Thoracic Spine Pain in Adolescents and Its Association With Electronic Devices and Other Factors

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Abstract

Purpose: To determine the prevalence of thoracic spine pain (TSP) in adolescents and to analyze its association with sociodemographic characteristics, use of electronic devices, habitual practice of physical activity and mental health problems.

Methods: Cross-sectional study with 1628 students of public schools from the city of Bauru/SP. Data collection: 1. Characterization of the participants, use of electronic devices (TV, computer, tablet and phone), psychosocial factors and lifestyle; 2. Strengths and difficulties questionnaire (SDQ); 3. Baecke Questionnaire; 4. Nordic questionnaire. Descriptive analyzes, bivariate and multivariate logistic regression were used.

Results: The overall prevalence of TSP was 51.5% (CI 49.1 to 53.9). Women showed a prevalence of 59.6% (CI 56.2 to 62.9) and men of 43.1% (CI 39.7 to 46.5), with significant difference. The variables associated with TSP were: female gender (PR= 1.96), use of computer for more than 3 hours per day (PR= 1.29), use of computer for more than 3 times per week (PR= 1.35), distance from eye to the computer screen (PR= 1.29), use of cell phone in semi-lying position (PR= 1.37), time of use of cell phone for more than 3 hours per day (PR= 1.44), use of tablet in sitting position (PR= 1.47) and presence of mental health problems (PR= 2.62)

Conclusion: There is a high prevalence of TSP in adolescents and a marked association with female sex, the use of electronic devices, the presence of mental health problems. The level of physical activity was a protective factor.

Introduction

Thoracic spine pain (TSP) is relatively common in children and adolescents. In a review study, TSP in adolescents in the last twelve months and lifetime varied from 4.2–9.7%, and 15.6–19.5%, respectively, being comparable lumbar pain (7.0-50.8% and 7.0–72.0%) and cervical pain (7.6–13.0% and 3.0–28.0%) [1]. There is also evidence that the presence of TSP should not be underestimated in adolescence. In contrast to adulthood, when TSP incidence and prevalence is considerably lower than that of LBP and NP, TSP incidence and prevalence are similar to that of LBP and NP in children and adolescents [1].

A review article found few studies regarding the risk factors of TSP, reflecting the general observation that the thoracic spine receives noticeably less attention in the literature compared to NP and LBP [1, 2]. The literature relates TSP to female sex [1, 2, 3], back pack weight and chair height at school [4], as well as parental smoking [2, 4], increased body weight [1, 2], and mental health problems [5]. To the best of our knowledge there are no studies that have assessed tablet and phone use, and there is no national or international data regarding on their relationship with TSP until now. Since we already know that the use of phones and tablets is associated with NP and LBP [4], and the thoracic spine articulates with both the cervical and lumbar vertebrae, the use of these devices and their association with TSP cannot be ignored, as it may be that they represent some risk for that region of the spine.

Preliminary evidence suggests that TSP in youth is as important as LBP, and therefore it is a cause for concern. Epidemiological studies have been characterized as important predictors of TSP later in life. In children, it can cause marked discomfort and impairment in daily life, causing long term problems. Studies suggest that children and adolescents who report TSP have increased use of health services, absenteeism, impairment in school, restrictions on physical activity and often experience the coexistence of other health, physical or mental complaints [6].

The present study will contribute to other epidemiological investigations and collaborate for the knowledge of the national estimates about the prevalence of TSP in adolescents and its risk factors. It will also contribute to systematic reviews and meta-analysis, once the available data regarding the association among TSP and sociodemographic variables, the use of electronic devices, the practice of physical activity and mental health problems in adolescents from Brazil and other countries are scarce. This study may also aid at the understanding of its global cause and contribute to public policies aimed to control this problem, based on preventive and/or therapeutic interventions.

Considering these points, the objective of the present study was to determine the prevalence of TSP and to analyze its association with the sociodemographic characteristics, the use of electronic devices, the practice of physical activity and the presence of mental health problems.

Methods

Design and population

This is a cross-sectional study, performed with the project data "*Back pain and associated factors in students of high school: a longitudinal study*" (Financed by Fapesp, Process: 2016/182837), with of 14- to 18-year-olds of both sexes attending the first and second years of high school in the morning in the urban area of Bauru, SP, Brazil. This study was approved by the institution Research Ethics Committee.

