Quality of sleep and musculoskeletal pain in adolescents: observational study

Qualidade de sono e dores musculoesqueléticas em adolescentes: estudo observacional

Jéssica Fernanda de Oliveira Lima Batista[1], Thais Costa de Alencar[1], Janaína Maria Gomes Fonsêca Tolêdo[1], Kelly Rodrigues Mota[1,2], Valdeci Elias dos Santos-Júnior[1,2], Mônica Vilela Heimer[1]

DOI 10.5935/2595-0118.20220010

ABSTRACT

BACKGROUND AND OBJECTIVES: Musculoskeletal pain (MSP) is related to psychogenic factors and quality of sleep, showing that this triad is a biopsychosocial process. The aim of this study was to analyze an association between poor sleep quality and MSP in adolescents.

METHODS: This study has an observational, cross-sectional character, in which 545 adolescents, aged between 11 and 15 years, were analyzed. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), the presence of MSP using the Nordic Musculoskeletal Questionnaire (NMQ), temporomandibular disorder using the Axis II of the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) and excessive daytime sleepiness using the Epworth Sleepiness Scale (ESS). Pearson Chi-square or Fishers Exact test were used to assess the association between two categorical variables.

RESULTS: The prevalence of poor sleep quality, sleep disorders, MSP and excessive daytime sleepiness were, respectively, 66.8, 9.5, 87.5 and 30.5%. An association was observed between the quality of sleep and the number of hours of sleep per night [OR = 1.49; (1.01 to 2.21)], and between sleep disorders and MSP in the upper back [OR=1.9; (1.0 to 3.3)], and the wrists and hands [OR=2.8; (1.4 to 5.7)]. However, there was no association between sleep quality and MSP [OR=1.29; (0.76 to 2.17)].

CONCLUSION: An association was found between sleep disorders and MSP, as well as between the number of hours slept per night and quality of sleep.

Keywords: Adolescent, Musculoskeletal pain, Sleep wake disorders.

RESUMO

JUSTIFICATIVA E OBJETIVOS: As dores musculoesqueléticas (DME) possuem relação com fatores psicogênicos e qualidade de sono, evidenciando que essa tríade se refere a um processo biopsicossocial. O objetivo deste estudo foi analisar a associação entre má qualidade de sono e DME em adolescentes.

MÉTODOS: Realizou-se estudo observacional, com delineamento transversal, no qual foram analisados 545 adolescentes, na faixa etária entre 11 e 15 anos. A qualidade do sono foi avaliada através do Índice de Qualidade do Sono de Pittsburgh (PSQI), a presença de DME pelo Questionário Nórdico de Sintomas Osteomusculares (QNSO), disfunções temporomandibulares pelo Eixo II dos Critérios Diagnósticos de Pesquisa em Disfunção Temporomandibular (RDC/TMD) e a sonolência diurna excessiva através da Escala de Sonolência de Epworth (ESE). Para avaliar associação entre duas variáveis categóricas, foi utilizado o teste Qui-quadrado de Pearson ou o teste Exato de Fisher.

RESULTADOS: A prevalência da má qualidade do sono, distúrbios do sono, DME e sonolência diurna excessiva foram 66,8, 9,5, 87,5 e 30,5%, respectivamente. Observou-se associação entre qualidade do sono e quantidade de horas de sono por noite [OR=1,49; (1,01 a 2,21)], e entre distúrbios do sono e DME na parte superior das costas [OR=1,9; (1,0 a 3,3)] e nos punhos e mãos [OR=2,8; (1,4 a 5,7)]. No entanto, não foi verificada associação entre qualidade do sono e DME [OR=1,29; (0,76 a 2,17)].

CONCLUSÃO: Foi verificada associação entre distúrbios de sono e DME, bem como entre qualidade do sono e quantidade de horas dormidas por noite.

Descritores: Adolescente, Dor musculoesquelética, Transtornos do sono-vigília.

