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Factors associated with intensity and frequency of low back pain in high school students

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ABSTRACT

Introduction: Low back pain is frequent among schoolchildren and the variables related to high intensity and high back frequency are important predictors for the increase of such complaints in adulthood. **Objective:** To determine the high intensity and high frequency of low back pain and its associated factors in high school students. **Methods:** This cross-sectional study included 760 students (319 boys and 441 girls) who reported low back pain. Demographic, socioeconomic, electronic devices, habitual physical activity practice, mental health, and high frequency and high intensity low back pain data were collected. Descriptive analyzes and bivariate and multivariate logistic regressions were used. **Results:** Of the total number of subjects with low back pain, 14.6% reported high frequency of pain, being 36.9% boys and 63.1% girls, while 42.6% reported high intensity, being 35.8% boys and 47.2% girls. The variables associated with the high frequency of low back pain were altered mental health, posture lying on the use of tablet, time of daily use of the cell phone and distance of the screen to the eyes of the computer user, while the female sex, mental health problem, posture lying on the use of cell phone and the distance of the screen to the eyes of the computer user with severe intensity of low back pain. **Conclusion:** The demographic factors and related to the use of electronic devices were associated with high intensity and high frequency of low back pain.

Keywords: low back pain; adolescent; risk factors; pain; pain threshold.

INTRODUCTION

Low back pain (LBP) is a public health problem, with a high prevalence in school-age children and adolescents. Its presence at this stage of school development increases the risk of such complaints in adulthood. Indeed, studies have shown that LPB can lead to disabilities and limitations in the daily lives of 9.7% to 40% of adolescents[1].

The prevalence of LBP has been investigated in several countries, including China[2], USA[3], and United Arab Emirates[4]. Recently, in Brazil, some localities have reported the prevalence of LBP, as follows: 13.7% in Pelotas[5], 46.6%, in Garibaldi[6], 27.7% in São Leopoldo[7], and 13.4% in Porto Alegre[8], state of Rio Grande do Sul; 42.1% in Petrolina[9] and 46.9% in Recife[10], state of Pernambuco; and 32.9% in the state of Piauí[11].

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Several studies have associated the prevalence of LBP among adolescents with numerous influences, such as demographic, lifestyle, ergonomic, and psychosocial risk factors[2-5,7]. However, some studies show that the factors associated with the presence of pain differ from those related to the frequency and intensity of pain, such as time spent on screen-based activities (using the mobile phone, using computer and playing), lack of physical activity, disability and mental health problems[12,13].

These data reinforce the discrepancy between predictors of the presence of pain and its frequency and intensity. Therefore, new studies for the knowledge of modifiable predictors of back pain in Brazilian adolescents are needed since there is an undeniably negligent epidemic in Brazil today. It is urgent to address the problem through preventive interventions on the risk factors of low back pain and strategies to avoid it and should be directed to teachers, parents and students. These measures should promote health care and high-quality epidemiological research, always focused on the Brazilian reality which, differently from developed countries, presents limitations in the availability of health-related resources, great cultural, socioeconomic and political diversity[14].

Another point to be considered is that, according to our knowledge, there are a few Brazilian studies on the intensity and frequency of LBP with demographic and socioeconomic variables and, mainly, with the use of electronic devices and mental health in high school students. Thus, this will serve as a reference for other epidemiological investigations, for systematic reviews and meta-analyses.

Thus, the objective of the study was to determine high intensity and frequency of low back pain and its associated factors in high school students.

METHODS

Study design and population

This was 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), collected in 2017, with 14- to 18-year-olds of both sexes attending to the first and second years of High School, in the morning, in the urban area of Bauru, São Paulo, Brazil. This study was approved by the Research Ethics Committee of Universidade do Sagrado Coração (no. 1.972.579).

Sample calculation

Adolescents enrolled in the first and second grades of High School in public schools in the city of Bauru, São Paulo, Brazil, were enrolled[15]. According to data provided by the State Department of Education, 9,000 students were enrolled in 2017[15].

Age groups and sex were defined as sampling areas, for which minimum numbers that would allow subsequent analyses were guaranteed.

To determine 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, it was determined that the minimum sample size would comprise at least 990 individuals, to which we added a 20% expected loss and 15% for association studies, reaching a total of 1,366 adolescents[15].

