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Sleep quality and metabolic syndrome in overweight or obese children and adolescents

Qualidade do sono e síndrome metabólica em crianças e adolescentes com sobrepeso ou obesidade

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ABSTRACT

Objective

To assess sleep quality and its association with metabolic syndrome and its components.

Methods

This cross-sectional study was conducted from June 2011 to March 2012 at the Childhood Obesity Center, *Campina Grande*, *Paraíba*, Brazil, with 135 overweight or obese children and adolescents. Sleep quality was assessed by the Pittsburgh Sleep Quality Index. Metabolic syndrome diagnosis was based on abdominal circumference, blood pressure, glycemia, high density lipoprotein-cholesterol, and triglycerides. The data were treated by the software Statistical Package for the Social Sciences version 22.0 at a significance level of 5%.

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Results

The prevalence of poor sleep quality or sleep disorder according to the Pittsburgh Sleep Quality Index was 40.7%, and females had higher mean global Pittsburgh Sleep Quality Index score. Metabolic syndrome prevalence was 63.0%. Females also had higher daytime dysfunction. Poor sleep quality was associated with high diastolic blood pressure (OR=2.6; *p*=0.015) and waist circumference (OR=3.17; *p*=0.024) after adjusting for sex and age.

Conclusion

Girls had higher global Pittsburgh Sleep Quality Index score, which was associated with daytime dysfunction. Poor sleep quality was a predictor of high diastolic blood pressure in the study sample.

Keywords: Adolescent. Child. Metabolic syndrome. Obesity. Sleep.

RESUMO

Objetivo

Avaliar a qualidade do sono e sua associação com a síndrome metabólica e seus componentes.

Métodos

Estudo transversal, realizado entre junho de 2011 e março de 2012 no Centro de Obesidade Infantil, Campina Grande, Paraíba. Foram incluídas 135 crianças e adolescentes com sobrepeso ou obesidade. A qualidade do sono foi avaliada pelo Pittsburgh Sleep Quality Index*. Para o diagnóstico de síndrome metabólica, consideraram-se circunferência abdominal, pressão arterial, glicemia, lipoproteínas de alta densidade e triglicerídeos. Os dados foram analisados pelo* Statistical Package for the Social Sciences *versão 22.0, sendo adotado um nível de significância de 5%.*

Resultados

A prevalência de má qualidade ou distúrbio do sono avaliado pelo Pittsburgh Sleep Quality Index *foi 40.7%, e a média do escore global* Pittsburgh Sleep Quality Index *foi significativamente maior no sexo feminino. A prevalência de síndrome metabólica foi 63.0%. A disfunção diurna foi significativamente maior no sexo feminino. A má qualidade do sono esteve associada à pressão arterial diastólica elevada (OR=2,6; p=0,015) e à circunferência abdominal elevada (OR=3,17; p=0,024), após ajuste para sexo e idade.*

Conclusão

As meninas apresentaram um maior escore global do Pittsburgh Sleep Quality Index *e associação com a disfunção diurna. A má qualidade do sono mostrou-se fator preditor de pressão arterial diastólica elevada na amostra estudada.*

Palavras-chave: *Adolescente. Criança. Síndrome metabólica. Obesidade. Sono.*

INTRODUCTION

Sleep is a vital necessity and its periodicity, quality, and constancy characterize very important variables in the development of children and adolescents[1]. Changes in sleep pattern and quality can affect people at a very young age and their consequences range from poor school performance to compromised physical and mental health[2].

In the last years, the prevalence of voluntary sleep restriction, insomnia, and even poor sleep quality has increased concomitantly with the growing prevalence of obesity in children and adolescents[3].

The reason for the relationship between sleep and obesity has not been fully elucidated. Studies suggest that partial or chronic sleep deprivation causes energy unbalance by changing the levels of many hormones, including leptin and grehlin[4,5], whose function relates to energy balance and control of body weight[6,7] and insulin.

Regarding insulin, short sleep duration may be associated with insulin resistance[6], which

is related to the metabolic syndrome in overweight and obese children and adolescents[8].

Hence, sleep has an important metabolic role as it may promote endocrine and metabolic changes that increase hunger and appetite, and consequently, the risk of overweight and obesity[8].