INTRODUCTION

Sleep is a condition in which the state of consciousness is altered, featuring a reduced sensitivity to environmental stimuli and autonomous changes[1]. Since it's related to energy repair, protection and conservation, it's considered an important factor for maintaining homeostasis and the well-being of an individual's overall health[2]. Changes in its pattern, resulting from changes in lifestyle, can result in great loss, especially in adolescents[2,3].

Jéssica Fernanda de Oliveira Lima Batista – https://orcid.org/0000-0002-9029-6727;
Thais Costa de Alencar – https://orcid.org/0000-0001-8610-9290;
Janaína Maria Gomes Fonsêca Tolêdo – https://orcid.org/0000-0003-4122-6746;
Kelly Rodrigues Mota – https://orcid.org/0000-0002-1656-608X;
Valdeci Elias dos Santos-Júnior – https://orcid.org/0000-0001-9748-5830;
Mônica Vilela Heimer – https://orcid.org/0000-0003-3842-192X.

1. University of Pernambuco, Hebiatrics, Camaragibe, PE, Brazil.
2. Federal University of Alagoas, Pediatric Dentistry, Maceió, AL, Brazil.

Submitted on March 11, 2021.
Accepted for publication on January 18, 2022.
Conflict of interests: none – Sponsoring sources: The present work was carried out with the support of the *Coordenação de Aperfeiçoamento de Pessoal de Nível Superior* - Brazil (CAPES) - Finance Code 001.

Correspondence to:
Kelly Rodrigues Mota
E-mail: kellyrmota@outlook.com

Studies indicate that this age group is the most vulnerable to sleep disorders because the nervous system reaches maturity during this phase, in addition to biological, psychological, and social changes[4,5]. These conditions associated with the lack of physical activities and the excessive use of technology and media may hinder the restorative action of sleep and, consequently, generate manifestations of pain[6]. Furthermore, sleep can become fragmented, increasing the number of awakenings, and compromising physical and mental health[7].

Studies suggest that there is a reciprocal relationship between sleep problems and pain, that pain can affect both quality and quantity of sleep, and that lack of sleep may increase pain[2].

Based on this premise, there is a substantial overlap between musculoskeletal pain (MSP), psychogenic factors and sleep quality, making it evident that this triad refers to a biopsychosocial process[8]. Within this context and considering the growing number of individuals reporting poor quality of sleep and MSP as complaints, this study sought to analyze these associations in adolescents.

METHODS

Observational, cross-sectional study conducted with 545 students aged 11 to 15 years old of both genders enrolled in public schools in Recife, PE. This study followed the recommendations of the STROBE Statement (Strengthening the Reporting of Observational studies in Epidemiology)[9].

Data collection was conducted in public schools in Recife-PE, from October to November 2018, inside the classroom, under confidentiality, without the presence of the principal and/or teachers, in order to avoid the student feeling embarrassed during the process of answering the questionnaires. The tabulation and analysis of data were carried out between November and December 2018 by the researchers.

Students who were undergoing any treatment directed at sleep disorder, MSP or who presented cognitive difficulties (referred by teachers) that compromised the application of the instruments were excluded.

Data was collected by measuring demographic variables, sleep quality (Pittsburgh Sleep Quality Index - PSQI), musculoskeletal symptoms (Nordic Musculoskeletal Questionnaire - NMQ), symptoms of temporomandibular disorder (Research Diagnostic Criteria for Temporomandibular Disorders - RDC/TMD, Axis II, questions 3 and 7) and level of sleepiness (Epworth Sleepiness Scale - ESS).

The sociodemographic questionnaire included questions about age (years), gender, schooling, and marital and professional status of legal guardians.

The Brazilian version of the PSQI, validated for the adolescent population between 10 and 19 years of age[10], was used for the evaluation of sleep quality. In this study, sleep quality was categorized as good (≤ 4) and poor (≥ 5) (poor sleep quality + sleep disorder). In addition, the adolescents who presented sleep disorders were evaluated.

To assess the presence of musculoskeletal symptoms, the general NMQ questionnaire was used. This questionnaire presents a figure of the human body divided into 9 areas and, through binary choices, the individual answers about the occurrence of symptoms in the last 12 months and the last 7 days[11].