The sample size calculation considered a plan with cluster sampling in two stages, where the primary sampling units (PSU) were the schools, and the secondary sampling units (SSU) were the classes of the three years of secondary education in the selected schools. The sample of school children was formed by all the students of SSU classes selected in the sample of PSU schools[15].

The PSU schools were initially stratified by their geographical location. in accordance with the division of the city into eight sectors. Schools with classes of first and second years of secondary education were counted to reach the required number in each sector. In three consecutive sectors, between 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 concentrated the 30 schools, between the east and west of the city (counterclockwise), were considered[15].

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. The 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 the percentage of each year in relation to the total number of students (9,000), i.e., 36.9% and 33.6%, respectively. These percentages were applied to the sample (1,366 students). 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[15].

Inclusion and exclusion criteria

This study included students who were part of the research in 2017, who answered the questionnaire alone, were 14-18 years old and whose parents had given their informed consent. Students who reported pain in the interviews conducted in 2017 but were under 14 years of age or over 18 years of age, did not submit an informed consent form signed by the parents/guardians, and refused to participate, were excluded.

Study participants

Considering the inclusion and exclusion criteria described above, the participants in this study were 760 school children,

who had participated in the study in 2017, and had reported back pain.

Data collection procedure

The State Department of Education authorized the research. After consent obtained from the parents/guardians, data collection took place in the months of March to June 2017, conducted by undergraduates and post-graduates, who had been trained based on a protocol of standardization procedures (theoretical and practical), previously established with the intention of minimizing possible intra- and inter-rater errors[15].

After parental/guardian permission was received, the researchers distributed the questionnaires, moving from room to room. For 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, the right to leave the study at any time, and the right to confidentiality regarding 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 were asked to not communicate, to minimize possible undesirable interference with their responses[15].

After the interviews, the questionnaires were coded by the researchers and interviewers and reviewed by the responsible researcher. The supervisors also performed the quality control, which consisted in the administration of questionnaires reduced to 10% of the interviewees.

In order to measure reproducibility, a pilot study was conducted with 42 high school students who did not participate in the study. A retest was used with a 7-day interval protocol, and good values were obtained for all questions in the questionnaire (κ range: 0.66-0.88).

For each school, three extra visits were made with the aim to collect data from students who were absent from class when data was collected. Students who did not participated after three visits were considered lost. Students who refused to answer the questionnaire by personal choice were considered refusals. Participants who had left school or had changed town or school were contacted by phone on three different occasions. Students who were contactable after the three contact attempts were lost.

Variable description

Sociodemographic aspects, variables related to the usage of electronic devices, the usual practice of physical activity, and mental health status were considered independent. Sociodemographic factors included sex, age, marital status (single, married, and widowed/separated), race (white, black, mixed/mulatto, asian, and indigenous), and academic year[15].

The questions asked to participants regarding the use of electronic devices (TV, computer, tablet, or mobile phone) were the following: 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); 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 computer 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); 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); 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); 14. Do you use tablet? (a. Yes. b. No.); 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)?"[2,15]. The questions regarding the use of electronic equipment (type of posture adopted when using the computer, cell phone, and tablet; distance from the computer, cell phone, and tablet) were illustrated with photographs, to facilitate understanding by the participants. In the questions "What posture do you use your cell phone or tablet?", participants could choose more than one option. For the analysis each posture was transformed into a variable and afterwards they were categorized into individuals who used the equipment in this posture (yes) and those who did not (no).

To estimate the level of habitual physical activity practice, we used the Baecke et al.[16] questionnaire, validated in Brazil (Baecke Questionnaire of Habitual Physical Activity). Through the application of this instrument, it was possible to determine the score of each domain of physical activity, and the sum of the scores of each section comprises 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.[16]. 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)[16].

The Strengths and Difficulties Questionnaire (SDQ), validated in Brazil by Fleitlich-Bilyk[17], was used to assess adolescents' mental health. The results indicated by the instrument for all five subscales and the total number of difficulties are organized into three categories: "Normal" (healthy): there are no difficulties with what is being assessed; "Borderline": the child or adolescent already presents some difficulties which, if not properly cared for, can deteriorate and jeopardize their development; and "Altered" (unhealthy): there are major difficulties with what is being assessed that require specialized intervention[17].

