

Behaviors associated to sleep among high school students: cross-sectional and prospective analysis

Comportamentos associados ao sono em estudantes do ensino médio: análises transversal e prospectiva

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Abstract – The association between health behaviors and sleep patterns in youths has been tested using cross-sectional data, and prospective evidence is needed. The aim of this study was to investigate the cross-sectional and prospective associations between behavioral variables and sleep quality and duration. A secondary analysis was conducted using data that were collected in March and December 2006 from a random sample of high school students (aged 14–24 years) from Recife and Florianópolis, Brazil, for the “Saúde na Boa” intervention. Data on the perception of sleep quality and duration and lifestyle variables were obtained through self-reported questionnaires. Data were analyzed using crude and adjusted binary logistic regressions. The percentages of students reporting poor sleep quality and insufficient sleep duration were 45.7% and 76.7%, respectively, considering the cross-sectional data, and 45.8% and 77.5%, respectively, considering the longitudinal data. There was a cross-sectional association between lower physical activity (OR = 0.74, 95% CI: 0.55, 0.99) and higher snack consumption (OR = 1.67, 95% CI: 1.18, 2.36) and negative sleep quality. Excessive TV watching (OR = 0.48, 95% CI: 0.30, 0.75) and higher levels of soft drink consumption (OR = 1.84, 95% CI: 1.19, 2.84) were associated with insufficient sleep duration. However, no behavioral variables were associated with sleep quality and duration in the prospective analysis. The prevalence of self-reported poor sleep quality and duration were similar in the cross-sectional and longitudinal analyses. Some behaviors were associated with sleep patterns in the cross-sectional analyses, but these findings were not confirmed in the prospective analyses.

Key words: Adolescent, Adolescent behavior; Brazil; Prospective studies; Sleep.

Resumo – A associação entre comportamentos de saúde e sono tem sido testada em jovens com dados transversais, mas evidências prospectivas são necessárias. O objetivo do estudo foi verificar associações transversais e prospectivas entre variáveis comportamentais e percepções de qualidade e duração de sono. Análise secundária transversal e longitudinal dos dados da pesquisa “Saúde na Boa”, desenvolvido de março a dezembro de 2006, com amostra aleatória de estudantes de ensino médio (14–24 anos) de 20 escolas públicas de Recife e Florianópolis. A percepção da qualidade e da duração do sono e as variáveis do estilo de vida foram obtidas por autorrelato. Utilizaram-se regressões logísticas binárias brutas e ajustadas. Nos dados transversais e longitudinais, 45,7% e 45,8% dos jovens relataram má qualidade e 76,7% e 77,5% reportaram duração insuficiente do sono, respectivamente. Na análise transversal, a menor prática de atividade física (OR = 0,74; IC 95%: 0,55; 0,99) e o maior consumo de salgadinhos (OR = 1,67; IC 95%: 1,18; 2,36) estiveram associados à qualidade negativa do sono, enquanto o tempo excessivo de televisão (OR = 0,48; IC 95%: 0,30; 0,75) e de consumo de refrigerantes (OR = 1,84; IC 95%: 1,19; 2,84) associaram-se à duração insuficiente do sono. Na análise prospectiva, nenhum dos comportamentos estudados se manteve associado à qualidade e duração do sono. As prevalências de percepção de qualidade e duração do sono se mantiveram estáveis nos dois momentos analisados. Alguns comportamentos se associaram às percepções de sono em análises transversais, mas estes achados não se confirmaram em análises prospectivas.

Palavras-chave: Adolescente; Brasil; Comportamento do adolescente; Estudos prospectivos; Sono.

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INTRODUCTION

Sleep is considered to be a key factor for learning and memory, and it is directly involved in hormonal and behavioral regulation¹. Studies have demonstrated that there is a high prevalence of insufficient sleep duration and poor sleep quality among young people^{2,3}, which may be due to the biological and maturational factors that occur during adolescence, as well as behavioral changes such as increasing school obligations, social activities⁴, and excessive use of electronic equipment².

