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ORIGINAL ARTICLE

Association between home posture habits and low back pain in high school adolescents

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Abstract
Purpose To investigate the prevalence of low back pain (LBP) and the association with home posture habits while watching TV and using the computer in adolescents.
Methods This is a cross-sectional study with high school adolescents in Rio de Janeiro, Brazil. Students answered questions regarding sociodemographic variables, lifestyle, posture (illustration), time watching TV, time using computer, time playing video game and the presence and impact of LBP. Multivariate logistic regression was used to investigate the association between home posture habits and LBP.
Results The prevalence of LBP was 46.8 % (18.2 % chronic low back pain [CLBP] and 28.6 % acute low back pain [ALBP]). As LBP consequence, 23 % ($n = 253$) of the students took medication, 9.1 % ($n = 100$) missed classes and 8.2 % ($n = 90$) sought a physician. Slump postures while watching TV and using the desktop computer were associated with CLBP (OR 3.22, 95 % CI 1.38–7.5 and OR 1.7, 95 % CI 1.06–2.73, respectively). Participants who watched TV seated in bed yielded an OR of 2.14 (95 % CI 1.06–4.32) for ALBP and who used the notebook lying belly down in bed yielded an odds ratio (OR) of 2.26 (95 % CI 1.02–5.01) for ALBP. Among confounding factors, female sex was associated with CLBP and ALBP, work (no) was a protective factor associated with ALBP.
Conclusion Our findings support the high prevalence and the substantial impact of LBP in late adolescence and add the association with inappropriate home postural habits.

Keywords Low back pain · Adolescence · Posture · Prevalence

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Introduction

Low back pain is the first cause of years lived with disability all over the globe [1]. The lifetime prevalence of LBP is documented to be as high as 80 %, and the point prevalence of chronic low back pain (CLBP) is about 20 % [2]. In Brazil back pain is the first cause of disability retirement and in many countries the costs with disability pension make LBP the most expensive public health problem [3, 4]. The prevalence of LBP in teenagers is as high as in adults and when LBP starts in adolescence there is a fourfold increase in risk of developing CLBP in adulthood [5].

O'Sullivan et al. [6] reported a point prevalence of CLBP as 20 % in 17-year-old adolescents and the pain was associated with seeking professional help, using medication, school absenteeism, reduced activity levels and reduced health-related quality of life. The same author also found a cluster of 17-year-old adolescents with high probability of associated spinal pain (low back and

shoulder/neck pain) [7]. Onofrio et al. [8] reported a prevalence of acute low back pain (ALBP) as 13.7 % in 13–19-year-old adolescents in South Brazil.

Increase in age, female sex, smoking and high and low levels of physical activity are also risk factors for LBP in adolescence [9, 10]. Mechanical predictors are scarce, but there is a concern about the time spent watching TV, and using the computer. The first was associated with LBP in cross-sectional studies [11]. There is a lack of studies investigating how the home postural habits of the teenagers are while in passive activities at home and if such habits are associated with low back pain.

This study investigated the prevalence of LBP and its association with home posture habits (by posture illustrations) while watching TV and using computer (desktop or notebook) in high school adolescents.

Methods

Participants

Study population was 1,102 high school students from the morning shift from a cross-sectional study conducted from August 2012 to July 2013, developed in a public high school from the city of Rio de Janeiro.

Measures

The adolescents completed a self-reported questionnaire containing 41 questions in classroom with the presence of the researcher and the teacher. A pretest was conducted to adapt the questionnaire and to ensure understanding by the participants. A pilot study was conducted as a "dress rehearsal" of the whole process of the field research, including the test–retest reliability of the questionnaire.

Low back pain The below questions were based on the ÓSullivan study and on the Nordic Questionnaire [6, 12]. The low back was showed on a body map above the correspondent question. We also used the following questions to assess the mid back and the neck. "Has your low back been painful at any time in the previous month?" and "Has your low back pain ever lasted for more than 3 months?" Subjects were classified as CLBP participants when they answered "yes" in the first and in the second question. When the answer was "yes" only in the first, they were classified as ALBP participants.