Low back pain patterns (high frequency of LBP, and high intensity of LBP) represented the response variables of interest in this study.

Low back pain, characterized by pain or discomfort in the lower back, below the costal margin and above the gluteal fold that may or may not radiate to thighs[18], was assessed by the Nordic questionnaire[19]. At the time of the interview, an image of the spinal regions in different colors was also presented, so the interviewees could more accurately specify the low back region where the pain was[12]. The participants were asked not to report pain due to febrile illness, trauma, previous illness, or menstruation.

The pain frequency was obtained by the following question: "How often does your LBP occur?" The students could choose between "on a few days" (up to two days); "on most days" (two to four days); and "every day"[20]. For pain intensity, the Numerical Visual Pain scale was used, which ranges from 0 (total absence of pain) to 10 (the most severe pain). For the purpose of analyses, the pain intensity was categorized into mild (0 to 3.4), moderate (>3.4 to 7.3), and severe (>7.4 to 10)[21].

Students who reported LBP were distributed into two groups according to the intensity of the pain, i.e., LBP-IL (mild and moderate intensity) and LBP-IH (severe intensity). In addition, they were stratified into two groups according to the LBP frequency, i.e., LBP-FL (low frequency: few days [up to two days] to most days [two–four days], and LBP-FH (high frequency: every day).

Data analysis

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, entered the data. The accuracy of the data entry was tested in 10% of randomly chosen questionnaires. An error was detected and corrected. After that, another set of 5% of randomly chosen questionnaires was tested, and no error was found.

Distributions of absolute and relative frequencies for categorical variables, and the calculation of prevalence ratios (PR) with 95% confidence intervals (CI) were calculated. In the bivariate analysis, the Wald chi-square test was performed to evaluate the association of each outcome (LBP-FH and LBP-FH) with the independent variables.

The multivariate analysis was performed using Poisson regression, with robust variance, respecting a hierarchical model of relations between variables[22,23]. Considering the factors associated with LBP-FH and LBP-FH pain described in the literature, the present study proposed the organization of these determinants into four levels: Level 1 - gender, age, skin color, socioeconomic and marital status; Level 2 - health variable (mental health); Level 3 - variables related to the use of electronic devices; Level 4 - habitual practice of insufficiently active physical activity.

The effects of the first level variables were controlled among themselves; those of the second level were controlled among themselves and for those of the first level; those of the third level were controlled among themselves and for those of the two previous levels. Finally, the fourth level variable was controlled for the previous three levels. All the variables that presented, in the bivariate analysis, a p value of 0.10 entered the hierarchical model of analysis. The variables that, in the multivariate analysis, also presented a p value of 0.2 remained in the model whenever they met the criteria for probable confounding factors. All variables with values of $p<0.05$ will remain in the regression model.

RESULTS

After deducting the percentage correspondent to refusals (2.05%), 1,628 students remained. Of these, 760 were analyzed, as they were the ones who had reported back pain in 2017. This represents a prevalence of LBP of 46.7% (95% CI 44.27-49.11), of which 42.0% (95% CI 36.63–43.41) is in boys, and 58.0% (95% CI 49.73 to 56.51) in girls.

Of the total number of subjects with low back pain, 14.6% reported high frequency of pain, being 36.9% boys and 63.1% girls, while 42.6% reported high intensity, being 35.8% boys and 47.2% girls.

Regarding the sociodemographic characteristics of the sample, 51.5% of the boys and 53.7% of the girls are in the first year of high school, 87.0% of the boys and 82.5% of the girls are in the age group of 15 to 18; 47.4% of boys and 51.9% of girls are white and 85.9% of boys and 97.2% of girls are single. Regarding the level of physical activity, most boys (46.5%) and girls (50.7%) were classified as sufficiently active and 16.4% were boys and 35.7% were girls as insufficiently active. Regarding mental health, 68.7% of boys and 42.3% of girls were normal, while 11.3% of boys and 30.0% of girls were affected.

The variables related to the use of electronic devices in high school adolescents are presented in Table 1.

In Table 2 it is noted that the female sex was associated with high intensity of lumbar pain and that mental health problems were associated with high frequency and high intensity of lumbar pain.