Adolescents with short sleep duration (<7 hours/night) had lower intake of fruits and vegetables and higher intake of fast foods[9]. Along with inappropriate eating habits, it is possible that qualitative and quantitative sleep changes reduce the level of physical activity in children and adolescents[1].

Most studies on the association between sleep and obesity in children assess sleep duration[9-15], and few assess sleep quality[14,16,17]. However, assessment of sleep duration alone is not enough, qualitative aspects must also be assessed[18]. This is because when individuals have difficulty falling asleep or when they wake up frequently, effective sleep duration decreases, and the body does not spend enough time in deep sleep stages, even if total sleep duration is adequate[19].

Questionnaires have been used for diagnosing sleep disorders, and although they are indirect and subjective assessment instruments, their administration requires little time, and they are free and easy to use in epidemiological studies[16,17,20].

The Pittsburg Sleep Quality Index (PSQI) is an instrument commonly used for assessing sleep quality[17,21]. The version validated for the Brazilian population was developed in a study that compared PSQI and polysomnography, the gold standard sleep quality assessment method in adults. The results have shown that the Brazilian PSQI version is a valid and reliable instrument for assessing sleep quality in the month prior to the interview[22].

Some studies have reported that sleep quality in adults assessed by the PSQI is associated not only with excess weight, but also with metabolic syndrome[18,21]. Metabolic syndrome is an aggregation of cardiometabolic risk factors represented by hypertension, abdominal obesity, hypertriglyceridemia, low High Density Lipoprotein-cholesterol (HDL-c), and glucose intolerance[23]. Therefore, the detection of this condition at an early age is important for the implementation of prevention strategies.

In adolescents short sleep duration was associated with overweight but not with metabolic syndrome. Short sleep duration was associated with high blood pressure, and long sleep duration, with hypertriglyceridemia[12].

Nevertheless, until now, no study has assessed the association between sleep quality and metabolic syndrome in children and adolescents. Moreover, studies that assess sleep quality in this population are scarce.

Hence, in order to contribute to this qualitative sleep aspect, and given the repercussion of sleep disorders on overweight and obese individuals, this study aimed to assess sleep quality and its association with the metabolic syndrome and its components in overweight or obese children and adolescents.

METHODS

This cross-sectional study was conducted during the school year from June 2011 to March 2012 at the Childhood Obesity Center, located in the *Instituto de Saúde Elpídeo de Almeida*, *Campina Grande* (PB), Brazil. Childhood Obesity Center is a reference public service for providing multidisciplinary care to overweight and obese children and adolescents. Currently, 390 children and adolescents are registered.

This study is part of a larger project called "Prevalence of cardiometabolic risk factors in overweight or obese children and adolescents", approved by the Research Ethics Committee of the *Universidade Estadual da Paraíba* (UEPB) under Protocol nº 0040.0.133.000-08. The study followed all the ethical precepts for human research.

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The convenience sample consisted of all overweight and obese children and adolescents aged 5 to 18 years who attended the routine medical visit on Fridays during the school year, since sleep habits change during vacations[24]. Students with adenotonsillar hypertrophy; cardiorespiratory, neuromuscular, neoplastic, and/or advanced hepatic disease; and taking drugs that affected sleep (antidepressants, benzodiazepines, bronchodilators, corticosteroids, and illicit drug or alcohol abuse) at data collection were excluded.

During this period 190 individuals were treated. Seventeen of these were excluded, eleven because they were outside the study age range, two were normal weight, two had asthma, and two had adenoid hypertrophy. Thirty-three individuals did not show up for blood collection and five did not have one of the results for metabolic syndrome components, so the final sample consisted of 135 individuals.

The anthropometric variables (weight, height, and abdominal circumference) were measured twice and averaged, as recommended by the World Health Organization[25].

Nutritional status classification was based on Body Mass Index (BMI), as recommended by the Centers of Disease Control and Prevention: overweight (85th percentile ≤BMI <95th percentile), obesity (95th percentile ≤BMI <97th percentile), and morbid obesity (97th percentile ≤BMI)[26]. Abdominal circumference was considered high when ≥90th percentile, as recommended by the International Diabetes Federation[27], with a maximum limit of 88 cm for girls and 102 cm for boys, as recommended by the National Cholesterol Education Program Adult Treatment Panel III (NCEP/ATPIII)[28].