Several studies have identified a significant association between specific health behaviors – including drug and alcohol use^{5,6}, sedentary behaviors², unhealthy eating habits^{5,7}, and physical inactivity^{8,9,10} – and inadequate sleep patterns. However, there are gaps in the literature because it is unclear how sleep patterns manifest during adolescence and how changes in sleep patterns occur and/or persist due to behavioral changes over time. Cross-sectional studies^{5,11} have been reported, but the evidence for causality is limited because these studies could not determine the changes in sleep patterns over time or the temporality of their association with health behaviors.

Little research has explored the prospective relationships between sleep and a specific unhealthy behavior¹² and, to our knowledge, no studies have explored the prospective associations between simultaneous behaviors and sleep in youth.

Thus, this study aimed to verify cross-sectional and prospective associations between behavioral variables and self-perceived sleep quality and duration among high school students. The conceptual model of this study is illustrated in Figure 1.

METHODOLOGICAL PROCEDURES

This study was a secondary analyses of cross-sectional and prospective data from a randomized-controlled trial entitled “*Saúde na Boa*”¹³. The purpose of this intervention was to promote healthy behaviors among high school students (aged 14-24 years) who were enrolled in night classes at public schools in Florianópolis (Santa Catarina state, southern Brazil) and Recife (Pernambuco state, northeastern Brazil).

Approximately 2,000 students were evaluated in March 2006. The students were randomly selected from 20 schools (10 in each municipality, 5 intervention schools, and 5 control schools). Post-intervention data were collected 9-months later (December 2006), with a response rate of 45.9% (989 adolescents assessed at follow-up). Other sampling details were described previously¹³. Additionally, the sample loss at follow-up was analyzed in another publication from this supplement¹⁴.

This study included valid cross-sectional data for sleep quality and duration for 1,567 and 1,564 students (55.0% female), respectively. Longitudinal analyses were performed using data from 949 and 950 students

(59.7% female) who provided valid information concerning sleep quality and duration, respectively. These sample sizes provided sufficient power to detect statistically significant odds ratios of > 1.25 and > 1.22 in the cross-sectional analyses for sleep quality and duration, respectively. In the prospective analyses, the sample sizes provided sufficient power to detect statistically significant odds ratios of > 1.29 and > 1.25 for sleep quality and duration, respectively. For these estimates, we considered the prevalence of negative sleep quality and insufficient sleep duration in unexposed students to be 45.7% and 72.0%, respectively, for the cross-sectional data (time spent playing computer/video games was the behavior with the lowest value) and 24.4% and 69.8%, respectively, for prospective data (snack consumption was the behavior with the lowest value). For other behaviors, the sample size allowed us to detect a statistically significant odds ratio equal to or greater than these values, considering a confidence interval (CI) of 95% and a power of 80%.

In March and December 2006, the students answered a questionnaire¹⁵ that included closed-answer items on physical activity, eating habits, and other lifestyle factors (e.g., alcohol consumption and sleep duration and quality). This instrument was based on the PACE+ (Patient-centered Assessment and Counseling for Exercise plus nutrition) project questionnaire¹⁵. Students completed the questionnaire in their classrooms. The study followed a standardized protocol and was conducted by a properly trained team that included Physical Education and Nutrition students and teachers.

The perception of sleep quality was measured using the question: “How often do you think that you sleep well?” For the analyses, the perception of sleep quality was dichotomized as positive (always or almost always) or negative (sometimes, almost never, or never). Sleep duration was measured using the question: “How many hours, on average, do you sleep per day?” We used bridge cutting to consider ≥ 8 hours a day to be sufficient sleep duration and < 8 hours per day to be insufficient sleep duration^{5,7-9}.

The following behavioral variables were analyzed: the weekly frequency of physical activity for 60 or more minutes per day (≥ 5 or < 5 days/week)¹⁶, weekly frequency of exercise for muscular strength/endorurance (0 or ≥ 1 day/week); daily time spent watching TV watching and playing computer/video games (< 2 or ≥ 2 hours/day)¹⁷; weekly frequency of snack and soft drink consumption (< 5 or ≥ 5 days/week)¹⁷; and the frequency of alcohol consumption in the previous month (0 or ≥ 1 day/month)¹⁷.

Statistical analyses were performed based on the conceptual model illustrated in Figure 1. Frequency distributions and crude and adjusted binary logistic regressions were used. The paths “a” and “b” in Figure 1 refer to the cross-sectional analyses of the relationship between behaviors and sleep quality and duration. The paths “c” and “d” in Figure 1 refer to the association between behaviors at baseline and sleep quality and duration after nine months of follow-up (prospective analysis).