Low back pain impact The following questions were based on the ÓSullivan study [6] and on the pretest. "Have you ever sought a doctor due to the low back pain?", "Have you ever taken medicine due to the low back pain?" and "Have you ever missed school due to the low back pain?"

Home posture habits were represented by illustrations (Tables 3, 4 and 5). Posture watching TV, using the desktop computer, and using notebook computer were assessed by the three following questions. "Which is your most frequent position while watching TV? Please, choose only one of the eight options below", "Which is your most frequent position while using the desktop computer? Please, choose only one of the six options below" and "Which is your most frequent position while using the notebook computer? Please, choose only one of the nine options below". The response options (illustrations and two written options) are showed in the Tables 3 and 4. The time spent on each of the above activities was asked by the following questions from PENSE (National Research of Schoolchildren Health) [13]. "How many hours in a regular day do you spend watching TV?", "How many hours in a regular day do you spend using a computer?" The nine response options ranged from none to 7 h. As the question about time in the computer did not differentiate notebook from desktop, we used the following question to know which was the most used. "Do you spend more time using notebook or desktop?" The response options were "notebook", "desktop" or "I don't use any of them above".

Sociodemographic characteristics Age (14–15, 16–17 and 18–20-year-old) sex, maternal education (first grade incomplete, high school incomplete, high school complete, college, I don't know), work (yes or no) and if the participant have any children (yes or no).

Lifestyle Physical activity was assessed by questions from PENSE, including commuting, recreational and physical education [14]. Adolescents were classified as active if performing >300 min/week of physical activity, insufficiently active <300 min/week or inactive (less than 10 min/week) [14]. Smoke status was assessed by the question from PENSE "On the past 30 days, how many days did you smoke a cigarette?" with eight options to choose [13]. When the students answered "never smoke" or "didn't smoke any day on the past 30 days" were classified as nonsmoker.

Institute for Social Medicine ethics Committee of the University of the State of Rio de Janeiro granted ethical approval according to the National Council of Health.

Statistical analysis

Low back pain prevalence, subgroup prevalence and respective 95 % confidence intervals were calculated.

Logistic models were fitted to investigate the association between LBP and home posture habits. We assumed home posture habits as an independent variable for LBP because (1) the population was in a steady state over the study period, (2) no selective survival was allowable, (3) the exposure did not seem to influence the survival or recovery

probabilities, (4) reverse causality was not likely, and (5) temporal directionality from the exposure to the outcome was sustainable, either theoretically or by means of a thorough data collection procedure. Under these assumptions the exponential of the logistic regression coefficient can estimate the incidence density ratio (IDR) when these conditions are met [15, 16].

Six models for acute and chronic low back pain were fitted including interaction terms between home postural habits (TV posture, desktop posture, notebook posture) and exposure time (less or more than 2 h). Variables with, $p < 0.2$ in the univariate analysis were also included. The variable related to the use of notebook or desktop use was inserted in the 4 multivariate models of the exposures

Table 1 Prevalence of LBP and 95 % CI by sociodemographic, lifestyle, time watching TV, time using computer and time playing video-game variables