Blood pressure was measured three times two minutes apart each, as recommended by the V Brazilian Guidelines for High Blood Pressure[29] using a mercury Tycos® sphygmomanometer made in Germany by WelchAllyn and appropriate-size cuff. The mean of the two last measurements was considered the systolic and diastolic blood pressure.

Blood was collected after a 12-hour fast by the Laboratory of Clinical Analyses of the UEPB. HDL-c, triglycerides, and glycemia were assessed by enzyme colorimetry by an automatic device (Modelo BioSystems 310, *Curitiba*, *Paraná*, Brazil).

Metabolic syndrome diagnosis was based on the criteria provided by NCEP/ATPIII[28] adapted for the age group, which requires the presence of at least three of these criteria: abdominal circumference ≥90th percentile for sex, age, and race; triglycerides ≥100 mg/dL; HDL-c <45 mg/dL; fasting glycemia ≥100 mg/dL; and systolic and/or diastolic blood pressure ≥90th percentile for sex, height, and age.

The Pittsburg Sleep Quality Index[30] assessed sleep quality during the previous month. This Portuguese version of this instrument has been validated[31]. PSQI contains seven components: subjective sleep quality (subjective sensation of satisfaction with daily sleep), sleep latency (long sleep start time), sleep duration, habitual sleep efficiency (proportion between hours slept and total hours in bed), sleep disorders (sleep interruption), use of sleeping pills, and daytime dysfunction.

The global score is given by adding the seven components. Each component receives a score ranging from 0 to 3 points with the same weight, and 3 represents the negative extreme of a Likert-type scale. Hence, the total score may range from 0 to 21 points. Sleep quality is classified as follows: 0-5 = good sleep quality; 6-10 = poor sleep quality; >10 = sleep disorder. All participants with a PSQI score higher than 5 (PSQI >5) were diagnosed with poor sleep quality as the score indicates great difficulty in at least two components, or moderate difficulty in more than three components[30].

The score of each component was also assessed and compared with metabolic syndrome and its components. Subjective sleep quality scored 0-3 points (0 - very good sleep quality; 1 - good sleep quality; 2 - bad sleep quality; and 3 - very bad sleep quality). Sleep latency scored 0-3 points (time in minutes required to fall asleep

every night and frequency of not falling asleep within 30 minutes). Sleep duration scored 0-3 points (0 = sleep duration >7 hours; 1=6 -≤7 hours; 2=5 -<6 hours; 3=<5hours). Habitual sleep efficiency scored 0-3 points (classified according to the sum of the answers related to sleeping problems caused by nine reasons and their frequency, such as feeling hot or cold: 0=0; 1=9-1; 2=10-18; 3=19-27). The use of sleeping pills scored 0-3 points (0 = did not use in the last month; 1 = used less than once a week; 2 = used once or twice a week; 3 = used three or more times a week). Daytime dysfunction scored 0-3 points (classified according to the sum of the answers related to the frequency of having problems to stay awake while driving, during meals, or during social activities, and the frequency of having problems to remain enthusiastic enough to carry out activities of daily living: 0-0; 1-2=1; 3-4=2; 5-6=3).

The population was described according to their anthropometric and clinical variables, expressed as absolute and relative frequencies, means, and standard deviations. Group means were compared by the Student's *t* test or Analysis of Variance (Anova) for three groups and the proportions were compared by the Chi-square test or Fisher's exact test. Univariate logistic regression assessed the relationship between metabolic syndrome and its components and sleep disorder diagnosed based on PSQI score, which was later adjusted for sex and age. The *Odds Ratio* (OR) was calculated based on logistic regression. The logistic regression was performed by transforming the PSQI variable into dummy variables, the reference group being good sleep quality.

The statistical analyses were performed by the software Statistical Package for the Social Sciences (SPSS Inc., Chicago, Illinois, United States), version 22.0, at a significance level of 5%.