The adjusted model for the cross-sectional analysis included gender (female or male), age group (14-16 years, 17-19 years or 20-24 years), skin color (white or non-white), marital status (single or non-single), occupation (worker, intern or not working), resides with the family (yes or no), and city (Florianopolis or Recife). In the prospective analysis, we added the design group (control or intervention) and respective behavior at follow-up. The variables were entered in the model simultaneously. The significance level was fixed at 5%.

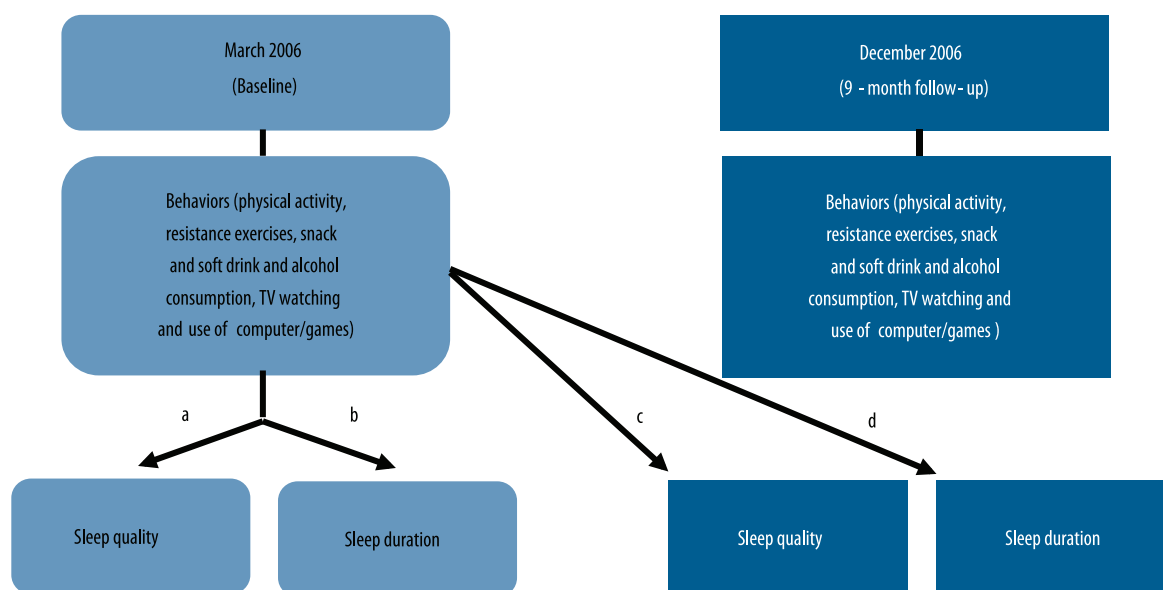


Figure 1. Conceptual model of this study, including cross-sectional (paths “a” and “b”) and prospective (paths “c” and “d”) associations between behaviors and sleep quality and duration.

All procedures were approved by the Ethics Committee of the Federal University of Santa Catarina (031/2005) and the *Instituto Materno Infantil de Pernambuco* (587/2005). Negative consent term (“passive parental consent form”) was obtained from the parents or guardians of students younger than 18 years of age, as was consent from students who were 18 years old or older.

RESULTS

Approximately five of every ten students reported poor sleep quality. Eight of every ten students reported insufficient sleep duration. The prevalence of each risk behavior is presented in Table 1.

Physical activity and snack consumption were significantly associated with sleep quality in both the bivariate and cross-sectional analyses. After adjusting for confounding variables, students with a lower frequency of physical activity were less likely to report negative sleep quality (OR = 0.74, 95% CI: 0.55, 0.99). Conversely, the frequency of snack consumption (OR = 1.67, 95% CI: 1.18, 2.36) was positively associated with negative sleep quality (Table 2).

Considering sleep duration in the bivariate and cross-sectional analyses, we found that muscular strength/endurance exercise, snack consumption, and TV watching were protective factors for insufficient sleep duration. After adjusting for confounders, excessive time watching TV was associated with a lower odds ratio (OR = 0.48, 95% CI: 0.30, 0.75) of insufficient sleep duration, whereas a higher frequency of soft drink consumption was associated with a higher odds ratio (OR = 1.84, 95% CI: 1.19, 2.84) of insufficient sleep duration (Table 2).