Orofacial pain was assessed through question 3 (''Have you had pain in your face, jaw, temple, front ear or ear in the past month"?) and 7 (''How would you rate your facial pain on a scale from zero to 10 at the present moment, i.e., exactly right now, where zero means 'no pain' and 10 means the 'worst possible pain?') of the RDC/TMD[12].

Excessive daytime sleepiness was evaluated using the ESS, composed of eight situations with the objective of quantifying the possibilities of the individual falling asleep. Its score can vary from 0 to 24 points, with values higher than 9 being considered excessive daytime sleepiness and above 16 being considered severe sleepiness[13,14]. For this study, sleepiness was divided into two categories: Yes (≥10) and No (≤9).

The Pearson's Chi-square test or Fisher's Exact test were used to evaluate the association between two categorical variables. In addition, to assess the strength of associations, the Odds Ratio (OR) values and respective confidence intervals (CI) of each category in relation to the base category were obtained. The margin of error used in the decision of the statistical tests was 5%.

Bias

Sampling bias was avoided through cluster sampling. First, the following conglomerates were defined: 1 - municipal school and state school; 2 - classes. Then, randomization was performed in two stages. In the first stage, the municipal and state schools were randomized to ensure that the research was conducted proportionally to the number of schools in the six political-administrative regions (RPA - *regiões político-administrativas*) for the municipal institutions, and, in the northern and southern areas, for the state institutions. In the second stage, after the schools had been defined, the students were randomly drawn, taking into account the proportionality among the classes.

The sample size calculation was performed using the statistical software Epi Info version 7, with a 95% CI, admitting a 5% error and a design effect of 1.5. Using a prevalence of 50% of sleep disorders in adolescence, due to the possibility of multiple outcomes, since the present study is an arm of a larger research, a minimum sample size of 574 adolescents was obtained based on the study by Schlarb et al.[15]. In addition, 20% more was added to compensate for possible losses, resulting in a final sample size of 688 adolescents.

This study was approved by the Ethics Committee for Research with Human Beings of the University of Pernambuco (Brazil), under process number 1.432.302/2016. All volunteers and their parents or guardians signed a Free and Informed Consent Term (FICT) before data collection.

Statistical analysis

To evaluate the association between two categorical variables, the Pearson's Chi-square test or Fisher's Exact test was used. To assess the strength of the associations, the OR values and respective CI of each category in relation to the base category were obtained. The margin of error used in the decision of the statistical tests was 5%.

Table 1. Quality of sleep, excessive daytime sleepiness, hours of sleep, frequency of coughing or heavy snoring and presence of pain

Variables	n	%
Total	545	100.00
Quality of sleep		
Good	181	33.2
Poor	312	57.2
Sleep disorder	52	9.5
Classification of sleep		
Good	181	33.2
Poor	364	66.8
Degree of excessive daytime sleepiness		
Normal	348	63.9
Excessive daytime sleepiness	172	31.6
Severe sleepiness	25	4.6
Excessive daytime sleepiness		
Yes	197	36.1
No	348	63.9
Hours of sleep		
Less than 8 hours	179	32.8
More or equal to 8	366	67.2
Coughing or heavy snoring		
None in the past month	384	70.5
Less than 1 time/week	85	15.6
From 1 to 2 times/week	48	8.8
3 or more times/week	28	5.1
Pain (Q1+ Q4 + Q3 Axis)		
Yes	477	87.5
No	68	12.5

Q1 = Have you had any problems (such as pain, tingling/numbness) in the past 12 months?
Q4 = In the past 7 days, did you have any problems in the?'
Q3 Axis = Have you had pain in your face, jaw, temple, front ear, or ear in the past month?

RESULTS

Among the respondents, it was possible to identify that more than half of students attended school during the afternoon (56.0%); the most prevalent age was 13 years old (28.1%) and the gender distribution was approximately uniform, i.e., 50.3% were male and 49.7% female. Regarding the guardians, 71.9% were employed and 56.7% reported having partners.