Sample calculation

Adolescents enrolled in the first and second grades of secondary education in public schools in the city of Bauru/SP were enrolled. According to data provided by the State Department of Education, 9,000 students were enrolled in 2017 [4].

Age groups and sex were defined called sampling areas for which minimum numbers in the sample were guaranteed that would allow subsequent analyses. The sampling areas were students of both sexes in the 1st and 2nd years of secondary education [4].

To determine the sample size, the formula to calculate samples for finite populations was used with the following parameters: confidence level, 95%; prevalence, 50%, unknown percentage complement (100-p); population size, 9,000 high school students from state public schools; and maximum permissible error, 3%. Thus, the sample size for the group was at least 990 individuals, to which we added a 20% expected loss and 15% for association studies, reaching a total of 1,366 adolescents [4].

The sample size calculation considered a plan with cluster sampling in two stages, where the primary sampling units (UPA) are the schools and Secondary Sampling Units (USA) are the classes concerning the three years of secondary education of the selected schools. The sample of school children was formed by all the students of USA classes selected in the sample of UPA schools [4].

The UPA schools were initially stratified by their geographical location in accordance with the division of the city into eight sectors. Schools with classes of 1st and 2nd years of secondary education were counted to reach the required number in each sector. In three consecutive sectors between the west and east of the city (counterclockwise), there were no public state high schools; therefore, these three sectors were rejected, and only the five that concentrate the 30 schools between the east and west of the city (counterclockwise) were considered [4].

In each geographic stratum, the sample was obtained in two stages. First, schools were selected using a method of selection with probabilities proportional to the size. Size considered in the selection of the schools was the total number of students in the two years of secondary education in each school, and that the percentage of each year in relation to the total number of students (9000): 36.9% and 33.6%, respectively. These percentages were applied to the sample (1,366 students). Second, the total number of students to be interviewed per sector and per year of high school was determined. To reach the total determined for each sector, the schools were randomly selected, as were the classes of the schools [4].

Inclusion and exclusion criteria

Included in this study were students who were part of the study in 2017 and who answered the questionnaire alone, were aged 14–18 years, whose parents provided informed consent, and who did not report low back pain in 2017. Students who changed school, or who changed school in the morning to night school, were excluded from study.

Data collection procedure

The State Department of Education authorized the research. After parental/guardian consent was provided, baseline data were collected from March to June 2017 by undergraduate and graduate students trained [4].

After parental/guardian permission was received, the researchers moved from room to room applying questionnaires. For the data collection, the following procedure was performed: first, in each classroom, the researcher explained the research objectives, and the students were informed about the voluntary nature of their participation, right to leave the study at any time, and right to confidentiality of their data. Subsequently, the questionnaires were distributed with instructions and recommendations for completion, although no deadline was established. During the process, any questions expressed were promptly answered by the interviewer collecting the data. While completing the questionnaire, students did not communicate to minimize possible undesirable interference with their responses [4].

For each school, three extra visits were made that aimed to collect the data from the students who were absent from class related to previous collections. Students who were not found after three visits were considered lost. Students who refused to answer the questionnaire by personal choice were considered refusals [4].

Variable description

The TSP represented the response variable of interest in this study. The variable TSP was observed using the Nordic questionnaire, which was validated and adapted to the Brazilian culture [7]. The question used to define the outcome of TSP was: "In the past twelve months, have you had any pain or discomfort in the thoracic spine?" In the present study, TSP pain was defined as a non-specific pain experienced in the spinal cord extending from the cervicothoracic joint (C7-T1) to the thoracolumbar junction (T12-L1) and the corresponding posterior aspect of the trunk, and it can occasionally cause radiating pain into the anterior chest wall [8]. In addition to the verbal questionnaire, an image of the spinal regions in different colors was also presented, so the interviewees could better specify the low back region where the pain was [7].

Sociodemographic aspects, variables related to electronic devices, the usual practice of physical activity and mental health were considered independent. Sociodemographic factors include sex, age, marital status (single, married, and widowed/separated), ethnicity (white, black, brown, yellow and indigenous) and academic year [4].

Table 1 shows the questions asked to the participants regarding electronic devices use [4, 9] (TV, computer, tablet or mobile phone).