RESULTS

Table 1 shows the sample characteristics. Of the 135 study children and adolescents, 56.3% were females, 64.4% were classified as morbidly obese, and 76.3% were adolescents. The mean age was 12.7±3.4 years (5.0-20.0). Sex was associated with nutritional status, males were associated with morbid obesity when the groups morbid obesity and obesity were compared (p=0.010).

The prevalence of poor sleep quality/sleep disorder according to the PSQI score was 40.7%, and the prevalence was higher in females (44.7 *versus* 35.6%) (Table 1).

More than half (55.6%) the sample classified their sleep in the previous month as bad or very bad. Metabolic syndrome prevalence was 63.0%. Low HDL-c and blood glucose changes were the most and least frequent metabolic syndrome components, respectively. High abdominal circumference was associated with being male (Table 1).

The mean Pittsburgh Sleep Quality Index score of adolescents was higher than that of children. While adolescents had a mean score of 5.21±2.60 (4.70-5.72), children had a mean score of 4.44±3.29 (3.25-5.62) (p=0.170).

Pittsburgh Sleep Quality Index component with the highest mean was subjective sleep quality. Females had higher mean scores in six PSQI components, except efficiency, and the mean daytime dysfunction score was significantly higher in girls (Table 2).

The mean Pittsburgh Sleep Quality Index and PSQI component scores were not different between those with and without metabolic syndrome, regardless of sex. Although no association was found in females with metabolic syndrome, most of their PSQI items had higher mean scores than those of males with metabolic syndrome (Table 3).

Pittsburgh Sleep Quality Index and/or its components were not associated with metabolic syndrome, according to logistic regression (Table 4).

Logistic regression analysis between PSQI and metabolic syndrome components showed

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Table 1. Characterization of the entire sample and by sex (N=135). *Campina Grande* (PB), Brazil, 2011-2012.

Variables	Total population		Sex				*p*
			Male		Female		
	M	DP	M	DP	M	DP	
Age (years)	12.70	3.40	12.16	3.26	13.11	3.41	0.102
Body mass index	29.84	5.90	30.26	6.97	29.51	4.94	0.471
Mean sleep duration (h/day)	8.45	1.84	8.76	1.64	8.21	1.95	0.086
	n	%	n	%	n	%	
Age group							
Child (6 to 9 years)	32	23.7	17	28.8	15	19.7	0.219
Adolescent (10 to 18 years)	103	76.3	42	71.2	61	80.3	
Body mass index percentile							
Overweight	5	3.7	2	3.4	3	3.9	0.036
Obese	43	31.9	12	20.3	31	40.8	
Morbidly obese	87	64.4	45	76.3	42	55.3	
Sleep quality							
Good quality (PSQI ≤5)	80	59.3	38	64.4	42	55.3	0.113
Poor quality (PSQI 6-10)	46	34.1	20	33.9	26	34.2	
Sleep disorder (PSQI >10)	9	6.7	1	1.7	8	10.5	
PSQI scores							
0-1	11	8.1	6	10.2	5	6.6	0.162
2-3	32	23.7	15	25.4	17	22.4	
4-5	37	27.4	17	28.8	20	26.3	
6-7	29	21.5	16	27.1	13	17.1	
8-9	17	12.6	4	6.8	13	17.1	
10-11	6	4.4	1	1.7	5	6.5	
12-13	3	2.2	0	0.0	3	3.9	
14-15	0	0.0	0	0.0	0	0.0	
16-21	0	0.0	0	0.0	0	0.0	
Subjective sleep quality							
Very good	33	24.4	16	27.1	17	22.4	0.531
Good	27	20.0	11	18.6	16	21.1	
Bad	45	33.4	22	37.3	23	30.3	
Very bad	30	22.2	10	16.9	20	26.3	
Sleep latency							
0	67	49.6	30	50.8	37	48.7	0.464
1	36	26.7	17	28.8	19	25.0	
2	19	14.1	9	15.3	10	13.2	
3	13	9.6	3	5.1	10	13.2	
Sleep duration							
>7 hours	114	84.4	52	88.1	62	81.6	0.427
6-7 hours	11	8.1	5	8.5	6	7.9	
5-6 hours	7	5.2	1	1.7	6	7.9	
<5 hours	3	2.2	1	1.7	2	2.6	
Habitual sleep efficiency							
0 (≥85%)	133	98.5	58	98.3	75	98.7	1.000
1 (75-84%)	2	1.5	1	1.7	1	1.3	
2 (65-74%)	0	0.0	0	0.0	0	0.0	
3 (<65%)	0	0.0	0	0.0	0	0.0	
Sleep disorders							
0	16	11.9	7	11.9	9	11.8	0.164
1	86	63.7	42	71.2	44	57.9	
2	30	22.2	8	13.6	22	28.9	
3	3	2.2	2	3.4	1	1.3	

