

Prevalence of excessive daytime sleepiness and associated factors in adolescents of the RPS cohort, in São Luís (MA), Brazil

Prevalência de sonolência diurna excessiva e fatores associados em adolescentes da coorte RPS, em São Luís (MA)

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ABSTRACT: *Objectives:* To estimate the prevalence and factors associated with excessive daytime sleepiness (EDS) in adolescents from the São Luís, Maranhão birth cohort. *Method:* Cross-sectional study conducted with 2,514 adolescents aged 18 and 19 years old. A hierarchical approach was used, and prevalence ratios were calculated using Poisson regression with robust variance adjustment. Sociodemographic characteristics (gender, race, economic class, and occupation), lifestyle (leisure activities, smoking, alcohol, illicit drug use, coffee and energy consumption, physical activity, body adiposity, screen time, and depression), and factors related to sleep were studied. *Results:* The prevalence of EDS was 36.8%. The female gender (PR = 1.33; 95%CI 1.19 – 1.49), high risk for alcohol consumption (PR = 1.26; 95%CI 1.09 – 1.46), current major depressive episode (PR = 1.26; 95%CI 1.08 – 1.46), sleep alteration score from 10 to 18 (PR = 1.43; 95%CI 1.10 – 1.85), and sleep score from 5 to 7 of daytime dysfunction (PR = 2.51; 95%CI 2.06 – 3.07) were risk factors for EDS. Economic class D/E was a protective factor for EDS (PR = 0.47; 95%CI 0.27 – 0.85). *Conclusion:* More than one-third of adolescents had EDS. Adolescents at higher risk need to improve their sleeping habits and lifestyle so that they no longer have EDS and can improve their quality of life.

Keywords: Sleep. Teens. Sleepiness. Adolescent health.

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RESUMO: *Objetivos:* Estimar a prevalência de sonolência diurna excessiva (SDE) e os fatores associados a ela em adolescentes da coorte de nascimentos de São Luís (MA). *Método:* Estudo transversal realizado com 2.514 adolescentes com idade de 18 e 19 anos. Utilizou-se abordagem hierarquizada e calculou-se a razão de prevalências utilizando regressão de Poisson com ajuste robusto da variância. Foram estudadas características sociodemográficas (sexo, cor, classe econômica, ocupação), hábitos de vida (lazer, fumo, álcool, uso de drogas ilícitas, consumo de café e de bebidas energéticas, prática de atividade física, adiposidade corporal, tempo de tela, depressão) e fatores relacionados ao sono. *Resultados:* A prevalência de SDE foi de 36,8%. Sexo feminino (razão de prevalência — RP = 1,33; intervalo de confiança de 95% — IC95% 1,19 – 1,49), alto risco de consumo de bebidas alcoólicas (RP = 1,26; IC95% 1,09 – 1,46), episódio depressivo maior atual (RP = 1,26; IC95% 1,08 – 1,46), escore de 10 a 18 de alterações do sono (RP = 1,43; IC95% 1,10 – 1,85) e escore de 5 a 7 da disfunção durante o dia (RP = 2,51; IC95% 2,06 – 3,07) foram os fatores de risco para SDE. A classe econômica D/E foi fator de proteção para SDE (RP = 0,47; IC95% 0,27 – 0,85). *Conclusão:* Mais de um terço dos adolescentes apresentou SDE, e aqueles com maiores riscos precisam melhorar seus hábitos de vida e de sono para que não tenham mais SDE, visando melhorar sua qualidade de vida.

Palavras-chave: Sono. Adolescentes. Sonolência. Saúde do adolescente.

INTRODUCTION

Excessive daytime sleepiness (EDS) is one of the main consequences related to sleep disorders¹, and is defined by increased predisposition to sleep, with a subjective need to sleep during the day². The presence of EDS is associated with losses in school and work performance, in learning, in social interaction and in quality of life^{1,3}.

EDS is common in adolescence, with a tendency to increase over the years. Adolescents present important changes in the sleep-wake cycle that include delay in the sleep phase, marked by sleeping and waking up later, which, when considering commitments in the early morning, contribute to the occurrence of EDS⁴. During adolescence, EDS can cause mood swings, poor school performance⁵, contribute to stress, and compromise functioning and vitality⁶.