It was observed that most adolescents (66.8%) had poor sleep quality (poor quality + sleep disorder). Excessive daytime sleepiness was present in 30.5% of adolescents (excessive daytime sleepiness + severe sleepiness), 32.8% slept less than 8 hours per night, and 87.5% reported pain (Table 1).

No significant associations between quality of sleep and sociodemographic characteristics (school period, age group, gender, marital and professional status of guardians) were found. It was observed that the hours of sleep variable were the only variable that showed an association with sleep quality, OR 1.49 (1.01 to 2.21) (Table 2).

Q1 and Q4 were questions from the questionnaire. This questionnaire had a picture of the human body, where the teenager marked the location of pain. Thus, following the question In the past 7 days, did you have any problems in the? Right below would come the human body figure where the adolescents could mark the pointed locations.

It's possible to verify a statistically significant association between sleep disorder and upper back pain (p=0.038, Table 3). These adolescents were 1.9 times more likely to have upper back pain compared to those without sleep disorders. There was also an association between sleep disorders and pain in the wrists and hands (p=0.004), an area where adolescents without sleep disorders were almost three times more likely to have no pain.

Table 2. Evaluation of sleep quality according to hours of sleep, frequency of coughing or heavy snoring, excessive daytime sleepiness, and presence of pain

Variables	Quality of sleep						p-value	OR (CI 95%)
	Poor		Good		Total			
	n	%	n	%	n	%		
Hours of sleep							p [(1)] = 0.043*	
Less than 8 hours	130	72.6	49	27.4	179	100.0		1.49 (1.01 to 2.21)
More or equal to 8	234	63.9	132	36.1	366	100.0		1.00
Coughing or heavy snoring							p [(1)] = 0.939	
None in the past month	256	66.7	128	33.3	384	100.0		1.00
Less than 1 time/week	56	65.9	29	34.1	85	100.0		0.97 (0.59 to 1.59)
From 1 to 2 times/week	52	68.4	24	31.6	76	100.0		1.08 (0.64 to 1.84)
Excessive daytime sleepiness							p [(1)] = 0.979	
Yes	111	66.9	55	33.1	166	100.0		1.00 (0.68 to 1.48)
No	253	66.8	126	33.2	379	100.0		1.00
Pain (Q1 + Q4 + Q3 Axis)							p [(1)] = 0.347	
Yes	322	67.5	155	32.5	477	100.0		1.29 (0.76 to 2.17)
No	42	61.8	26	38.2	68	100.0		1.00

*Significant association at 5%. [(1)] Chi-square test; Q1 = Have you had any problems (such as pain, tingling/numbness) in the past 12 months? Q4 = In the past 7 days, did you have any problems in the? Q3 Axis = Have you had pain in your face, jaw, temple, front ear or ear in the past month?

Table 3. Evaluation of sleep disorder, according to the location of pain in the last 12 months (Q1)

Variables	Sleep disorder						p-value	OR (CI 95%)
	Yes		No		Total			
	n	%	n	%	n	%		
Neck							p [1] = 0.896	
Yes	15	9.8	138	90.2	153	100.0		1.0 (0.6 to 2.0)
No	37	9.4	355	90.6	392	100.0		1.0
Shoulders							p [1] = 0.804	
Yes	10	8.9	102	91.1	112	100.0		1.0
No	42	9.7	391	90.3	433	100.0		1.1 (0.5 to 2.3)
Upper back							p [1] = 0.038*	
Yes	21	13.7	132	86.3	153	100.0		1.9 (1.0 to 3.3)
No	31	7.9	361	92.1	392	100.0		1.0
Elbows							p [2] = 1.000	
Yes	4	9.5	38	90.5	42	100.0		1.0 (0.3 to 2.9)
No	48	9.5	455	90.5	503	100.0		1.0
Wrists and hands							p [1] = 0.004*	
Yes	10	4.9	196	95.1	206	100.0		1.0
No	42	12.4	297	87.6	339	100.0		2.8 (1.4 to 5.7)
Lower back							p [1] = 0.118	
Yes	16	13.2	105	86.8	121	100.0		1.6 (0.9 to 3.1)
No	36	8.5	388	91.5	424	100.0		1.0
Hip/thighs							p [1] = 0.865	
Yes	12	9.2	119	90.8	131	100.0		1.0
No	40	9.7	374	90.3	414	100.0		1.1 (0.5 to 2.1)
Knees							p [1] = 0.517	
Yes	16	10.9	131	89.1	147	100.0		1.2 (0.7 to 2.3)
No	36	9.0	362	91.0	398	100.0		1.0
Ankles/feet							p [1] = 0.459	
Yes	20	8.5	216	91.5	236	100.0		1.0
No	32	10.4	277	89.6	309	100.0		1.3 (0.7 to 2.2)
Facial pain							p [1] = 0.482	
Yes	15	8.3	166	91.7	181	100.0		1.0
No	37	10.2	327	89.8	364	100.0		1.3 (0.7 to 2.4)