Table 1. Characterization of the entire sample and by sex (N=135). *Campina Grande* (PB), Brazil, 2011-2012.

Variables	Total population		Sex				*p*
			Male		Female		
	M	DP	M	DP	M	DP	
Use of sleeping pills							
0	36	26.7	18	30.5	18	23.7	0.778
1	77	57.0	33	55.9	44	57.9	
2	19	18.1	7	11.9	12	15.8	
3	3	2.2	1	1.7	2	2.6	
Daytime dysfunction							
0	110	81.5	54	91.5	56	73.7	0.068
1	9	6.7	2	3.4	7	9.2	
2	12	8.8	2	3.4	10	13.2	
3	4	3.0	1	1.7	3	3.9	
Metabolic syndrome							
Present	85	63.0	41	69.5	44	57.9	0.166
Absent	50	17.0	18	31.5	32	42.1	
N metabolic syndrome components							
0	1	0.7	0	0.0	1	1.3	0.313
1	11	8.1	2	3.4	9	11.8	
2	38	28.1	16	27.1	22	28.9	
3	56	41.5	28	47.5	28	36.8	
4	28	20.7	12	20.3	16	21.1	
5	1	0.7	1	1.7	0	0.0	
Abdominal circumference							
High	102	75.6	51	86.4	51	67.1	0.010
Normal	33	24.4	8	13.6	25	32.9	
Blood Pressure							
High	72	53.3	32	54.2	40	52.6	0.853
Normal	63	46.7	27	45.8	36	47.4	
Systolic blood pressure							
High	27	20.0	10	16.9	17	22.4	0.435
Normal	108	80.0	49	83.1	59	77.6	
Diastolic blood pressure							
High	62	45.9	28	47.5	34	44.7	0.753
Normal	73	54.1	31	52.5	42	55.3	
Fasting glycemia							
High	1	0.7	1	1.7	0	0.0	0.437
Normal	134	99.3	58	98.3	76	100.0	
Triglycerides							
High	85	63.0	40	67.8	45	59.2	0.306
Normal	50	17.0	19	32.2	31	40.8	
High density lipoprotein-cholesterol							
Low	112	83.0	47	79.7	65	85.5	0.369
Normal	23	17.0	12	20.3	11	14.5	

Note: Difference between the groups with morbid obesity and obesity, *p*=0,010; Difference between the groups with overweight and obesity, *p*=0.573; Difference between the groups with morbid obesity and overweight, *p*=0.610.

SD: Standard Deviation; PSQI: Pittsburgh Sleep Quality Index.

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Table 2. Mean values and standard deviations of the Pittsburgh Sleep Quality Index (PSQI) domains by sex (N=135). *Campina Grande* (PB), Brazil, 2011-2012.

Variables	Study population		Males		Females		*p*
	M	SD	M	SD	M	SD	
PSQI score	5.03	2.78	4.44	2.31	5.49	3.04	0.025
Subjective sleep quality	1.53	1.09	1.44	1.07	1.61	1.11	0.387
Sleep latency	0.84	1.00	0.75	0.90	0.91	1.07	0.353
Sleep duration	0.25	0.65	0.17	0.53	0.32	0.73	0.181
Sleep efficiency	0.01	0.12	0.02	0.13	0.01	0.11	0.858
Sleep disorders	1.15	0.64	1.08	0.62	1.20	0.65	0.313
Use of sleeping pills	0.92	0.70	0.85	0.69	0.97	0.71	0.302
Daytime dysfunction	0.33	0.76	0.15	0.55	0.47	0.87	0.010

Note: M: Média; SD: Standard Deviation.