Table 1
Questions asked to investigate the use of electronic devices among participants and their respective possible answers.

Question	Possible answers
Television	
1. In a normal week class, do you watch TV?	a. Yes. b. No.
2. How many times a week do you watch TV?	a. Once or twice. b. Three or four times. c. Five times. d. More than five times.
3. How many hours a day do you watch TV?	a. Less than one hour. b. Two hours. c. Three hours. d. Four hours. e. Five hours. f. More than five hours a day.
Computer	
4. Do you use a computer?	a. Yes. b. No.
5. What type of computer do you use?	a. Desktop. b. Laptop.
6. What is the height of your PC screen?	a. Eyes above the midpoint of the screen. b. Eyes approximately in the middle point of the screen. c. Eyes below the mid-point of the screen.
7. How many times a week do you use the computer?	a. Once or twice. b. Three or four times. c. Five times. d. More than five times.

Question	Possible answers
8. How many hours a day do you use the computer?	a. Less than one hour. b. Two hours. c. Three hours. d. Four hours. e. Five hours. f. More than five hours a day.
9. What is the eye-to-screen distance while using your computer?	a. <20 cm. b. 20 cm to 25 cm. c. 25 cm to 30 cm. d. > 30 cm.
Mobile phone	
10. Do you use a cell phone?	a. Yes. b. No.
11. In which posture do you use the cell phone?	a. Standing b. Sitting. c. Lying. d. Semi-lying.
12. What is your average of daily time using cell phone?	a. Less than one hour. b. Two to three hours. c. Three to four hours. d. More than four hours.
13. What is the eye-to-screen distance during the use of the cell phone?	a. <10 cm. b. 10 cm to 15 cm. c. 15 cm to 20 cm. d. > 20 cm.
Tablet	
14. Do you use tablet?	a. Yes. b. No.

Question	Possible answers
15. In which posture do you use the tablet?	a. Standing b. Sitting. c. Lying. d. Semi-lying.
16. What is your average of daily time using the tablet?	a. Less than one hour. b. Two to three hours. c. Three to four hours. d. More than four hours.
17. What is the eye-to-screen distance while using the tablet?	a. <10 cm. b. 10 cm to 15 cm. c. 15 cm to 20 cm. d. > 20 cm.

To estimate the level of habitual physical activity practice, we used the Baecke Questionnaire of Habitual Physical Activity validated in Brazil [10]. Through the application of this instrument, it was possible to determine the score of each domain of physical activity. The sum of the scores of each section comprised a value of total dimensionless, that is, habitual physical activity. For the classification of habitual physical activity, we used the formula proposed by Baecke et al [10]. Students were subdivided into quartiles according to the individual total score provided by the instrument, which resulted in the following physical activity groups: sedentary (1st quartile); moderately active (2nd and 3rd quartiles); and active (4th quartile) [11].

Mental health was evaluated by the Strengths and Difficulties Questionnarie (SDQ) validated in Brazil by Fleitlich-Bilyk [12]. The possibilities of results indicated by the instrument for all five subscales and the total number of difficulties are three: "Normal" (healthy): indicates that there are no difficulties regarding what is being assessed; "Borderline": indicates that the child or adolescent already presents some difficulty which, if not properly cared for, can deteriorate and jeopardize their development; "Abnormal" (clinical): indicates that there are major difficulties relating to what is being assessed, requiring specialized intervention[12, 13].

Data Analysis

The data analysis was performed using the Statistical Package for the Social Sciences version 18.0. An independent student who did not participate in the study introduced the data. The accuracy of the data entry was tested in 10% of randomly chosen questionnaires. An error was detected and corrected. Another set of 5% of the randomly chosen quizzes was tested, and no error was found.

In the descriptive analysis, the prevalence and confidence intervals of all variables included in the study was calculated. Statistical association methods were used using bivariate and multivariate logistic regression analysis between the prevalence of TSP (dependent variable) and all independent variables studied with determination of significance level and estimated relative risk of the 95% of confidence interval.