	n	%	Chronic low back pain		Acute low back pain	
			%	95 % CI	%	95 % CI
Overall	1,102	–	18.2	15.9–20.5	28.6	25.9–31.2
Sex						
Male	515	46.7	14.4	11.4–17.4	21.2	17.7–24.7
Female	587	53.3	21.7	18.4–25.0	35.1	31.2–38.9
Age group (years)[b]						
14–15	387	35.1	19.4	15.5–23.3	28.5	24.0–32.9
16	320	29.0	19.1	14.8–23.4	33.1	27.9–38.3
17	282	25.6	17.0	12.6–21.4	24.5	19.5–29.5
18–20	112	10.2	15.2	8.6–21.8	26.8	18.5–35.0
Mother scholarity[a]						
1st grade incomplete	311	28.2	20.6	16.1–25.1	28.3	23.3–33.3
High school incomplete	192	17.4	15.1	10.0–20.2	29.7	23.2–36.2
High school complete	332	30.1	18.1	13.9–22.2	30.8	25.8–35.8
College	101	9.2	18.8	11.2–26.4	24.8	16.4–33.2
Work[b]						
Yes	237	21.5	18.6	13.7–23.6	32.9	26.9–38.9
No	864	78.4	18.1	15.5–20.7	27.5	24.5–30.5
Smoke[b]						
Smoker	32	2.9	31.2	15.1–47.3	12.5	1.0–23.9
Nonsmoker	1,069	97.0	17.9	15.6–20.2	29.1	26.4–31.8
Physical activity						
Active	437	39.7	17.4	13.8–20.9	26.4	22.2–30.5
Insufficiently active	486	44.1	18.1	14.7–21.5	31.7	27.6–35.8
Inactive	179	16.2	20.8	14.9–26.7	25.7	19.3–32.1
Time watching TV[b]						
2 h or more per day	817	74.1	17.8	15.2–20.4	28.8	25.1–32.5
Less than 2 h per day	284	25.8	19.7	15.1–24.3	26.3	21.8–33.8
Time using computer[b]						
2 h or more per day	889	80.7	18.9	16.3–21.5	29.1	26.1–32.1
Less than 2 h per day	212	19.2	15.6	10.7–20.4	26.9	20.9–32.9
Computer type preference						
Never use computer	56	5.1	21.4	10.7–32.1	28.6	16.8–40.4
Desktop computer	718	65.2	17.6	14.8–20.4	27.3	24.0–30.6
Notebook	328	29.8	19.2	14.9–23.5	31.4	26.4–36.4
Time playing video-game[b]						
2 h or more per day	246	22.3	15.4	10.9–19.9	25.9	20.4–31.4
Less than 2 h per day	854	77.5	19.1	16.5–21.7	29.6	26.5–32.7

[a] There were 15.1 % of the participants reporting not knowing their mother scholarity

[b] Missing data were 0.2 % or less

posture/time using notebook and posture/time using desktop because the exposure time variable did not differentiate between these two devices. Statistical analysis was performed with R-project 2.10 for Windows.

Results

The proportions of male and female participants were almost the same (46.7 and 53.3 %, respectively). The average age of the participants was 16.8 years, only 2.9 % of the participants were smokers and more than half were insufficiently active (44.1 %) or inactive (16.2 %). The majority of the students (74.1 %) reported 2 h or more of watching TV per day, 80.7 % reported 2 or more hours while using the computer (desktop or notebook), 65.2 % commonly used desktop computer and 22.3 % played video game for 2 h or more per day.

The reliability of the questionnaire, evaluated by test–retest method was moderate (>0.4) or substantial (>0.6) for the majority of the answers [17]. For TV postures the Kappa coefficient was 0.59 (95 % CI 0.45–0.72), for desktop postures 0.53 (95 % CI 0.38–0.67) and 0.52 (0.38–0.68) for notebook postures.

The prevalence of chronic or acute low back pain was 46.8 % (18.2 % CLBP and 28.6 % ALBP). Female reported chronic low back pain more frequently than males (Table 1). Participants with chronic neck pain (CNP) and chronic mid back pain (CMBP) reported an increased prevalence of CLBP (Table 2). The same occurred for ALBP. Table 2 also shows the specific impact of low back pain. As a consequence of LBP, 23 % of the students took medication, 9.1 % missed classes and 8.2 % sought a physician. CLBP participants went more to the doctor and missed more classes than ALBP participants. The proportion of medication use was the same for both types (37.3 % for CLBP and 35.2 % for ALBP).

Table 3 presents the proportions of different postures watching TV. The majority of students frequently changed their position while watching TV and did not have a preferred position (32.8 %). Table 4 shows the proportions of different postures using desktop or notebook computer. Among the participants, 24.9 % frequently changed their position while using desktop computer and did not have a preferred position and 25.4 % said that the neutral posture is the usual. Almost half of the students (43 %) did not use notebook computer, 15.4 % of the participants frequently changed their position and did not have a preferred position and 13.2 % used the notebook computer sitting on bed.