In a systematic review with studies from different countries, it was found that the prevalence of EDS in adolescents ranged from 7.8 to 55.8%³. In the study by Liu et al.⁶, carried out with children and adolescents aged 6 to 18 years in Hong Kong, the prevalence of EDS was 29.2%. However, in a study carried out in a city in southern Brazil⁵, the presence of EDS was identified in 54.2% of the adolescents evaluated, aged 14 to 19 years old. These differences observed in prevalences can be attributed to the different instruments used and the populations evaluated³.

Studies carried out on EDS in adolescents have found that several factors are associated with its occurrence: socioeconomic status⁷, sex⁵, smoking⁸, alcohol⁹, illicit drugs¹⁰, caffeine

consumption¹¹, energy drinks¹², physical activity¹³, body composition¹⁴, use of electronic devices¹⁵, depression^{1,16}, in addition to factors related to sleep^{5,6}.

Although there is a lot of research on the topic, some of these studies suggest that other research should be carried out in order to make it more clear^{1,3,6,9,17}, as there are disparities in terms of prevalence, the analysis instruments used, and the populations surveyed⁷. In addition, the factors associated with EDS are quite comprehensive, which leads to the need for further studies on the subject, given the complexity of this relationship.

Thus, the present study contemplated variables on factors related to sociodemographic issues and lifestyle and sleep habits, in order to deepen the knowledge on the topic and contribute to the implementation of intervention proposals to mitigate EDS in adolescents. Given this premise, this study aimed to estimate the prevalence of EDS and the factors associated with it in adolescents in the RPS birth cohort — a consortium of Brazilian birth cohorts from Ribeirão Preto, Pelotas and São Luís —, in São Luís (MA), which started in 1997/1998.

METHODS

STUDY DESIGN AND SAMPLE

This was a cross-sectional study from a cohort of births that included individuals born in the city of São Luís, in 1997/98. This cohort is included in the *Determinants throughout the life cycle of obesity, precursors of chronic diseases, human capital and mental health* survey, which was developed by the Universidade Federal de Maranhão, by the Ribeirão Preto Medical School (Universidade de São Paulo) and by the Universidade Federal de Pelotas. In São Luís, the participants in this cohort were evaluated in three stages of life: at birth, in childhood (7 to 9 years old) and in adolescence (18 and 19 years old). The present study used data collected only in the third phase of the birth cohort in the city of São Luís.

In the first phase, the study was conducted in ten public and private hospitals in the city from March 1997 to February 1998, and 2,542 births were included, representing one third of those born in the city of São Luís at the time. The second phase was performed with children between seven and nine years of age, in 2005/2006, totaling a sample of 673 children. In the third phase of the study, adolescents aged 18 and 19 years old were studied in 2016. All individuals included in the third phase of the study were found in the four military enlistment boards of the island of São Luís, in the 2014 school census and in universities. Those identified as participants in the cohort were invited to attend the follow-up, totaling 684 participants. In order to increase the power of the sample and prevent future losses, the cohort was expanded to include other individuals born in São Luís in 1997. In the first part of this stage, a drawing was performed using the Database of the Information System on Live Births and the second part included volunteers identified in schools and universities. They were submitted to the same tests and

questionnaires as the other participants in the third phase of the cohort. The total sample consisted of 2,515 adolescents present in the third phase of the study. For this study, data from 2,514 adolescents were analyzed after the exclusion of one individual due to data inconsistency.

COLLECTING AND ORGANIZING OF THE DATA

Data were collected by trained researchers and a pilot study was conducted. EDS was considered the outcome variable and was evaluated using the Epworth Sleepiness Scale (ESS). This scale was validated in Brazil by Bertolazi et al.¹⁸. The ESS contains eight questions that present situations of drowsiness in daily life, and the individual answers them, taking into account his or her chance of falling asleep. The answers to each question range from 0 to 3 points, so the ESS has a total of 24 points. In this study, the scores from 0 to 8 were considered normal and those from 9 to 24 indicated the presence of EDS¹⁸⁻²⁰.