Bivariate and logistic regression analyses were performed according to the theoretical-conceptual hierarchical model. For all variables, a reference category was established that was considered the lowest risk for the occurrence of the outcome. To construct the hierarchical model, the variables were organized into four levels according to the temporal and causal relationship for TSP. The adjustment of the first level was performed by all variables belonging to it. The second was adjusted by variables of the previous level that presented values of $p < 0.10$ after adjustment and by those belonging to it. The third was adjusted by variables of the first and second levels with values of $p < 0.10$ after adjustment besides those belonging to it. Finally, the fourth level variable was controlled for the previous three levels. To select the variables that will remain in the regression model, the backward selection process was used, leaving in the final model all variables with values of $p < 0.05$ [14, 15].

Results

A total of 1,628 students were studied, already deducted from the final percentage of 2.05% refusals. The socio-demographic characteristics of the sample can be seen in Table 2.

Table 2
Distribution of absolute and relative frequencies of the sociodemographic characteristics, level of physical activity and mental health problems in high school adolescents of the city of Bauru (São Paulo, Brazil).

Factors	Sex			
	Male (n = 798)		Female (n = 830)	
	n	%	N	%
Academic Year				
First year	411	51.5	446	53.7
Second year	387	48.5	384	46.3
Age				
Until 14 years	104	13.0	145	17.5
15 years to 18 years	694	87.0	685	82.5
Race				
White	378	47.4	431	51.9
Black	88	11.0	55	6.6
Brown /Mulatto	305	38.2	312	37.2
Yellow	27	3.4	32	3.9
Marital Status				
Married	33	4.1	23	2.8
Single	765	85.9	807	97.2
Level of physical activity				
Insufficiently active	131	16.4	296	35.7
Sufficiently active	371	46.5	421	50.7
Very active	296	37.1	113	13.6
Mental health				
Normal	548	68.7	351	42.3
Borderline	142	17.8	222	26.7
Clinical	90	11.3	249	30.0

The variables related to the use of electronic devices in high school adolescents are presented in Table 3.

Table 3
Distribution of absolute and relative frequencies of electronic devices in high school adolescents by sex.

Factors	Sex			
	Male (n = 798)		Female (n = 830)	
	n	%	n	%
Watch TV				
No	123	15.4	67	8.1
Yes	675	84.6	763	91.9
How many times TV/week				
Up to 2 times	168	24.7	205	21.1
3 times or more	507	67.2	558	63.5
Number of hours of TV/day				
Up to 2 h	383	48.0	376	45.3
Above 3 h	292	36.6	387	46.6
Use the computer				
No	105	13.2	215	25.9
Yes	693	86.8	615	74.1
Type of computer				
Desktop	344	43.1	224	27.0
Laptop	263	33.0	339	40.8
Desktop and Laptop	86	10.8	52	6.3
Height of the computer screen				
Above the midpoint	153	19.2	114	13.7
At the midpoint	473	59.3	435	52.4
Below the midpoint	67	8.4	66	8.0
How many times /week				
Up to 2 times	184	23.1	295	35.5
3 times or more	509	63.8	320	38.6
How many hours /day				

Factors	Sex			
	Male (n = 798)		Female (n = 830)	
	n	%	n	%
Up to 2 h	250	31.3	341	41.1
3 h or more	443	55.5	274	33.0
Use cell phone				
No	33	4.1	9	1.1
Yes	765	95.9	821	98.9
What posture use the cell phone				
Standing	276	34.6	282	34.0
Sitting	403	50.5	441	53.1
Lying down	436	54.6	491	59.2
Semi-lying	215	26.9	344	41.4
Daily use time				
Up to 2 h	220	27.6	125	15.1
3 h or more	545	68.3	696	83.9
Use tablet				
No	656	82.2	649	78.2
Yes	142	17.8	181	21.8
What posture use the tablet				
Standing	25	3.0	47	5.6
Sitting	83	10.4	102	12.3
Lying down	68	8.5	82	9.9
Semi-lying	26	3.3	56	6.7
Daily use time				
Up to 2 h	94	11.8	149	18.0
3 h or more	48	6.0	32	3.9

Table 4 shows that there was a significant association among TSP and female sex and the presence of mental health problems.

Table 4
Bivariate analysis of the prevalence of thoracic spine pain with socio-demographic characteristics, level of physical activity and mental health in high school adolescents.