Table 3. Comparison between global Pittsburgh Sleep Quality Index (PSQI) score and its components by presence of metabolic syndrome (N=135). *Campina Grande* (PB), Brazil, 2011-2012.

Variables	Presence of metabolic syndrome			Absence of metabolic syndrome			*p*
	Mean	SD	95%CI	Mean	SD	95%CI	
Males							
Global PSQI score	4.41	2.29	3.69-5.14	4.50	2.43	3.29-5.71	0.898
Subjective sleep quality	1.44	1.09	1.09-1.79	1.44	1.04	0.93-1.96	0.986
Sleep latency	0.73	0.89	0.45-1.01	0.78	0.94	0.31-1.25	0.858
Sleep duration	0.24	0.62	0.05-0.44	0.00	0.00	0.00-0.00	0.104
Habitual sleep efficiency	0.00	0.00	0.00-0.00	0.06	0.23	-0.06-0.17	0.132
Sleep disorders	1.10	0.70	0.88-1.32	1.06	0.42	0.85-1.26	0.814
Use of sleeping pills	0.76	0.62	0.56-0.95	1.06	0.80	0.66-1.45	0.126
Daytime dysfunction	0.15	0.57	-0.03-0.33	0.17	0.51	-0.09-0.42	0.898
Females							
Global PSQI score	5.57	3.07	4.64-6.50	5.38	3.06	4.27-6.48	0.787
Subjective sleep quality	1.61	1.10	1.28-1.95	1.59	1.13	1.19-2.00	0.939
Sleep latency	0.93	1.09	0.60-1.26	0.88	1.07	0.49-1.26	0.821
Sleep duration	0.34	0.80	0.10-0.59	0.28	0.63	0.05-0.51	0.729
Habitual sleep efficiency	0.02	0.15	-0.02-0.07	0.00	0.00	0.00-0.00	0.397
Sleep disorders	1.18	0.62	0.99-1.37	1.22	0.71	0.96-1.47	0.810
Use of sleeping pills	0.95	0.72	0.74-1.17	1.00	0.72	0.74-1.26	0.787
Daytime dysfunction	0.48	0.88	0.21-0.74	0.47	0.88	0.15-0.79	0.967

Note: SD: Standard Deviation; 95%CI: 95% Confidence Interval.

that individuals with poor sleep quality were up to 2.5 times more likely to have high diastolic blood pressure (p=0.018; 95% Confidence Inteval-95%CI=1.17-5.43), and the risk increased to 2.62 (p=0.01; 95%CI=1.20-5.69) after adjusting for sex and age (OR=2.62) (Table 5).

After adjusting the components for sex and age, high abdominal circumference was associated with poor sleep quality (OR=3.17; p=0.02; 95%CI=1.17-8.60) (Table 5).

The possibility of sleep disorder was not associated with metabolic syndrome components probably because of the small sample size.

DISCUSSION

It is critical to identify sleep disorders during childhood because of the importance of introducing strategies to promote sleep quality and prevent metabolic complications, such as

Table 4. *Odds Ratio* (OR) of metabolic syndrome by Pittsburgh Sleep Quality Index (PSQI) and its components (N=135). *Campina Grande* (PB), Brazil, 2011-2012.