* significant association at 5%; [1] Chi-square test; [2] Fisher's Exact test.

DISCUSSION

The present study showed that sleep disorders were associated with the presence of MSP and sleep quality was associated with the number of hours of sleep per night. The results were in agreement with the study that addressed pain-related deterioration of physical health in the face of negative presence of sleep disorders and quantity of sleep[16]. Therefore, these findings suggest that sleep quantity and sleep disorders are risk factors for MSP, thus the null hypothesis of the study was rejected.

The observed percentage of adolescents with poor sleep quality was higher among those who had less than 8 hours of sleep per night, which can be explained by a bidirectional relationship, in which there is a desynchronization between biological and social clocks, so that the needs imposed by society make individuals modify the sleep patterns considered ideal[3]. Therefore, a complex daily life demands fewer hours of sleep, which provokes a pathological increase in the nocturnal secretion of the cortisol hormone, favoring, in the long run, the onset of subjective stress, depression, and excessive daytime sleepiness[17].

Firstly, it was thought that only the adolescents who attended classes during the morning period would present poor sleep quality, since, with the phase delay characteristic of adolescence, they sleep late; however, since they need to wake up early, they end up sleeping fewer hours than necessary. Nevertheless, the present research showed that more than half of the adolescents had classes during the afternoon period and had poor quality of sleep. Therefore, having classes in the afternoon influences the adolescent to sleep even later, and, besides the amount of sleep hours being related to sleep quality, sleep hygiene is also very relevant, since sleeping in bright environments provides melatonin suppression, changes the circadian rhythm, causing sleep disorders[18].

Differently from other studies, no significant association was found between poor quality of sleep and the presence of coughing

or heavy snoring in the adolescents evaluated[19-21]. However, it's worth mentioning that the nocturnal symptoms of snoring, wheezing, or coughing are sleep disorders which can lead to important medical implications, such as obstructive sleep apnea, negatively impacting the quality of sleep and compromising daily performance[22].

In turn, sleep disorders have been associated with prognosis of MSP and, although the mechanism of this relationship is still unclear, physical alterations and the opioidergic, immune, and endocrine systems seem to be the cause[23]. There is an association between fragmented sleep and pain, with the presence of an increase in pro-inflammatory cytokines that can lead to hyperalgesia or increased sensitivity to pain, as well as a decrease in ghrelin, a neurohormone responsible for inducing spinal antinociception and regulating pain in the brain[24].

Thus, the report of upper back pain in the last 12 months prior to this research is based on the hypothesis that sleep disorders could have influenced posture, generating muscle imbalance. Likewise, the opposite may have occurred, and the altered sleep may also be caused by an already installed MSP, resulting from unbalanced physical practices[25,26].

Unlike the findings on the association between upper back pain and sleep disorders, an association between pain in the wrists and hands and the absence of sleep disorders was identified. This fact is consistent with studies that state the increasing use of electronic devices by the adolescent population, especially before bedtime and, as a result, the tendency to acquire pain in the hands and wrists, as well as greater chances of having poor quality of sleep and excessive daytime sleepiness[27,28].