Factor	Thoracic spine pain		
	n	%	PR (95%CI)
Sex			
Female	495	59,6	1,00
Male	344	43,1	1,38 (1,26–1,52)
Age			
Until 14 years	121	14,4	1,00
15 years to 18 years	718	85,6	1,07 (0,93–1,23)
Marital Status			
Married	32	3,8	1,00
Single	761	96,2	0,90 (0,72–1,14)
Ethnicity			
White	433	51,6	1,00
Black	60	7,2	0,78 (0,64–0,96)
Brown	323	38,5	0,95 (0,86–1,05)
Yellow	23	2,7	1,13 (0,87–1,47)
Level of physical activity			
Very active	35	24,5	1,00
Sufficiently active	73	51,0	1,15 (0,80–1,66)
Insufficiently active	35	24,5	1,04 (0,68–1,59)
Mental health			
Normal	70	49,0	1,00
Borderline	36	25,2	1,43 (0,99–2,05)
Clinical	37	25,9	2,21 (1,57–3,11)
PR = Prevalence ratio/ CI = Confidence interval			

It was observed that 51.5% (CI 49.1 to 53.9) of the participants reported TSP at least some time in the 12 months preceding the interview. From the participants who reported pain, 59.6% (CI 56.2 to 62.9) were

women and 43.1% (CI 39.7 to 46.5) were men, with significant difference.

TSP was associated to type of PC, daily time of cell phone use of more than 3 hours and to the use of tablet presented in Table 5.

Table 5
Bivariate analysis of the prevalence of thoracic spine pain with electronic devices in high school adolescents.

Factor	Thoracic spine pain		
	n	%	PR (95%CI)
Watch TV			
No	96	11,4	1,00
Yes	743	88,6	1,02 (0,88–1,19)
Times of TV/week			
Up to 2 times	189	22,5	1,00
3 times or more	554	66,0	1,03 (0,91–1,15)
Hours of TV/day			
Up to 2 h	376	44,8	1,00
3 h or more	367	43,7	1,09 (0,99–1,21)
Use of PC			
No	156	18,6	1,00
Yes	683	81,4	1,07 (0,95–1,21)
Type of PC			
Desktop	307	36,6	1,00
Laptop	330	39,3	0,98 (0,88–1,10)
Desktop and Laptop	46	5,5	1,23 (1,02–1,49)
Height of the PC screen			
Above the midpoint	156	18,6	1,00
At the midpoint	455	54,2	1,12 (0,98–1,27)
Below the midpoint	72	8,6	1,13 (0,93–1,37)
Distance from eye to the PC screen			
Up to 30 cm	499	59,5	1,00
30 cm or more	184	21,9	0,87 (0,77–0,98)
Times of PC/week			

PR = Prevalence ratio/ CI = Confidence interval

Factor	Thoracic spine pain		
	n	%	PR (95%CI)
Up to 2 times	265	31,6	1,00
3 times or more	418	49,8	0,91 (0,82–1,02)
Hours of PC/day			
Up to 2 h	302	36,0	1,00
3 h or more	381	45,4	1,04 (0,94–1,16)
Use of cell phone			
No	17	2,0	1,00
Yes	822	98,0	1,28 (0,88–1,89)
Posture in cell phone			
Standing	309	36,8	1,09 (0,99–1,21)
Sitting	434	51,7	0,98 (0,89–1,08)
Lying of prone	497	59,2	1,09 (0,99–1,20)
Semi-lying	322	38,4	0,87 (0,78–0,98)
Hours of cell phone/day			
Up to 2 h	151	18,0	1,00
3 h or more	671	80,0	1,24 (1,08–1,41)
Distance from eye to the cell screen			
Up to 20 cm	743	88,6	1,00
20 cm or more	79	9,4	0,89 (0,75–1,05)
Use of tablet			
No	654	77,9	1,00
Yes	185	22,1	1,14 (1,03–1,27)
Posture in tablet			
Standing	47	5,6	1,19 (0,97–1,45)
Sitting	111	13,2	1,12 (0,92–1,36)
Lying of prone	89	10,6	1,07 (0,89–1,29)

PR = Prevalence ratio/ CI = Confidence interval

Factor	Thoracic spine pain		
	n	%	PR (95%CI)
Semi-lying	50	6,0	1,09 (0,89–1,34)
Hours of tablet/day			
Up to 2 h	139	16,6	1,00
3 h or more	46	5,5	1,01 (0,81–1,25)
Distance from eye to the tablet screen			
Up to 20 cm	150	17,9	1,00
20 cm or more	35	4,2	1,07 (0,84–1,35)
PR = Prevalence ratio/ CI = Confidence interval			