Variables	Score	n	OR	(95%CI)	*p*
Global PSQI score	≤5	80	1.00	Reference	
	>5	55	0.73	(0.35-1.49)	0.391
Subjective sleep quality	0	33	1.00	Reference	
	1	27	1.42	(0.50-4.00)	0.511
	2	45	1.14	(0.46-2.82)	0.766
	3	30	1.94	(0.68-5.49)	0.210
Sleep latency	0	67	1.00	Reference	
	1	36	1.18	(5.23-2.69)	0.684
	2	19	0.53	(0.17-1.64)	0.270
	3	13	0.93	(0.27-3.13)	0.902
Sleep duration	0	114	1.00	Reference	
	1	11	0.94	(0.26-3.41)	0.929
	2	7	1.24	(0.26-5.80)	0.786
	3	3	2.67	(0.00-0.00)	0.999
Habitual sleep efficiency	0	133	1.00	Reference	
	1	2	0.58	(0.036-9.536)	0.705
	2	0	-	-	-
	3	0	-	-	-
Sleep disorders	0	16	1.00	Reference	
	1	86	0.56	(0.19-1.65)	0.296
	2	30	0.76	(0.23-2.58)	0.666
	3	3	0.50	(0.04-6.68)	0.600
Use of sleeping pills	0	36	1.00	Reference	
	1	77	0.79	(0.36-1.78)	0.581
	2	19	0.57	(0.18-1.86)	0.357
	3	3	0.62	(0.05-7.53)	0.711
Daytime dysfunction	0	110	1.00	Reference	
	1	9	1.14	(0.27-4.82)	0.856
	2	12	0.57	(0.17-1.89)	0.359
	3	4	1.71	(0.17-17.03)	0.645

Note: 95%CI: 95% Confidence Interval.

excess weight[10,32]. Sleep disorders are often underdiagnosed in this age group as they depend on the perception of caregivers given that children do not always verbalize symptoms related to this condition[33].

Sleep quality in this study was measured by the PSQI index and its components (subjective quality, latency, duration, habitual efficiency, sleep disorders, use of sleeping pills, and daytime sleepiness) in a group of children and adolescents with excess weight, and the prevalence of poor sleep quality in the sample was high.

A study with Brazilian university students with a mean age of 21.5 years found that 95.3% had poor sleep quality (PSQI >5), and the mean PSQI score was 9.4 points[34].

Some factors that may influence sleep quality in children and adolescents are long periods watching television[35] and changes in the daily routine and habit during vacations. This last item leads to changes in sleeping pattern, such as going to bed later and consequently, getting less rapid eye movement sleep. Both factors were associated with a higher risk for obesity in children and adolescents[36].

Poor sleep quality was more prevalent among the study adolescents. This condition may affect wake quality to a variable degree, especially in this age group, since they go to bed late in

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Table 5. Logistic regression between Pittsburgh Sleep Quality Index and components of metabolic syndrome adjusted for age and sex (N=135). *Campina Grande* (PB), Brazil, 2011-2012.

Pittsburgh Sleep Quality Index	Univariate analysis			Adjusted for sex and age		
	OR	(95%CI)	*p*	OR	(95%CI)	*p*
Metabolic syndrome						
0-5		1.00	Reference		1.00	Reference
6-10	1.52	(0.70-3.29)	0.284	1.60	(0.73-3.51)	0.242
>10	0.83	(0.21-3.34)	0.797	0.98	(0.24-4.08)	0.983
Diastolic blood pressure						
0-5		1.00	Reference		1.00	Reference
6-10	2.53	(1.17-5.43)	0.018	2.62	(1.20-5.69)	0.015*
>10	0.55	(0.13-2.36)	0.424	0.50	(0.11-2.21)	0.363
Systolic blood pressure						
0-5		1.00	Reference		1.00	Reference
6-10	0.70	(0.28-1.75)	0.444	0.73	(0.29-1.86)	0.515
>10	0.24	(0.06-1.03)	0.054	0.25	(0.06-1.10)	0.067
Triglycerides						
0-5		1.00	Reference		1.00	Reference
6-10	0.68	(0.32-1.45)	0.322	0.68	(0.32-1.46)	0.325
>10	0.38	(0.09-1.55)	0.180	0.43	(0.10-1.78)	0.246
High density lipoprotein cholesterol						
0-5		1.00	Reference		1.00	Reference
6-10	1.89	(0.64-5.60)	0.249	1.81	(0.61-5.43)	0.287
>10	0.46	(0.10-2.06)	0.311	0.38	(0.08-1.82)	0.226
Abdominal circumference						
0-5		1.00	Reference		1.00	Reference
6-10	2.25	(0.88-5.75)	0.091	3.17	(1.17-8.60)	0.024*
>10	0.81	(0.19-3.50)	0.775	1.12	(0.22-5.69)	0.891

Note: *$p<0.05$.