The exposure variables were those related to socioeconomic characteristics and life habits: gender (male; female); skin color (white; black; mixed-race/mulatto/cabocla/brown); studies or works (yes; no); economic class by the Brazil Economic Classification Criterion (A; B; C; D/E) according to criteria of the Brazilian Association of Research Companies²¹; performs leisure activities, considering whether the adolescent met with friends to talk, play or do other leisure activities (yes; no); smokes (yes; no); risk of alcohol abuse, assessed using the Alcohol Use Disorder Identification Test questionnaire, being classified as low risk (0 to 7 points) and high risk (8 to 40 points)²²; drug use (never used; has used or currently uses); coffee consumption (yes; no); consumption of energy drinks (yes; no); screen time measured by television, video games, mobile phone, tablet and computer exposure per hour/days of week, not considering weekends in the evaluation because they are considered atypical days²³ (0 to 5 hours; more than 5 hours); and level of physical activity, evaluated through the 24-hour Physical Activity Survey, developed through an adaptation of the Self-Administered Physical Activity Checklist²⁴. To calculate the number of Metabolic Equivalent of Tasks (MET) per week, the time spent with each activity was multiplied by the MET of the activity and by the number of days the adolescent practiced that activity. The METs for each activity were consulted in the Compendium of Physical Activities²⁵. The classification of the level of physical activity was insufficiently active (< 150 minutes of moderate intensity aerobic physical activity per week or < 75 minutes of vigorous intensity aerobic physical activity per week) and physically active (\geq 150 minutes of moderate intensity aerobic physical activity per week or \geq 75 minutes of vigorous intensity aerobic physical activity per week)²⁶; body adiposity was evaluated by the method of air displacement pletygraphy using the Bod Pod[®] Gold Standard device, of the Cosmed brand, and classified according to criteria by Williams et al.²⁷ as normal (< 25% for male adolescents and < 30% for female adolescents) and high (\geq 25% for male adolescents and \geq 30% for female

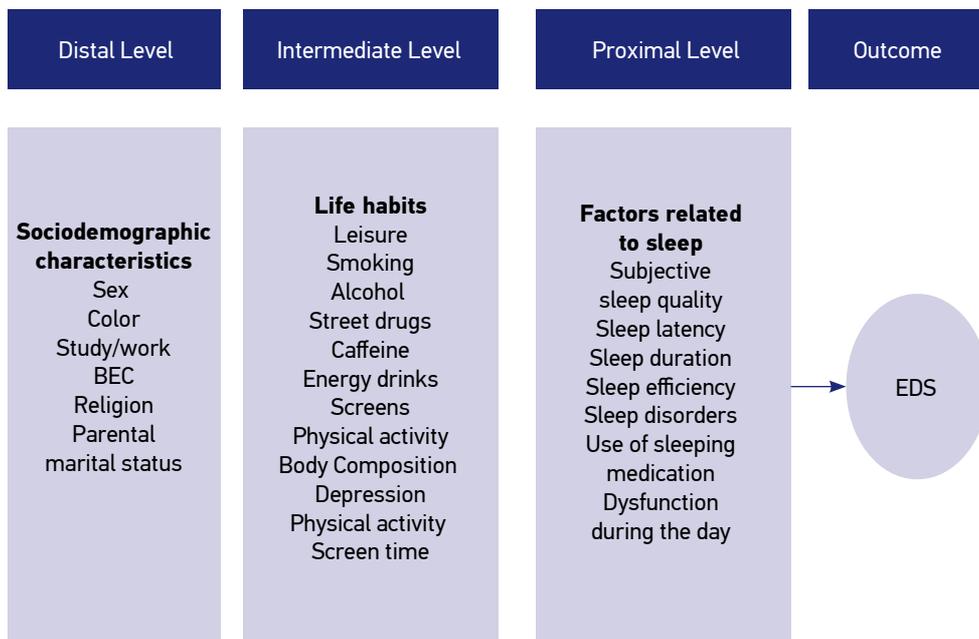
adolescents); current major depressive episode was evaluated through the Mini International Neuropsychiatric Interview²⁸.

Sleep-related exposure variables were evaluated using the Pittsburgh Sleep Quality Index (PSQI). The PSQI was created by Buysse et al.²⁹ and shows quantitative and qualitative information about sleep in the last month. In Brazil, this instrument was translated and validated by Bertolazi¹⁹, and its version for adolescents was validated by Passos et al.³⁰. The PSQI consists of 19 self-administered questions and evaluates subjective sleep quality (very good; good; bad; very bad), sleep latency (0; 1 to 2; 3 to 4; 5 to 6), sleep duration (greater than 7 hours; 6 to 6.9; 5 to 5.9; less than 5 hours), habitual sleep efficiency (<85%; 84 to 75%; 74 to 65 %; < 65%), sleep disorders (0; 1 to 9; 10 to 18; 19 to 27), use of sleeping medications (not once; less than once a week; once or twice a week; 3 or more times per week) and dysfunction during the day (0; 1 to 2; 3 to 4; 5 to 7)^{18,19}.