For the CLBP models, univariate analysis showed female sex and smoking associated to the outcome ($p < 0.2$). For the ALBP, the associated confounding factors were female sex, age, physical activity status, work status and smoking status.

Table 3 shows the adjusted independent OR for posture while watching TV on the risk of reporting CLBP (model 1) and ALBP (model 2). The interaction term was not statistically significant for any model. As compared with those who watched TV adopting the neutral posture, participants who watched it in the slump posture yielded an odds ratio (OR) of 3.22 (95 % CI 1.38–7.5) for CLBP. Participants who watched it seated on bed yielded an OR of 2.14 (95 % CI 1.06–4.32) for ALBP.

Table 4 shows the adjusted independent effects of posture while using the desktop or notebook computer on the risk of reporting CLBP (model 3) and ALBP (model 4). As

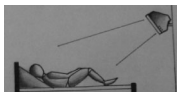
Table 2 Presence of other spinal pain areas and specific LBP impacts

Other spinal pain areas	Chronic low back pain			Acute low back pain		
	n	%	95 % CI	*n*	%	95 % CI
Overall ($n = 1{,}102$)	201	18.2	15.9–20.5	315	28.6	25.9–31.2
Other spinal pain areas						
No CMBP or CNP	77	9.7	7.6–11.8	240	30.3	27.1–33.5
CMBP or CNP	124	40.1	34.6–45.6	75	24.3	19.5–29.1
CMBP and CNP	39	54.2	42.7–65.7	13	18.1	9.2–26.9
No AMBP or ANP	122	20.6	15.4–21.2	123	20.8	17.5–24.1
AMBP or ANP	79	15.6	12.4–18.8	192	37.7	33.5–41.9
AMBP and ANP	9	8.4	0.0–26.5	45	42.1	32.7–51.5
Specific LBP impacts						
Sought physician care ($n = 90$ of 1,102—8.2 %)	39	19.4	11.2–27.6	21	6.7	1.5–11.9
Took medication ($n = 253$ of 1,102—23 %)	75	37.3	31.3–43.3	111	35.2	29.3–41.1
Missed school[a] ($n = 100$ of 1,102—9.1 %)	45	22.4	14.2–30.6	32	10.2	4.3–16.1

CMBP chronic midback pain, *AMBP* acute midback pain, *CNP* chronic neck pain, *ANP* acute neck pain

[a] Missing data were 0.2 % or less

Table 3 Proportions of the different postures watching TV and adjusted OR for acute and chronic low back pain

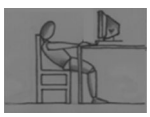
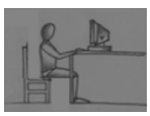
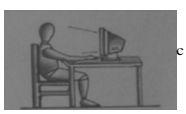
	Posture watching TV	*n*	%	Acute low back pain(model 1)[a]		Chronic low back pain (model 2)[b]	
				Adjusted OR	95 % CI[c]	Adjusted OR	95 % CI[c]
Overall	–	1,102		–	–	–	–
	I do not watch TV	25	2.3	1.31	0.43–3.97	2.42	0.69–8.50
		172	15.6	1.74	0.88–3.44	1.7	0.7–4.12
		196	17.8	1.78	0.91–3.47	3.22	1.38–7.5
		122	11.1	2.14	1.06–4.32	2.1	0.85–5.21
		76	6.9	1.34	0.6–2.98	2.09	0.79–5.55
	 [c]	78	7.1	1	1	1	1
	I frequently change my position while watching TV, I do not have a preferred position	351	31.9	1.56	0.82–2.95	1.98	0.86–4.55
	My preferred position while watching TV is very different from the options above	82	7.4	1.85	0.87–3.96	1.25	0.45–3.5

[a] Model for acute low back pain adjusted for sex, age, work status, physical activity status and smoke status

[b] Model for chronic low back pain was adjusted for sex and smoke. Interaction term was not significant for acute and chronic low back pain

[c] Neutral posture was the reference

Table 4 Proportions of the different postures using desktop computer and adjusted OR for acute and chronic low back pain