Table 1: Distribution of absolute and relative frequencies concerning the use of electronic devices in high school adolescents.

Factors		Sex			
		Male (n=319)		Female (n=441)	
		n	%	n	%
Watches TV	No	45	14.1	34	7.7
	Yes	274	85.9	407	92.3
Times of TV/ week	Up to 2 times	73	26.6	101	24.8
	3 times or more	201	73.4	306	75.2
Hours of TV/ day	Up to 2h	158	57.7	187	45.9
	Above 3h	116	42.3	220	54.1
Use of computer	No	35	11.0	113	25.6
	Yes	284	89.0	328	74.4
Type of computer	Desktop	130	45.8	113	34.4
	Laptop	119	41.9	185	56.4
	Desktop and Laptop	35	12.3	30	9.2
Height of the computer screen	Above the midpoint	70	24.7	68	20.7
	At the midpoint	185	65.1	231	70.5
	Below the midpoint	29	10.2	29	8.8
Distance from eye to the computer screen	Up to 30 cm	173	60.9	248	75.6
	30 cm or more	111	39.1	80	24.4
Computer use/ week	Up to 2 times	80	28.1	153	46.7
	3 times or more	204	71.9	175	53.3
Hours of computer/day	Up to 2h	102	35.9	172	52.4
	3h or more	182	64.1	156	47.6
Use of cell phone	No	16	5.0	6	1.4
	Yes	303	95.0	435	98.6
Posture in cell phone	Standing	117	36.7	168	38.1
	Sitting	172	53.9	239	54.2
	Lying of prone	181	56.7	277	62.8
	Semi-lying	99	31.0	202	45.8
Hours of Cell phone/day	Up to 2h	75	24.7	61	13.8
	3h or more	228	75.3	374	84.8
Distance from eye to the cell screen	Up to 20 cm	256	84.5	408	92.5
	20 cm or more	47	15.5	27	6.1
Use of Tablet	No	245	76.8	331	75.1
	Yes	74	23.2	110	24.9
Posture in tablet	Standing	13	17.5	32	7.3
	Sitting	47	14.7	61	13.8
	Lying of prone	34	10.7	51	11.6
	Semi-lying	19	6.0	34	7.7
Hours of Tablet/day	Up to 2h	50	67.5	86	78.2
	3h or more	24	32.5	24	21.8
Distance from eye to the tablet screen	Up to 20 cm	57	77.0	92	83.6
	20 cm or more	17	23.0	18	16.4

In Table 3 it can be observed that the high frequency of low back pain (LBP-FH) was significantly associated with the variables distance of the screen to the eyes of the computer and posture lying on the use of tablet, while the high intensity of low back pain (LBP-IH) was significantly associated with the variables type of computer and posture lying on the use of cell phone (Table 4).

Table 2: Bivariate analysis between high frequency of low back pain (LBP-FH) and high-intensity low back pain (LBP-IH) with the sociodemographic characteristics in high school adolescents.