In multiple factor analysis, after adjustment by logistic regression according to the hierarchical model, at the first level, female sex remained associated with pain and was maintained as an adjustment variable for the next level. At the second level, clinical mental health problem acted as a predictor of pain and remained as an adjustment variable for the next level along with sex. At the third level, use of computer for more than 3 hours per day, use of computer for more than 3 times per week, use of cell phone in semi-lying position, time of use of cell phone for more than 3 hours per day, use of tablet in sitting position remained associated with pain remained as an adjustment variable for the next level, together with the previous ones. On the fourth level, only the activity level physics acted as a pain predictor after adjustments to the same level and previous variables (Table 6).

Table 6
Multivariate logistic regression, for associations of variables with thoracic spine pain in high school adolescents.

Factors	Thoracic spine pain	
	Value of p	PR adjusted (95% CI)
Sex		
Male	0.001	1.00
Female		1.96 (1.61–2.38)
Mental health problems		
Normal	0.001	1.00
Borderline		1.87 (1.46–2.39)
Clinical		2.10 (1.63–2.70)
Number of hours of computer/day		
Up to 2 h	0.04	1.00
Above 3 h		1.29 (1.01–1.66)
How many times of computer /week		
Up to 2 times	0.04	1.00
3 times or more		1.35 (1.03–1.75)
Use of the cell phone in semi-lying down posture		
No	0.003	1.00
Yes		1.37 (1.11–1.69)
Daily use time cell phone		
Up to 2 h	0.004	
3 h or more		1.44 (1.12–1.85)
Use of tablet phone in sitting posture		
No	0.01	1.00
Yes		1.47 (1.07–2.01)
Level of physical activity		
Active	0.01	1.00

PR = Prevalence ratio/ CI = Confidence interval

Factors	Thoracic spine pain	
	Value of p	PR adjusted (95% CI)
Insufficiently active		0.84 (0.73–0.96)
PR = Prevalence ratio/ CI = Confidence interval		

Discussion

In the present study, the prevalence of TSP was 51.5%, higher than that reported in other countries, such as Australia (20.0%) [1], Portugal (13.2%) [3]; in the region of Southern Denmark (36%) [16]. It was also higher than previously Brazilian studies carried out in a South State of Brazil, that showed a prevalence of 26.2% in the city of Rio Grande [17], 36,9% in the city of Pelotas [14]. On the other hand, the prevalence was similar to that reported in Canada [18] of 59.0%. These prevalence variations may be a result of sociocultural, demographic, economic and occupational differences of the investigated regions.

Then, considering these high and still underestimated prevalence of TSP in adolescents, it is important to recognize its risk factors. In the present study, it was observed that TSP was associated with female sex, computer use for more than 3 hours a day, computer use for more than 3 times a week, short distance from eye to computer screen, use of the cell phone in semi-lying position, cell phone use for more than 3 hours a day, use of tablet in sitting position and presence of mental health problems.

Women was approximately 1.96 times more likely to develop pain in comparison to men, a result similar to other studies with adolescents [1, 2, 3, 6, 19]. Female sex presents structural and psychosocial differences in relation to males, such as musculoskeletal differences, which make women predisposed to overload in the vertebral column. Additionally, among adolescents women, the long periods sitting in school, the hormonal changes resulting from puberty and the low levels of physical activity predisposes them to report pain with greater frequency [20].

The use of computer and cell phone for more than 3 hours a day and more than 3 times a week was associated with TSP, corroborating with other investigations [3, 19]. In fact, a great number of studies suggest the association between spinal pain and electronic devices use, specially cell phone and computer [3, 4, 19, 21]. The semi-lying and sitting postures to use the cell phone and tablet, respectively, were factors associated with TSP in the present study, corroborating with the results from Briggs et al. [1].