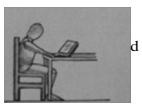
	Posture using desktop computer	*n*	%	Acute low back pain (model 3)[a]		Chronic low back pain (model 4)[b]	
				Adjusted OR	95 % CI	Adjusted OR	95 % CI
Overall	–	1,102	–	–	–	–	–
	I do not use desktop computer	169	15.3	0.83	0.5–1.36	1.19	0.67–2.13
		200	18.1	1.23	0.82–1.86	1.7	1.06–2.73
		91	8.3	0.99	0.57–1.73	0.88	0.44–1.76
	 [c]	280	25.4	1	1	1	1
	I frequently change my position while using the computer, I do not have a preferred position	274	24.9	1.14	0.78–1.66	1.3	0.83–2.04
	My preferred position while using the computer is very different from the options above	88	8.0	1.08	0.63–1.87	1.16	0.61–2.21

[a] Model for acute low back pain was adjusted for sex, age, work, physical activity status, smoke status and computer type preference

[b] Model for chronic low back pain was adjusted for sex, smoke and computer type preference

[c] Neutral posture was the reference. Interaction term was not significant for acute or chronic low back pain

Table 5 Proportions of the different postures using notebook computer and adjusted OR for acute and chronic low back pain

	Posture using notebook computer[a]	*n*	%	Acute low back pain (model 5)[b]		Chronic low back pain (model 6)[c]	
				Adjusted OR	95 % CI	Adjusted OR	95 % CI
Overall	–	1,102	–	–	–	–	–
	I do not use notebook	474	43.0	1.24	0.6–2.56	1.04	0.47–2.29
		26	2.4	2.18	0.75–6.29	1.54	0.48–4.93
		94	8.5	2.26	1.02–5.01	1.12	0.46–2.71
		146	13.2	1.89	0.89–4.04	1.04	0.45–2.4
		22	2.0	2.19	0.73–6.6	0.76	0.18–3.12
		82	7.4	1.41	0.61–3.26	1.23	0.5–3.02
	 [d]	58	5.3	1	1	1	1
	I frequently change my position while using the notebook, I do not have a preferred position	170	15.4	1.88	0.89–3.96	1.01	0.44–2.29
	My preferred position while using the notebook is very different from the options above	27	2.5	0.82	0.25–2.69	1.10	0.33–3.70

[a] Missing data of notebook posture were 0.3

[b] Model for acute low back pain was adjusted for sex, age, work status, physical activity status, smoke status and computer type preference

[c] Model for chronic low back pain adjusted for sex, smoke and computer type preference. Interaction term was not significant for acute or chronic low back pain

[d] Neutral posture was the reference

compared with those who used the desktop computer adopting the neutral posture, participants who used it in the slump posture yielded an OR of 1.7 (95 % CI 1.06–2.73) for CLBP. Participants who used notebook lying belly down, yielded an odds ratio (OR) of 2.26 (95 % CI 1.02–5.01) for ALBP (Table 5). The inclusion of the interaction term was not statistically significant for any model.

Among variables inserted in the models as confounding factors, female sex was associated with CLBP and ALBP, work (no) was a protective factor associated with ALBP.

Discussion

According to our knowledge this is the first study assessing the association of home posture habits and LBP by use of illustrations of the usual positions in the sagittal plane while watching TV and using the computer. The association between slump posture watching TV, using the desktop computer and CLBP is predictable. The slump sitting is the most relaxed posture for the spine, with high demands in the posterior passive tissues of the low back and very low muscle activation [18, 19]. Staying seated in bed while watching TV and lying belly down while using the notebook also produce elevated stress in the passive tissue but in opposite directions. Regarding these two last postures, hip joints are at the end range of movement. While seated in bed, the end range of hip flexion naturally produces a tendency of an excessively flexed low back. Otherwise, while lying belly down in bed, the hip joints are at the end range of extension. So there is a tendency to keep the low back excessively extended.

The absence of interaction between posture and time was probably because the majority of the students spend many hours watching TV and using the computer and because some bad postures need little time to be provocative.