Table 1. Description of cross-sectional and prospective data on behavioral variables and perception of sleep quality and duration.

Variables	Cross-sectional	Prospective
	n (%)	n (%)
Sleep quality		
Positive	851 (54.3)	514 (54.2)
Negative	716 (45.7)	435 (45.8)
Sleep duration (hours/day)		
≥ 8	365 (23.3)	214 (22.5)
< 8	1,199 (76.7)	736 (77.5)
Physical activity for 60 minutes per day (days/week)		
≥ 5	966 (45.3)	323 (32.9)
< 5	1,168 (54.7)	660 (67.1)
Muscular strength/endurance exercises (days/week)		
≥ 1	854 (40.2)	421 (43.0)
None	1,272 (59.8)	559 (57.0)
Snack consumption (days/week)		
< 5	1,592 (74.5)	781 (79.6)
≥ 5	545 (25.5)	200 (20.4)
Soft drink consumption (days/week)		
< 5	1,393 (64.9)	694 (70.6)
≥ 5	752 (35.1)	289 (29.4)
Alcohol consumption (days/month)		
None	978 (46.2)	514 (52.5)
≥ 1	1,138 (53.8)	465 (47.5)
Time spent watching TV (hours/day)		
< 2	812 (37.8)	410 (41.5)
≥ 2	1,336 (62.2)	577 (58.5)
Time spent using computer/video games (hours/day)		
< 2	1,626 (76.2)	696 (70.7)
≥ 2	509 (23.8)	288 (29.3)

In the prospective analysis, we found that none of the behaviors were associated with sleep quality in both the bivariate and multivariate analyses (Table 3). Students who were not engaged in muscular strength/endurance exercises (OR = 0.71, 95% CI: 0.51, 0.99), who ate snacks frequently (OR = 0.57, 95% CI: 0.41, 0.79), and who watched TV excessively (OR = 0.53, 95% CI: 0.38, 0.75) had a lower odds ratio of reporting insufficient sleep duration. Excessive use of computer/video games was associated with a greater odds ratio (OR = 1.59, 95% CI: 1.08, 2.33) of reporting insufficient sleep duration. However, after adjusting for confounders, no behavior remained associated with sleep duration (Table 3).

Table 2. Cross-sectional association between behaviors and the perception of sleep quality (reference: positive perception) and sleep duration (reference: > 8 hours/day) in Florianopolis and Recife, Brazil (2006).

	Poor sleep quality (n= 1,567)		Insufficient sleep duration (< 8 hours/day) (n= 1,564)	
	Crude OR (95% CI)	Adjusted OR [†] (95% CI)	Crude OR (95% CI)	Adjusted OR [†] (95% CI)
Physical activity for 60 minutes per day (days/week)				
≥ 5	1.00	1.00	1.00	1.00
< 5	0.81 (0.66; 0.99)	0.74 (0.55; 0.99)	1.24 (0.98; 1.57)	1.44 (0.95; 2.19)
Muscular strength/endurance exercises (days/week)				
≥ 1	1.00	1.00	1.00	1.00
None	1.05 (0.86; 1.29)	0.82 (0.59; 1.14)	0.73 (0.57; 0.93)	0.78 (0.48; 1.26)
Snack consumption (days/week)				
< 5	1.00	1.00	1.00	1.00
≥ 5	1.57 (1.24; 1.99)	1.67 (1.18; 2.36)	0.71 (0.55; 0.93)	1.31 (0.83; 2.09)
Soft drink consumption (days/week)				
< 5	1.00	1.00	1.00	1.00
≥ 5	1.12 (0.91; 1.38)	1.07 (0.78; 1.46)	1.23 (0.95; 1.59)	1.84 (1.19; 2.84)
Alcohol consumption (days/month)				
None	1.00	1.00	1.00	1.00
≥ 1	1.03 (0.84; 1.26)	1.10 (0.82; 1.48)	0.87 (0.69; 1.10)	0.70 (0.46; 1.07)
Time spent watching TV (hours/day)				
< 2	1.00	1.00	1.00	1.00
≥ 2	0.98 (0.80; 1.20)	0.89 (0.65; 1.21)	0.43 (0.33; 0.56)	0.48 (0.30; 0.75)
Time spent using computer/video games (hours/day)				
< 2	1.00	1.00	1.00	1.00
≥ 2	0.96 (0.76; 1.22)	1.05 (0.74; 1.50)	1.20 (0.91; 1.59)	1.16 (0.68; 1.98)

† Adjusted for sex, age, skin color, city, marital status, occupation and residing with family. OR (95% CI) = odds ratio and 95% confidence interval.

