit and vegetable intake was directly associated with sleep negative indicators, but did not persist after adjustments. Excessive consumption of salty snacks and sweets remained associated with both of the aforementioned variables, even after adjustments. Individuals with poor sleep quality and insufficient duration are more likely to eat lower quantities of fruits and vegetables and more high-calorie foods derived from fat and refined carbohydrates<sup>29</sup>.

Alcohol intake remained associated with poor sleep quality and/or insufficient sleep duration in the present study. American teenagers consuming  $\geq 1$  drink for one or more days in the month prior to the study were 1.64 times more likely to report insufficient sleep duration<sup>3</sup>. Because sleep and alcohol consumption affect one another, it is unclear whether inadequate sleep increases the propensity for alcohol intake or vice versa. Wong<sup>12</sup> highlights the need for longitudinal studies to determine this cause-effect relationship. Teenagers who drink alcohol regularly tend to prefer later bedtimes because this substance is usually consumed at parties and other nighttime events.

For our knowledge, this is the first study that assessed the simultaneous association between a number of unhealthy behaviors and sleep quality and duration in a representative sample of students in a Brazilian state, contributing to the epidemiological literature, given the lack of sleep research

on South American teenagers<sup>13</sup>. However, the study exhibits the following limitations: 1) it is a cross-sectional study, precluding the establishment of a cause-effect relationship; 2) the sample included only adolescents who attend school and thus is not representative of all individuals in this age range; 3) sleep duration was self-reported and subjective; and 4) insufficient or poor quality sleep may be the result of a number of sleep disorders, which were not investigated here.

## CONCLUSIONS

More than one-third of high school students in Santa Catarina reported poor sleep quality, and over half reported insufficient sleep duration, which was associated with a range of unhealthy behaviors. Making adolescents aware of the importance of adopting healthy behaviors is therefore relevant to improving sleep quality and prolonging sleep duration in adolescents. It is suggested that more studies be undertaken to investigate the association between different unhealthy behaviors and sleep in teenagers and to determine the time of day and extent of these behaviors, and especially the use of electronics and physical activity, to elucidate the divergent findings reported to date.

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