Independent variable	n (%)	Prevalence of high-frequency Low Back Pain (%)	Prevalence ratio (95% CI)	p
Gender (n=760)				
Female	441 (58.0)	70 (15.9)	1.00	0.14
Male	319 (42.0)	41 (12.9)	1.23 (0.86–1.77)	
Age Range (n=760)				
14 years	108 (14.2)	15 (13.9)	1.00	0.84
15 to 18 years	652 (85.8)	96 (14.7)	0.94 (0.57–1.56)	
Marital Status (n=760)				
Married	30 (3.9)	6 (20.0)	1.00	0.46
Single	730 (96.1)	105 (14.3)	1.39 (0.67–2.91)	
Race (n=760)				
White	395 (52.0)	60 (15.2)	1.00	0.58
Black	54 (7.1)	6 (11.1)	0.73 (0.33–1.61)	
Brown/ mulatto	262 (34.5)	35 (13.4)	0.87 (0.60–1.29)	
Asian	30 (3.9)	7 (23.3)	1.54 (0.77–3.06)	
Indigenous	19 (2.5)	3 (15.8)	1.04 (0.36–3.01)	
Physical activity (n=760)				
Active	194 (25.5)	22 (11.3)	1.00	0.29
Moderately active	370 (48.7)	60 (16.2)	1.43 (0.91–2.26)	
Sedentary	196 (25.8)	29 (14.8)	1.30 (0.78–2.19)	
Mental health (n=760)				
Normal	357 (47.0)	39 (10.9)	1.00	0.02
Borderline	188 (24.7)	33 (17.6	1.61 (1.05–2.47)	
Altered	215 (28.3)	39 (18.1)	1.66 (1.10–2.50)	
Independent variable	**n (%)**	**Prevalence of high-intensity Low Back Pain (%)**	**Prevalence ratio (95% CI)**	**p**
Gender (n=760)				
Female	441 (58.0)	208 (47.2)	1.00	0.003
Male	319 (42.0)	116 (36.4)	1.30 (1.09–1.55)	
Age Range (n=760)				
14 years	652 (85.8)	284 (43.6)	1.00	0.12
15 to 18 years	108 (14.2)	40 (37.0)	0.85 (0.65–1.10)	
Marital Status (n=760)				
Married	87 (11.4)	33 (37.9)	1.00	0.44
Single	673 (88.5)	291 (43.2)	0.88 (0.66–1.16)	
Race (n=760)				
White	395 (52.0)	170 (43.0)	1.00	0.46
Black	54 (7.1)	23 (42.6)	0.99 (0.71–1.38)	
Brown/ mulatto	262 (34.5)	108 (41.2)	0.96 (0.80–1.15)	
Asian	30 (3.9)	17 (56.7)	1.32 (0.94–1.84)	
Indigenous	19 (2.5)	6 (31.6)	0.73 (0.37–1.44)	
Physical activity (n=760)				
Active	194 (25.5)	86 (44.3)	1.00	0.42
Moderately active	370 (48.7)	149 (40.3)	0.91 (0.74–1.11)	
Sedentary	196 (25.8)	89 (45.4)	1.02 (0.82–1.28)	
Mental health (n=760)				
Normal	357 (47.0)	125 (35.0)	1.00	0.001
Borderline	188 (24.7)	92 (48.9)	1.40 (1.15–1.71)	
Altered	215 (28.3)	107 (49.8)	1.42 (1.17–1.73)	

Table 3: Bivariate analysis between high frequency of low back pain (LBP-FH) with the use of electronic devices in high school adolescents.