Table 3. Prospective association between behaviors at baseline and the perception of sleep quality (reference: positive perception) and sleep duration (reference: > 8 hours/day) in Florianopolis and Recife, Brazil (2006).

Behaviors at baseline	Poor sleep quality (n= 949)		Insufficient sleep duration < 8 hours/ day (n= 950)	
	Crude OR (95% CI)	Adjusted OR [†] (95% CI)	Crude OR (95% CI)	Adjusted OR [†] (95% CI)
Physical activity for 60 minutes per day (days/week)				
≥ 5	1.00	1.00	1.00	1.00
< 5	0.83 (0.64; 1.07)	0.91 (0.69; 1.20)	1.21 (0.89; 1.65)	0.99 (0.67; 1.46)
Muscular strength/endurance exercises (days/week)				
≥ 1	1.00	1.00	1.00	1.00
None	1.00 (0.76; 1.31)	0.96 (0.70; 1.33)	0.71 (0.51; 0.99)	0.72 (0.45; 1.14)
Snack consumption (days/week)				
< 5	1.00	1.00	1.00	1.00
≥ 5	1.26 (0.94; 1.68)	1.00 (0.73; 1.39)	0.57 (0.41; 0.79)	0.87 (0.56; 1.37)
Soft drink consumption (days/week)				
< 5	1.00	1.00	1.00	1.00
≥ 5	0.92 (0.71; 1.21)	0.80 (0.59; 1.07)	0.89 (0.65; 1.22)	1.13 (0.75; 1.70)
Alcohol consumption (days/month)				
None	1.00	1.00	1.00	1.00
≥ 1	1.04 (0.81; 1.35)	1.01 (0.75; 1.36)	1.03 (0.76; 1.40)	1.04 (0.69; 1.58)
Time spent watching TV time				
< 2	1.00	1.00	1.00	1.00
≥ 2	1.16 (0.87; 1.51)	1.15 (0.85; 1.55)	0.53 (0.38; 0.75)	0.82 (0.53; 1.28)
Time spent using computer/video games (hours/day)				
< 2	1.00	1.00	1.00	1.00
≥ 2	0.82 (0.60; 1.10)	0.86 (0.61; 1.20)	1.59 (1.08; 2.33)	1.27 (0.77; 2.11)

† Adjusted for sex, age, skin color, city, marital status, occupation, residing with family, intervention group (intervention or control) and behavior at follow-up. OR (95% CI) = odds ratio and 95% confidence interval.

DISCUSSION

In the present study, approximately five of every ten students reported poor sleep quality, and eight of every ten reported insufficient sleep duration. These prevalence rates remained stable over a nine-month period. One study that included representative samples of high school students from Santa Catarina in 2001 and 2011 identified lower prevalence rates compared to the present study of both poor sleep quality (26.3% and 34.5% in 2001 and 2011, respectively) and insufficient sleep duration (37.0% and 54.0%, respectively)¹⁸.

Another study that included a representative sample of American students showed stability in the prevalence rates of insufficient sleep duration in three different surveys (2007, 2009 and 2011). All three surveys found lower prevalence rates than the present study (approximately 70%)^{5,8,19}. Other studies also found lower prevalence rates of insufficient sleep duration, including one study in Canada (70%)²⁰ and another study in southern (54.8%)²¹ and southeastern (39%)²² Brazil. However, these studies used distinct cutoff points for insufficient sleep duration (8.5 or less hours and 8 or less hours, respectively). The prevalence rates of poor sleep quality that were found in this study were also well above those found in other countries (10-17%)^{9,23,24}.