OR: *Odds Ratio*; 95%CI: 95% Confidence Interval.

their biological configuration and tend to wake up late, which is not possible during the school year, resulting in excessive daytime sleepiness[37].

A study of Brazilian adolescents using the Sleep Behavior Questionnaire found that the obese group had worse sleep quality than the normal weight group[16].

Females had higher mean global PSQI and daytime dysfunction scores than males. This association with being female corroborates a study done with 1,481 adults that also assessed the relationship between sleep quality and metabolic syndrome by sex[18].

Although sleep quality was not associated with metabolic syndrome in the present study, sleep quality was associated with diastolic blood pressure and abdominal circumference.

Another two studies did not find an association between sleep duration and metabolic syndrome[12,38]. In male and female adults, the mean global PSQI score and the mean score of its components, especially sleep latency and sleep disorders, have been associated with metabolic syndrome[18].

Adolescents with sleep-related breathing disorders diagnosed by polysomnography were seven times more likely to have metabolic syndrome than those without sleep-related breathing disorders (OR=7.74; 95%CI=3.10-19.35), and this association was not explained by sex, race, or socioeconomic condition[39].

High diastolic blood pressure was found in children with obstructive sleep apnea[40]. Adolescents with low sleep efficiency determined

by actigraphy were 3.5 times more likely to have high blood pressure[41], a higher risk than the one found by the present study. This fact may be due to the different methods used for determining sleep quality.

A study that assessed sleep quality with full-night polysomnography found that the absence of deeper sleep stages, such as rapid eye movement sleep and slow-wave sleep, was associated with high morning blood pressure in obese adolescents regardless of BMI[42].

A study with obese Korean adolescents found that short sleep duration was associated not only with high blood pressure but also with high abdominal circumference[12].

In the present study, high abdominal circumference was associated with poor sleep quality after adjusting for age and sex, and may be used as a marker of sleep quality[12].

In this sense, assessment of obese adolescents must include investigation of blood pressure, abdominal circumference, and the signs and symptoms associated with poor sleep quality, including snoring, fatigue, and daytime sleepiness. Thus, poor sleep quality must be considered in the follow-up of hypertensive obese youth[42].

The present study found a high prevalence of poor sleep quality and the need of including this assessment in primary health care, especially in obese individuals. Health professionals who work with children and adolescents must know sleep physiology and its physiological maturation process to prevent or treat pathological behaviors. Therefore, questions regarding sleep quality and possible damaging factors should be included in the patient's assessment, in addition to advice on sleep hygiene, which should be part of children's health care[32].

Sleep hygiene practices include changes in the sleep environment, and parents' and children's practices and routines that favor good sleep quality of adequate duration, in addition to the practice of activities that favor sleepiness in order to promote sleep[43].

This study has limitations, such as the use of a convenience sample, the absence of a control group, the cross-sectional design, which does not allow the identification of the relationship of causality, and the use of a questionnaire to assess sleep quality, which although equivalent, is less accurate than other analytical methods such as polysomnography and actigraphy. The relative scarcity of pediatric studies that analyze the relationship between sleep quality and metabolic syndrome hindered comparison of the results.

The study is important because the assessment of the sleep quality of overweight and obese children and adolescents revealed a high prevalence of poor sleep quality and its association with high diastolic blood pressure in adolescents.

CONCLUSION

Girls had higher global Pittsburgh Sleep Quality Index score and an association between said score and daytime dysfunction. Sleep quality was not associated with metabolic syndrome in the study overweight or obese children and adolescents. Adolescents with poor sleep quality were significantly more likely to have high diastolic blood pressure.

The realization of other studies on this subject in other Brazilian municipalities with a larger sample, control group, and longitudinal design may contribute to the understanding of the influence of sleep quality on metabolic changes, risk factors for cardiovascular disease and indispensable for the institution of child health policies in the national landscape.

CONTRIBUTORS

NC GONZAGA and ASS SENA participated in the project design, analysis and interpretation of data and writing of the manuscript. AC COURA and FG DANTAS contributed to the writing and critical review of the manuscript. RC OLIVEIRA participated in the project design and final revision of the manuscript. CCM MEDEIROS participated in the project design, data analysis and final revision of the manuscript.

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