Independent variable	n (%)	Prevalence of high-frequency Low Back Pain (%)	Prevalence ratio (95% CI)	p
Watch TV (n=760)				
No	79 (10.4)	12 (15.2)	1.00	0.87
Yes	681 (89.6)	99 (14.5)	0.96 (0.55–1.66)	
Times TV/week (n=681)				
Up to 2 times	174 (25.5)	15 (8.6)	1.00	0.49
3 times or more	507 (74.5)	96 (18.9)	0.79 (0.53–1.17)	
Hours TV/day (n=681)				
Up to 2h	345 (50.6)	58 (16.8)	1.00	0.23
3h or more	336 (49.4)	41 (12.2)	0.73 (0.50–1.05)	
Use of computer (n=760)				
No	612 (80.5)	83 (13.6)	1.00	0.09
Yes	148 (19.5)	28 (18.9)	0.73 (0.33–1.61)	
Type of computer (n=612)				
Desktop	255 (41.6)	36 (23.3)	1.00	0.76
Laptop	357 (58.2)	47 (15.8)	0.94 (0.62–1.40)	
Height of the computer screen (n=612)				
Eyes aligned with the top of the screen level	194 (25.5)	22 (11.3)	1.00	0.29
Eyes below the top of the screen level	370 (48.7)	60 (16.2)	1.43 (0.91–2.26)	
Distance from eye to the computer screen (n=612)				
Up to 30 cm	181 (23.8)	19 (10.5)	1.00	0.006
30 cm or more	431 (56.7)	64 (14.8)	1.38 (1.09–1.74)	
Computer use/week (n=612)				
Up to 2 times	234 (30.8)	103 (44.0)	1.00	0.19
3 times or more	378 (49.7)	150 (39.7)	0.90 (0.75–1.09)	
Computer hours/day (n=612)				
Up to 2h	275 (44.3)	112 (40.7)	1.00	0.32
3h or more	337 (44.3)	141 (41.8)	1.03 (0.85–1.24)	
Use of cell phone (n=760)				
No	22 (2.9)	9 (40.9)	1.00	0.86
Yes	738 (97.1)	315 (42.7)	1.04 (0.63–1.74)	
Posture in cell phone (n=738)				
Standing	450 (59.2)	177 (39.3)	0.82 (0.70–0.97)	0.70
Sitting	327 (43.0)	137 (41.9)	0.97 (0.82–1.15)	0.91
Lying of prone	280 (36.8)	110 (39.3)	0.88 (0.73–1.05)	0.33
Semi-lying	437 (57.5)	184 (42.1)	0.97 (0.82–1.15)	0.91
Hours of cell phone/day (n=738)				
Up to 2h	136 (17.9)	13 (9.6)	1.00	0.17
3h or more	602 (79.2)	95 (15,8)	0.61 (0.35–1.05)	
Distance from eye to the cell screen (n=738)				
Up to 20 cm	665 (87.5)	101 (15.2)	1.00	0.43
20 cm or more	73 (9.6)	7 (9.6)	1.58 (0.77–3.28)	
Use of tablet (n=760)				
No	576 (75.8)	84 (14.6)	1.00	0.97
Yes	184 (24.2)	27 (14.7)	0.99 (0.67–1.48)	
Posture in tablet (184)				
Standing	139 (18.3)	24 (17.3)	0.39 (0.12–1.22)	0.21
Sitting	77 (10.1)	15 (19.5)	0.58 (0.29–1.16)	0.29
Lying of prone	99 (13.0)	9 (9.1)	2.33 (1.10–4.91	0.03
Semi-lying	132 (17.4)	22 (16.7)	0.58 (0.23–1.44)	0.47
Hours of tablet/day				
Up to 2h	136 (17.9)	22 (16.2)	1.00	0.62
3h or more	48 (6.3)	5 (10.4)	1.55 (0.62–3.87)	
Distance from eye to the tablet screen				
Up to 20 cm	149 (19.6)	24 (16.1)	1.00	0.52
20 cm or more	35 (4.6)	3 (8.6)	1.88 (0.60–5.89)	

Table 4: Bivariate analysis between high intensity of low back pain (LBP-IH) with use of electronic devices in high school adolescents.