The sample losses did not compromise results, since the sample size calculation was based on a prevalence of 50%, considering the possibility of evaluating other outcomes, as the research was part of a larger study. However, for the variables analyzed in this research, the required sample size would be 490, based on the study conducted by Schlarb et al.[15], whose prevalence found was 23.1%.

The limitations of the present study are related to its cross-sectional design, due to which it's not possible to establish a relationship of causality between variables. Therefore, more studies on this subject should be conducted in other Brazilian school institutions, public and private, as well as in different periods, so that a more consistent national panorama can be built.

CONCLUSION

There is an association between sleep disorders and MSP, as well as between the amount of hours slept per night and quality of sleep in adolescents. These data suggest that negative effects related to sleep may influence the prevalence of MSP and, consequently, the quality of life of this population group.

AUTHORS' CONTRIBUTIONS

Jéssica Fernanda de Oliveira Lima Batista
Statistical analysis, Data collection, Research, Methodology, Writing - Preparation of the original, Validation, Visualization

Thais Costa de Alencar
Statistical analysis, Data Collection, Resource management, Research, Writing - Preparation of original, Validation

Janaína Maria Gomes Fonsêca Tolêdo
Statistical analysis, Data Collection, Resource management, Research, Writing - Preparation of the original, Validation

Kelly Rodrigues Mota
Writing - Preparation of original, Writing - Review and Editing, Visualization

Valdeci Elias dos Santos-Júnior
Writing - Preparation of the original, Writing - Review and Editing, Supervision, Visualization

Mônica Vilela Heimer
Funding Acquisition, Conceptualization, Project Management, Methodology, Software, Supervision, Validation, Visualization

REFERENCES

1. da Mota Gomes M, Quinhones MS, Engelhardt E. Neurofisiologia do sono e aspectos farmacoterapêuticos dos seus transtornos. Rev Bras Neurol. 2010;46(1):5-15.
2. Finan PH, Goodin BR, Smith MT. The association of sleep and pain: an update and a path forward. J Pain. 2013;14(12):1539-52.
3. Segura-Jiménez V, Carbonell-Baeza A, Keating XD, Ruiz JR, Castro-Piñero J. Association of sleep patterns with psychological positive health and health complaints in children and adolescents. Quality Life Res. 2015;24:885-95.
4. Leger D, Beck F, Richard JB, Godeau E. Total sleep time severely drops during adolescence. PLoS One. 2012;7(10):e45204.
5. Essner B, Noel M, Myrvik M, Palermo T. Examination of the factor structure of the adolescent sleep–wake scale (ASWS). Behav Sleep Med. 2015;13(4):296-307.
6. Lima ACS, dos Santos IRDD, Guimarães LA, Queiroz BM. Qualidade do sono, atividade física e uso de tecnologias portáteis entre alunos do ensino médio. Adolesc Saúde. 2018;15(8):44-52.
7. Stepanski EJ. The effect of sleep fragmentation on daytime function. Sleep. 2002;25(3):268-76.
8. Brand S, Gerber M, Puhse U, Holsboer-Trachsler E. The relation between sleep and pain among a nonclinical sample of young adults. Eur Arch Psych Clin Neurosci. 2010;260(7):543–51.
9. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP; STROBE Initiative. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE)statement: guidelines for reporting observational studies. J Clin Epidemiol. 2008 Apr;61(4):344-9.
10. Passos MH, Silva HA, Pitangui AC, Oliveira VM, Lima AS, Araújo RC. Reliability and validity of the Brazilian version of the Pittsburgh Sleep Quality Index in adolescents. J Pediatr. 2017;93(2):200-6.
11. Pinheiro FA, Troccoli BT, Carvalho CV. Validação do Questionário Nórdico de Sintomas Osteomusculares como medida de morbidade. Rev Saúde Pública. 2002;36(3):307-12.
12. Lucena LB, Kosminsky M, Costa LJ, Góes OS. Validation of the Portuguese version of the RDC/TMD Axis II questionnaire. Braz Oral Res. 2006;20(4):312-7.
13. Almeida GMF, Silva CP, Schlindwein-Zanini R. Instrumentos de avaliação do sono em adolescentes: revisão da literatura brasileira. 2015. Disponível em: < http://fiepbulletin.net/index.php/fiepbulletin/article/download/5709/12189>.
14. Bertolazi NA. Tradução, adaptação cultural e validação de dois instrumentos de avaliação do sono: Escala de sonolência de Epworth e Índice de Qualidade de Sono de Pittsburgh. 2008. Disponível em: < https://www.lume.ufrgs.br/bitstream/handle/10183/14041/000653543.pdf?sequence=1&isAllowed=y>.
15. Schlarb A, Gulewitsch MD, Weltzer V, Ellert U, Enck P. Sleep duration and sleep problems in a representative Sample of german children and adolescents. Health. 2015;7 (11):1397-408.
16. Afolalu EF, Ramlee F, Tang NK. Effects of sleep changes on pain-related health outcomes in the general population: a systematic review of longitudinal studies with exploratory meta-analysis. Sleep Med Rev. 2018;39:82-97.
17. Araujo MFMD, Vasconcelos HCAD, Marinho NBP, Freitas RWJFD, Damasceno MMC. Niveis plasmaticos de cortisol em universitários com ma qualidade de sono. Cad Saude Colet. 2016;24(1):105-10.
18. Vinstrup J, Jakobsen MD, Calatayud J, Jay K, Andersen LL. Association of stress and musculoskeletal pain with poor sleep: cross-sectional study among 3,600 hospital workers. Front Neurol. 2018;9:968.
19. Santos Barbosa I, Souza JC, Muller PTG, Brito POC, Augusto CT, Cantarelli AC. Evaluation of the sleep disorders in patients submitted to polissomnography. Res Soc Develop. 2021;10(1):e40110111738.
20. Loekmanwidjaja J, Carneiro ACF, Nishinaka MLT, Munhoes DA, Benezoli G, Wan-