The present study showed that the prevalence rates of poor sleep quality and insufficient sleep duration remained stable after 9 months of follow-up. In contrast, a longitudinal study of adolescents from Minnesota (United States) showed a reduction in the average sleep duration of approximately 30 minutes after 24 months of follow-up²⁵.

The present study found that some behaviors were associated with sleep quality and duration in a cross-sectional analysis. For example, the frequency of physical activity was inversely associated with sleep quality. In contrast, epidemiological studies have shown positive associations between physical activity and sleep quality and duration among young people^{5,8,9,11}.

Noland and colleagues²⁶ reported that physical exercise before bedtime was cited as one of the strategies most frequently used by teenagers to fall asleep. In the United States, this practice is usually performed by 32% of adolescents⁹. This activity can have a stimulating effect, which may impair sleep quality.

Watching TV was positively associated with sleep duration. Similar results were found among students in the United States⁸, but the associations between these behaviors are still unclear^{5,8,11}.

Watching TV can be considered as much of a barrier as a facilitator of sleep duration for teenagers, which may partly explain the divergent results between the studies. The possibility of sleeping in front of the television might result in teenagers adding the number of hours spent watching TV to the hours of sleep duration²⁶, which might explain the protective association between the variables in the present study.

Frequent snack and soft drink consumption were inversely associated

with sleep quality and duration, respectively. Adequate sleep patterns have been associated with healthy eating habits because teenagers who get little sleep are more likely to consume high-calorie foods derived from fat, sugars, and refined carbohydrates^{7,11}.

In the prospective analysis, none of the health behaviors was a significant predictor of sleep quality and duration. To our knowledge, no studies have explored the prospective associations between simultaneous behaviors and sleep in youth, only between sleep and a specific unhealthy behavior^{12, 27}. A study found that extensive television viewing during adolescence may contribute to the development of sleep problems by early adulthood¹². Another study found that alcohol use predicted shorter weekend oversleep²⁷. However, the methodology used to measure sleep was distinct and the follow-up period was higher than the present study.

Cross-sectional studies have demonstrated that poor sleep quality and insufficient sleep duration have been associated with psychological variables such as high stress levels and antisocial behaviors²⁶. Additionally, there is a known association between sleep patterns and symptoms of sadness, hopelessness, and suicide trends in youths⁵. In contrast, teenagers who have effective stress control and are satisfied with life tend to report adequate sleep patterns¹¹.

Adolescence is an important period that includes cognitive, behavioral, social, and emotional changes⁴. Thus, variations in feelings and behaviors may affect the way that teenagers perceive their life and even the way that they perceive their sleep patterns.

Other prospective studies have demonstrated the impact of sleep problems on the future health status among teenagers, including interpersonal functioning, somatic and psychological indicators²⁸. However, sleep problems can also be predicted by the same psychosocial indicators²⁹. Therefore, although the present study did not find a prospective association between behaviors and sleep patterns, the cross-sectional association between these variables is relevant. Encouraging the adoption of healthy behaviors among young people can improve sleep patterns during the same period. Prospectively, these behaviors may reduce the presence of psychosocial problems and the adoption of unhealthy behaviors in the future which, in turn, will benefit sleep patterns.

The present study contributes to the scarce literature on cross-sectional and longitudinal associations between behaviors and perceptions of sleep quality and duration in young people. The present study included information on students living in two Brazilian cities that are located in different regions, which facilitates the extrapolation of the findings to other Brazilian populations. However, the present study had the following limitations: 1) all variables were self-reported by students; 2) insufficient sleep duration and poor sleep quality can result from various sleep disorders, which were not investigated or controlled for in this study. However, similar results for poor sleep quality and insufficient sleep duration were found in studies on insomnia and its consequences³⁰; 3) the follow-up period of nine months

may have been relatively short to find associations between variables; and 4) the sample loss to follow-up was greater than 50%.

CONCLUSIONS

We conclude that the prevalence rates of perceived poor sleep quality and insufficient sleep duration were elevated and remained stable in both periods. The cross-sectional analysis showed that some behaviors were associated with sleep patterns, but the prospective analysis did not confirm this association. Additional longitudinal studies that investigate prospective associations between different lifestyle behaviors and sleep patterns among young people are needed to confirm our results. The influence of psychological factors on this relationship also needs to be tested.

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