Independent variable	n (%)	Prevalence of high-intensity low back pain (%)	Prevalence ratio (95% CI)	p
Watch TV (n=760)				
No	79 (10.4)	29 (36.7)	1.00	0.26
Yes	681 (89.6)	295 (43.3)	1.18 (0.87–1.60)	
Times TV/week (n=681)				
Up to 2 times	174 (25.5)	79 (45.4)	1.00	0.43
3 times or more	507 (74.5)	216 (42.6)	0.94 (0.77–1.14)	
Hours TV/day (n=681)				
Up to 2h	345 (50.6)	144 (41.7)	1.00	0.37
3h or more	336 (49.4)	151 (44.9)	1.08 (0.91–1.28)	
Use of computer (n=760)				
No	148 (19.5)	71 (48.0)	1.00	0.14
Yes	612 (80.5)	253 (41.3)	0.86 (0.71–1.04)	
Type of computer (n=612)				
Desktop	255 (41.6)	91 (35.7)	1.00	0.04
Laptop	357 (58.2)	162 (45.3)	1.28 (1.04–1.56)	
Height of the computer screen (n=612)				
Eyes aligned with the top of the screen level	194 (25.5)	22 (11.3)	1.00	0.29
Eyes below the top of the screen level	370 (48.7)	60 (16.2)	1.43 (0.91–2.26)	
Distance from eye to the computer screen (n=612)				
Up to 30 cm	181 (23.8)	59 (32.6)	1.00	0.09
30 cm or more	431 (56.7)	194 (45.0)	0.41 (0.87–2.29)	
Use od computer/week (n=612)				
Up to 2 times	234 (30.8)	26 (11.1)	1.00	0.10
3 times or more	378 (49.7)	57 (15.1)	0.74 (0.48–1.14)	
Hours of computer/day (n=612)				
Up to 2h	275 (44.3)	31 (11.3)	1.00	0.08
3h or more	337 (44.3)	52 (15.4)	0.73 (0.48–1.11)	
Use of cell phone (n=760)				
No	22 (2.9)	3 (13.6)	1.00	0.86
Yes	738 (97.1)	108 (14.6)	0.93 (0.32–2.71)	
Posture in cell phone (n=738)				
Standing	450 (59.2)	62 (13.8)	1.16 (0.82–1.65)	0.70
Sitting	327 (43.0)	41 (12.5)	1.30 (0.91–1.86)	0.35
Lying of prone	437 (57.5)	51 (11.7)	1.62 (1.15–2.30)	0.02
Semi-lying	280 (36.8)	45 (16.1)	0.99 (0.70–1.42)	0.68
Hours of cell phone/day (n=738)				
Up to 2h	136 (17.9)	53 (9.6)	1.00	0.61
3h or more	602 (79.2)	262 (15,8)	1.12 (0.89–1.40)	
Distance from eye to the cell screen (n=738)				
Up to 20 cm	665 (87.5)	283 (15.2)	1.00	0.96
20 cm or more	73 (9.6)	32 (9.6)	0.97 (0.74–1.28)	
Use of tablet (n=760)				
No	576 (75.8)	244 (42.4)	1.00	0.79
Yes	184 (24.2)	80 (43.5)	1.03 (0.85–1.24)	
Posture in tablet (184)				
Standing	139 (18.3)	61 (43.9)	1.04 (0.70–1.54)	0.94
Sitting	77 (10.1)	38 (49.4)	1.26 (0.91–1.74)	0.37
Lying of prone	99 (13.0)	41 (41.4)	0.90 (0.65–1.25	0.80
Semi-lying	132 (17.4)	56 (42.4)	0.92 (0.64–1.31)	0.86
Hours of tablet/day				
Up to 2h	136 (17.9)	60 (44.1)	1.00	0.92
3h or more	48 (6.3)	20 (41.7)	0.94 (0.64–1.39)	
Distance from eye to the tablet screen				
Up to 20 cm	149 (19.6)	66 (44.3)	1.00	0.86
20 cm or more	35 (4.6)	14 (40.0)	0.90 (0.58–1.41)	

Table 4 shows that the variables that remained significantly associated in the final model of Poisson regression with the LBP-FH were altered mental health, posture lying on the use of tablet, time of daily use of the cell phone and distance of the screen to the eyes of the computer user, while the female sex, mental health problem, posture lying on the use of cell phone and the distance of the screen to the eyes of the computer user with LBP-IH (Table 5).

DISCUSSION

In the current study, 14.6% reported high frequency and 42.6% reported high intensity of low back pain. No studies assessing the frequency and intensity of back pain were found in students. However, one study of athletes noted that 59.6% reported moderate pain intensity and 44.3% high frequency of back pain[24].

In this study, the female sex was associated with LBP-IH, in the same way as in Portugal[12] and Finland[25], while in Turkey[26] such association was not observed. This result can be explained by the fact that women, regardless of age, report more frequently the presence of symptoms than men, due to cultural reasons, hormonal changes during puberty, and higher pain thresholds in men than in women[2,27,28].

Table 5: Poisson regression for associations of variables with the high frequency of low back pain and high intensity of low back pain in high school adolescents.

Factors	High Frequency of low back pain	
	Value of p	PR adjusted/CI 95%
Lying of prone posture using the tablet***		
No	0.002	1.00
Yes		3.84 (1.63–9.09)
Time of daily use of cell phone***		
Up to 2h	0.03	1.00
3h or more		1.63 (1.02–2.59)
Distance from eye to the computer screen***		
30 cm or more	0.03	1.00
Up to 30 cm		1.40 (1.03–1.92)
Mental health**		
Normal		1.00
Borderline	0.03	1.75 (1.02–2.86)
Altered	0.01	1.80 (1.11–2.92)
Factors	**High Intensity of low back pain**	
	Value of p	**PR adjusted/CI 95%**
Gender*		
Male	0.003	1.00
Female		1.58 (1.17–2.12)
Lying of prone posture using the cell phone***		
No	0.02	1.00
Yes		1.51 (1.06–2.17)
Distance from eye to the computer screen***		
30 cm or more	0.02	1.00
Up to 30 cm		1.56 (1.07–2.27)
Mental health**		
Normal		1..00
Borderline	0.002	1.77 (1.24–2.54)
Altered	0.001	1.83 (1.30–2.59)

*Adjusted for demographic and socioeconomic variables; **Adjusted for the first-stage variables and mental problems; ***adjusted for the variables of the first and second stages and for the variables relating to use of electronic equipment.
CI = confidence interval; PR = prevalence ratio.