DATA PROCESSING AND ANALYSIS

Data were collected online by the Research Electronic Data Capture program.

Statistical analysis was performed in Stata 14.0 (Stata Corporation, College Station, Texas, USA). Initially, a descriptive analysis was performed and later the univariate analysis was performed using Poisson regression with adjustment for robust variance; the unadjusted



BEC: Brazilian Economic Classification; EDS: excessive daytime sleepiness

Figure 1. Model for analyzing factors associated with excessive daytime sleepiness.

prevalence ratios and the 95% confidence interval (95%CI) were estimated. Then, a multivariate analysis was performed using Poisson regression, using a hierarchical approach.

In order to select the variables that would remain in the model, the exposure variables were arranged into three groups. The variables related to sociodemographic characteristics were analyzed at the distal level, the variables related to lifestyle habits were analyzed at the intermediate level, and the variables related to sleep were inserted at the proximal level (Figure 1). First, only the variables of the distal level and the outcome were inserted in the model, leaving only the variables with $p \leq 0.10$. Soon after, the intermediate variables were included with those with $p \leq 0.10$ remaining in the model and those adjusted for the variables of the previous level. The same was repeated with the proximal level. The significance level of 5% was adopted for the rejection of null hypotheses.

ETHICAL ASPECTS

The study met the criteria of Resolution No. 466/2012, the National Health Council (CNS - *Conselho Nacional de Saúde*), and the CNS Operational Standard No. 001/2013. The adolescents who agreed to participate in the study signed a Free and Informed Consent Form (*Termo de Consentimento Livre e Esclarecido* - TCLE). The participant could withdraw from the study, without any problem, at any stage of the research. The project and the TCLE were approved by the Research Ethics Committee of the University Hospital, and substantiated report no. 1,302,489, of October 29, 2015.

RESULTS

Most adolescents were female (52.4%), mixed race/mulatto/brown (63.6%), worked or studied (82.9%), belonged to economic class B (47.7%), performed leisure activities (82.8%), did not smoke (91.2%), had a low risk of alcohol abuse (80.3%), never used drugs (82.2%), consumed coffee (78.5%), did not consume energy drinks (76.0%), had a screen time of up to five hours a day (65.8%), were physically active (61.7%), had normal body fat (72.5%) and did not have a current major depressive episode (90.1%).

In relation to sleep, 36.8% of the adolescents had EDS, and the majority had good subjective sleep quality (66.3%), a sleep latency period of 16 to 30 minutes (39.3%), a duration of sleep greater than seven hours (46.0%), sleep efficiency greater than 85% (66.8%), they scored 1 to 9 for sleep alterations (70.7%), never used sleeping medication (96.5%) and obtained a score of 1 to 2 for dysfunction during the day (47.4%).

In the univariate analysis, the highest prevalence of EDS occurred among female adolescents (PR = 1.29; 95%CI 1.16 - 1.43), those who were at high risk of alcohol abuse (PR = 1.28; 95%CI 1.15 - 1.44), those who consumed energy drinks (PR = 1.14; 95%CI 1.02 - 1.28), the physically active (PR = 1.13; 95%CI 1.01 - 1.26) and those who had a current

major depressive episode (PR = 1.35; 95%CI 1.17 - 1.55). The economic class D/E was a protective factor for EDS (PR = 0.48; 95%CI 0.27 - 0.87). Of the factors related to sleep, the highest prevalence of EDS occurred for subjective poor sleep quality (PR = 1.40; 95%CI 1.09 - 1.80), sleep latency > 60 minutes (PR = 1.10; 95%CI 0.91 - 1.34), score of 10 to 18 for sleep disorders (PR = 1.68; 95%CI 1.32 - 2.14), use of medication to sleep once or twice a week (PR = 1.54; 95%CI 1.17 - 2.03) and a score of 5 to 7 for dysfunction during the day (PR = 2.62; 95%CI 2.18 - 3.14).