The posture illustration offered in the questionnaire a range of different positions commonly adopted by the participants while watching TV and using the computer (desktop and notebook). There were two more answering options. The first was "I frequently change my position

while watching TV (or using the desktop/notebook), I don't have a preferred position", it may represent the dynamic sitting that facilitates spinal motion and trunk muscle activation. Dynamic sitting was not effective as a stand-alone management approach for LBP [20, 21]. This answer was so far the most frequent answer regarding posture, but there were no protective association with chronic or acute low back pain. The second was "My preferred position while watching TV (or using the desktop/notebook) is very different from the options above", it may represent the more asymmetrical postures in the frontal plane. The decision to include the two questions above with the posture illustration options was based on the pretest when the students were free to give their opinions about the questionnaire.

The prevalence of chronic low back pain was almost the same as in the O'Sullivan study [22] that used similar methodology, but the prevalence of acute low back pain was very high when compared with the same study. The considerable impact of low back pain reinforces the findings of ÓSullivan [22]. CLBP also caused more missed classes and physician sought than acute low back pain, but CLBP and ALBP did not differ regarding medication use. The relatively low physician sought and probable high self medication, were probably related to the difficulty to see a doctor in the public health system of Rio de Janeiro. Prevalence of CLBP was very high in participants reporting other chronic spinal pain (CNP and CMBP). The same phenomenon was found for ALBP. The possible explanation is the psychological tendency that differ acute and chronic pain patients. As an example, ALBP patients with higher levels of pain catastrophizing and kinesiophobia used to have an elevated risk of becoming CLBP patients and chronic pain patients used to have widespread pain [23, 24]. The way the patients cope with the LBP is probably the same as when they suffer of neck and mid back pain, increasing or decreasing the probability of becoming a chronic pain patient.

This study has not shown LBP prevalence differences regarding physical activity levels. In Brazil, there is a lack of competitive sports practice in the majority of the high schools. Although 40 % of the study sample is physically active, almost all the participants lived far from the school, used to go to school by bus and remained frequently seated while in the physical education classes. The physically active participants are probably much less active than the adolescents from high income countries. The observed association between home postural habits and LBP could be a reflex of a population that spends much time in inappropriate passive postures at home without the counterbalance of a moderate physical activity level.

This study supports the assumption that LBP in adolescence is a public health issue. There is too little attention paid to this problem both at school and also at home. The advantage of assess posture by home habits is that it is easier to modify when comparing to posture itself. The questionnaire with posture illustrations would be a simpler tool to epidemiological research and also for the clinical use. Screening the home posture habits through a questionnaire applied at school could contribute to the implementation of prevention measures.

Limitations

Our findings should be interpreted with certain limitations. The population of the study does not represent a sample of Public High School adolescents of Rio de Janeiro. However, considering the distribution of exposure variables, the prevalence of the outcomes and the plausibility of the association, an inference to other adolescents may be possible. Another problem is the classification of acute low back pain as pain in the last month of any intensity and any duration tends to overestimate such prevalence. One would state that the lack of self-conscious in adolescence invalidates the assessment of home posture habits by illustrations in a questionnaire, but if there was information bias it would probably counteract the association. Even with a moderate reliability of the questionnaire, it was possible to find relevant associations. Other possibilities of position illustrations as more asymmetrical postures in the frontal plane could be inserted in the questionnaire, but there is evidence that the sagittal changes in the low back are more associated with LBP [25].

Although cross-sectional design is not the ideal one for causal inference, home posture habits probably precede LBP. Considering habits as a recurrent, often unconscious pattern of behavior that is acquired through frequent repetition, someone with good posture habits would hardly change such habit to a worst one after the onset of LBP, although antalgic changes in the posture itself can happen. The possibility of spontaneously changing a posture habit in chronic low back pain is remote. Reverse causality is also unlikely in the case of the association between staying seated in bed while watching TV or lying belly down while using the notebook and acute low back pain. As acute pain was considered pain in the previous month, there was no time to change a posture habit.

Conclusion

Our findings support that low back pain is common and causes a substantial impact in late adolescence. This is the

first study to find an important association between inappropriate home posture habits and low back pain.

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Conflict of interest None.

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