dalsen GF, Sole D. Distúrbios do sono em crianças com rinite alérgica persistente moderada-grave. Braz J Otorhinolaryngol. 2018;84(2):178-84.

21. Alencar TC, Batista JFDOL, Toledo JMGF, Silveira MAC, Lyra MCA, Vieira SCM, et al. Associação entre qualidade do sono, bruxismo do sono e sonolência diurna excessiva em adolescentes. Braz J Develop. 2020;6(9):69157-73.
22. Zielinski J, Zgierska A, Polakowska M, Finn L, Kurjata P, Kupsc W, et al. Snoring and excessive daytime somnolence among Polish middle-aged adults. Eur Respir J. 1999;14(4):946-50.
23. Harrison L, Wilson S, Munafo MR. Exploring the associations between sleep problems and chronic musculoskeletal pain in adolescents: a prospective cohort study. Pain Res Manag. 2014;19(5):e139-e145.
24. Souza Bleyer FT, Barbosa DG, Andrade RD, Teixeira CS, Felden EP. Sleep and musculoskeletal complaints among elite athletes of Santa Catarina. Rev Dor. 2015;16(2):102-8.
25. Albuquerque C, Almeida C, Martins R, Cunha M. Determinantes de alterações musculoesqueléticas em adolescentes: implicações para a prevenção. Int J Develop Educ Psychol. 2019;1(2):353-64.
26. Rocha SS, Mendonca JF, Alencar Junior FGP. Study of the prevalence of etiologic factors in patients with orofacial myofascial pain. Rev Odontol UNESP. 2007;36(1):41-6.
27. Freitas CCM, Gozzoli ALDM, Konno JN, Fues VLR. Relação entre uso do telefone celular antes de dormir, qualidade do sono e sonolência diurna. Rev Med. 2017;96(1):14-20.
28. Silva Bilche Soares AM, Prestes SCC, Prestes MP, Freitas Coelho TR, Lopes AC. O uso excessivo de smartphones em crianças, adolescentes e jovens: sintomas osteomusculares autorreferidos. J Health Sci Inst. 2019;37(3): 246-50.