In the adjusted analysis, associations remained with a higher prevalence of EDS only for women (PR = 1.33; 95%CI 1.19 - 1.49), adolescents at high risk of alcohol consumption (PR = 1.26; 95%CI 1.09 - 1.46), those with a current major depressive episode (PR = 1.26; 95%CI 1.08 - 1.46) and those who obtained a score of 10 to 18 for sleep alterations (PR = 1.43; 95%CI 1.10 - 1.85) and 5 to 7 of the dysfunction during the day (PR = 2.51; 95%CI 2.06 - 3.07). The economic class D/E was a protective factor for EDS (PR = 0.47; 95%CI 0.27 - 0.85) (Table 1).

DISCUSSION

In the present study, the prevalence and factors associated with EDS in adolescents from São Luís were estimated. The main findings were that being female, having a high risk of alcohol consumption, having a current major depressive episode, having sleep alterations and daytime sleep dysfunction were risk factors for EDS, while belonging to the economic class D/E was a protective factor.

The higher prevalence of EDS in females found in this study corroborates the results found in the literature, which show that female adolescents are more likely to have higher rates of sleep-related problems^{6,7,9}. This predominance in females may be related to the rate of brain maturation, which occurs more rapidly among women⁷. As a result, the effect of increased gonadal hormones on sleep, mood and circadian rhythms can have a direct or indirect impact on the presentation of EDS⁶.

It was also found that the economic class D/E was a protective factor for EDS. A study carried out in Hong Kong with 10,086 adolescents, using the ESS as an instrument, found no association between income and EDS⁶. However, in a study carried out in Brazil by Vilela et al.¹⁷ with 515 adolescents from public and private schools, it was observed that the prevalence of EDS was higher in students from private schools, the majority of these students belonging to more favored economic classes. This association can be explained by the fact that these classes have more social obligations and school fees, which can contribute to the occurrence of EDS.

The results also showed a higher prevalence of EDS among adolescents who were at risk for alcohol consumption. A study carried out in Brazil, in Campo Grande (MS) in 2007, with 378 adolescents who also used the ESS scale, found that 63.9% of students who drink alcohol sporadically have EDS³¹. In a study conducted by Kaur and Singh⁹ with Indian students,

Table 1. Adjusted analysis of factors associated with excessive daytime sleepiness in adolescents, São Luís (MA), 2016.

Variables	Adjusted PR	95%CI	p
BLOCK 1			
Sex			
Male	1.00	-	< 0.001
Female	1.33	1.19 - 1.49	
Economic class*			
A	1.00	-	< 0.001
B	0.72	0.61 - 0.86	
C	0.68	0.57 - 0.81	
D/E	0.47	0.27 - 0.85	
BLOCK 2			
Risk of alcohol consumption			
Low	1.00	-	0.001
High	1.26	1.09 - 1.46	
Current major depressive episode			
No	1.00	-	0.004
Yes	1.26	1.08 - 1.46	
BLOCK 3			
Sleep alterations			
0	1.00	-	0.018
1 to 9	1.22	0.96 - 1.55	
10 to 18	1.43	1.10 - 1.85	
19 to 20	1.12	0.56 - 2.25	
Sleep dysfunction during the day			
0	1.00	-	< 0.001
1 to 2	1.46	1.25 - 1.70	
3 to 4	1.89	1.59 - 2.24	
5 to 7	2.51	2.06 - 3.07	

PR: prevalence ratio; 95%CI: 95% confidence interval; *economic class (n = 2,229).

it was found that the average EDS scores were higher in young people who consumed alcoholic beverages. This greater predisposition to have EDS is due to the fact that alcohol has sedative and hypnotic properties which, although used to induce sleep, lead to fragmented, altered and worse quality sleep^{32,33}.

Another aspect observed was the existence of an association between having a major depressive episode and EDS. In depression, changes in rapid eye movement (REM) sleep occur, which is related to the breakdown of neurochemical interaction mechanisms, especially cholinergic and adrenergic interactions. With non-REM sleep loss, brain fatigue occurs, resulting in subjective tiredness and EDS¹⁶.