Long periods in inadequate postures using a portable device, usually cause the flexion of the cervical and thoracic spine, exerting great pressure on muscles, tendons and ligaments that support the head and maintain good posture. Then, these stressed soft tissues cannot adequately support the spine, which suffers structural deterioration, affecting musculoskeletal structures. When the weight of the head and upper body is moved forward and out of its central axis, the stress in all soft tissues and the spine are exponentially increased. In addition, the flexion and internalization of the cervical increases the stress in

the thoracic and low back regions, since all the dorsal muscles and structures of the spine work together to provide stability and movement to the trunk and limbs [22].

Additionally, inadequate postures during activities of daily living are worthy of concern, as these postures can increase the compression strength in the intervertebral discs, leading to disc malnutrition, compromising the integrity of the musculoskeletal system, predisposing to fatigue and higher levels of pain [23]. Frequent or sustained neck flexion and shoulder protrusion resulting in scapular dysfunction during upper limb movement, activities with the use of electronic equipment, may result in increased thoracic kyphosis and, consequently, this associated with a higher risk of thoracic spine pain [24].

The clinical category related to mental health problems was associated with TSP in adolescents, corroborating with previous studies [25, 26]. The emergence of emotional symptoms is common among students, which can be triggered by the moment experienced, pressure in the school environment, economic difficulties and relationship problems.

There seems to be a relationship between emotional symptoms and physical manifestations, such as increased secretion of the hormone cortisol and changes in the hormonal regulation of the adrenal glands, which generates inhibitory effects on the immune response, digestion and symptoms of excessive body wear, tiredness, fatigue, muscle pain, joint disorders and reduced physical capacity. Psychosomatic symptoms are common among children and adolescents and can manifest in different ways, for example, headache, abdominal pain and musculoskeletal problems, including pain in the spine.

On the other hand, the pain itself can also lead to some degree of social or emotional impact, resulting in low scores on stress and well-being parameters [26, 27]. Further studies are needed to determine the emotional relationship with TSP since the design of the present study does not allow us to determine what would be the cause of this association, but rather contributes to new questions.

In present study physical activity was associated with lower TSP. Some studies have shown that physically active adolescents were less likely to have back pain [28, 29], other authors have identified that physical activity can contribute to pain [30, 31], while other investigations have not noted an association between the variables [32].

The mechanisms of association between physical activity and spinal pain are not clear. One of the hypotheses about the association between physical activity and lower spinal pain prevalence is that it can lead to increased muscle strength and flexibility [31, 32].

The results of this study should be interpreted in their own context of limitations, i.e., the data were based entirely on interviews, so that an inaccurate estimate of the data and memory bias is inevitable, no data were collected regarding the use of other technologies, and another limitation is that students come from public schools, which limits the generalization of data to those from private schools. The strength of this study is that it is the first Brazilian study to examine the role of factors in the onset of TSP in young people, the use of validated questionnaires to evaluate the results and the number of people interviewed.

Considering that the available data from both national and international literature are scarce, this study will contribute as a reference to other epidemiological investigations and shall cooperate with the national evaluation of prevalence and risk factors, systematic reviews and meta-analyzes.

Conclusion

The TSP had high prevalence and marked association with female sex, use of computer for more than 3 hours a day and 3 times a week, use of the cell phone for more than 3 hours a day, use of cell phone in semi-lying position, use of tablet in sitting position, presence of mental health problems and the level of physical activity was a protective factor.

Declarations

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Conflicts of interest: The authors declare no conflict of interest.

Ethics approval: The study was approved by the Research Ethics Committee of the Sacred Heart University (nº: 1.972.579).

Consent to participate: The State Department of Education authorized the research. Informed consent was obtained from all participants parents orlegal guardians.

Consent for publication: Not applicable.

Availability of data and material: The data that support the findings of this study are available from the corresponding author, AV, upon reasonable request.

Code availability: Not applicable.

Authors' contributions: AV participated in the design and coordination of the study, analysis and interpretation of data and preparation of the manuscript. LDC participated in the analysis and interpretation of data and the preparation of the manuscript. TPFB conducted data collection, analysis and interpretation of data and preparation of the manuscript. LAF participated in analysis and interpretation of data and preparation of the manuscript. WLR participated in the analysis and interpretation of data and preparation of the manuscript. JAAF participated in the analysis and interpretation of data and preparation of the manuscript. NMM participated in the analysis and interpretation of data and preparation of the manuscript. PDOP participated in the analysis and interpretation of data and preparation of the manuscript. All authors read and approved the final manuscript.

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