While no studies were found that evaluated the relationship between the LBP-FH and the time spent using TV, mobile phones, or tablets in high school students, our results showed that LBP-FH is associated with the use of cell phones for three or more hours per day. Several reasons may explain the association between time spent on activities based on the use of a screen and frequency of pain, as the postures that students tend to adopt during such activities can put tension and/or stretching in sensitive structures. The long periods of time spent in static positions can contribute even more to the accumulation of tension, with a decrease in irrigation and peripheral oxygenation, and an increase in metabolics and algic substances[29,30].

The tendency to lie down while using a tablet and mobile phone is associated with LBP-FH and LBP-IH, respectively. Studies conducted in Philadelphia[31] and Las Vegas[32], found results similar to ours, while in China[2] a relationship between LBP and lying posture was not found.

Studies have shown that the non-neutral articular angles of the use of tablets or laptops can lead to higher levels of pain[31,33]. The use of the tablet while lying down generates hyperlordosis. Remaining in this posture for long periods of time induces high and potentially harmful stress on the articular capsules of the facet, in the joint processes of the facet joints, in the outer layers of the lumbar intervertebral disc ring and compression of the interapophyseal ligaments, generating a source of pain by stimulation of the nociceptors. In a pilot study, it was noted that in lying and supine positions, the critical values of pressure on the joint L4-L5 were 46N and 74N, respectively[34]. More studies are needed to examine the musculoskeletal stress resulting from the maintenance of these postures during the prolonged use of tablet-like devices[32].

Regarding the association between the distance from the screen and LBP-IH and LBP-FH, the present study found a lower prevalence observed in individuals who used the computer at a distance greater than 30 cm, while a higher prevalence was found in those who maintained a distance below 30 cm. A study conducted in China[2] reported a relationship between distance to screen and LBP. In Brazil, participants who maintained a distance between 61 and 66 cm between their eyes and the computer screen showed the low to medium symptoms. Murphy[34] recommends a distance from 45 to 75 cm between the eyes and the computer screen, while Blais[35] recommends 40 cm.

In what concerns to mental health, both the altered and borderline categories were associated with LBP-FH and LBP-IH in adolescents. This was the first Brazilian study to examine the role of factors in the onset of LBP-FH and LBP-IH in young people. Several studies[36,37] have reported the influence of prevalent pain on the worsening of mental health; however, there are few studies[38] on the association of the frequency and intensity of pain on mental health. Socioeconomic

and genetic factors, frequency of pain experience, and behavioral or cognitive processes, can provide an explanatory route for the association between pain and mental health dysfunctions[38].

The present study has some limitations. First, the questionnaire responses were self-reported and the possibility of a recall bias cannot be excluded, i.e., the responses might have been over- or underestimated. As such, the content of the responses should be interpreted with caution. Second, the cross-sectional design of the study does not allow an interpretation of the cause and effect of its conclusions and, in fact, the etiology of LBP in adolescents was not investigated in this study. Third, the sample size was smaller than calculated. Fourth, some factors, such as the use of other electronic equipment, occupational activity or internship in companies, and mental health, were not controlled.

However, this study has also several strengths. Namely, the fact that the results obtained are consistent with the existing literature, the use of validated questionnaires for the outcome studied, and the number of individuals interviewed.

Considering that the available data from national research on the high frequency and high intensity of LBP are scarce in both national and international literature, this study contributes to the knowledge of the prevalence and risk factors for the high frequency and intensity of LBP and, consequently, may contribute to the development of preventive actions.

Conclusion

Our results show that the variables that remained significantly associated with LBP-FH were mental health problems, lying posture when using a tablet, amount of daily time using a tablet; while the female sex, mental health problems, and the distance between the device's screen and the eyes of the user remained significantly associated with LBP-IH.

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