Regarding factors related to sleep, the literature points to the high prevalence of EDS in adolescence due to the physiological changes of puberty that interfere in the circadian cycle^{3,6} and that cause problems related to sleep, which are strongly related to the presence of EDS^{3,5,34}. Therefore, when analyzing factors related to EDS, it is essential to address these factors in order to explain their causes, despite the risk of collinearity between the factors related to sleep addressed in this study and EDS. It is worth mentioning that we extracted the sleep-related variables from the Pittsburgh scale, which is a scale validated for adolescents in Brazil by Passos et al.³⁰ and, thus, it is able to contemplate factors associated with EDS that are inherent to the adolescent phase.

Of the factors analyzed, two had a higher prevalence for EDS. Among them were sleep disorders and dysfunction during the day. Sleep changes are related to the reasons for sleep interruptions that occur during the night⁷, such as waking up to go to the bathroom, feeling pain and cold while sleeping, among others. Daytime dysfunction is inherent to EDS and sleep disorders³⁴. However, for daytime dysfunction, in addition to sleepy behaviors during the day, motivational aspects in daily activities related to sleep are also evaluated. Thus, these aspects related to sleep can also influence the presence of EDS⁷.

Problems that cause sleep disorders include: sleep hyperhidrosis, sleep debt, obstructive sleep apnea syndrome, inadequate sleep hygiene, idiopathic hyperinsomnia, restless legs syndrome, periodic sleep movement disorder and circadian rhythm disorders^{1,9,17}. These disorders prevent the maintenance of restorative sleep and contribute to the onset of EDS.

The literature points to other factors that can interfere with adolescents' sleep, such as caffeine consumption³⁵, drug use⁶, physical inactivity²⁰, high body adiposity¹⁴, the consumption of energy drinks^{2,35} and the use of electronics^{2,9,17}. However, in the present study, these factors were not associated with EDS. This fact may have occurred due to the low exposure to some risk factors in this study, such as lower percentages of drug use¹⁰, high body adiposity¹⁴, consumption of energy drinks³⁵, sedentary lifestyle¹³ and use of electronics when compared to other studies. Or because there is in fact no association between these characteristics and EDS. There was a considerable number of adolescents who consumed coffee, but the fact that we did not find an association may be due to other lifestyle habits that could mitigate the occurrence of EDS in these adolescents.

It should be noted that the EDS variable was used as an outcome due to the high prevalence of EDS in adolescence^{3,4} and the fact that its manifestations have faster and more

notorious impacts on daily activities than the other sleep variables, such as subjective sleep quality, latency, among others, that have worrying effects. However, they have repercussions later on for the organism of individuals. Furthermore, it was observed that in the univariate analyzes, a greater number of associated variables was obtained, mainly in relation to the variables related to sleep. However, when the hierarchical approach was performed, there was a loss of association between some variables. This fact can be explained because the exhibiting variables can present interference with each other, which can influence the outcome variable. In this way, it is possible to change the associations when they are analyzed together.

The strength of this study is its use of a validated scale for EDS. Another important factor is that the study had a large sample from a cohort study. However, it has some limitations. One of them is the fact that the ESS scale does not contain specific content aimed at adolescents. In addition, there is the possibility of reverse causality. However, the reasons for the cause and effect association have not been analyzed due to the fact that the data collection is cross-sectional and the temporal conditions cannot be controlled, as there was no longitudinal supervision of the subjects. Thus, there may be changes in the results due to these factors.

The knowledge of factors associated with EDS in adolescence, such as socioeconomic conditions, lifestyle and factors related to sleep, are mainly relevant to assist in the formulation of policies aimed at the health of children and adolescents, since in this period their health is closely related to learning, the process of academic and cultural formation and factors related to behavioral habits that will be taken into adult life, compromising the quality of future life^{9,17,36,37}.

CONCLUSION

EDS was found in most of the adolescents evaluated, and its occurrence was associated with females, consumption of alcoholic and energy drinks, depression and changes in sleep, and sleep dysfunction during the day. The economic class D/E presented a protective factor for EDS. Thus, these adolescents need to improve their lifestyle and sleep habits in order to avoid damage to their health. Therefore, the participation of schools and families for guidance on the importance of sleep hygiene habits, in order to reduce EDS to improve the quality of life of adolescents is necessary. In view of these results, it is suggested that further studies be performed, especially longitudinal studies, to confirm the aforementioned associations and to elucidate the relationship of reverse causality.

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