AUCTORES
Globalize your Research

Journal of Clinical Research and Reports
Benito Lourenço *

Open Access

Research Article

Musculoskeletal Pain, Musculoskeletal Syndromes, And Digital Media in Public School Adolescents

Benito Lourenço *, Ligia Bruni Queiroz, Daniela Mencaroni Rodrigues Lourenço, Clovis Artur Almeida da Silva

Instituto da Criança e Adolescente, Hospital das Clínicas HCFMUSP, Faculdade de Medicina, Universidade de São Paulo, São Paulo, SP, BR.

***Corresponding Author:** Benito Lourenço., Instituto da Criança e Adolescente, Hospital das Clínicas HCFMUSP, Faculdade de Medicina, Universidade de São Paulo, São Paulo, SP, BR.

Received date: July 31, 2025; Accepted date: August 22, 2025; Published date: September 04, 2025

Citation: Benito Lourenço, Ligia B. Queiroz, Rodrigues Lourenço DM, Clovis Artur Almeida DS, (2025), Musculoskeletal Pain, Musculoskeletal Syndromes, And Digital Media in Public School Adolescents, *J Clinical Research and Reports*, 21(1); **DOI:10.31579/2690-1919/564**

Abstract

Background/Aim: To assess digital media use, musculoskeletal pain and syndromes in adolescents and young adults from a public school.

Materials and Methods: A cross-sectional study included 386 healthy adolescents that completed a questionnaire including demographic data, musculoskeletal pain, physical activity, and media use. The following musculoskeletal pain syndromes and repetitive strain injuries were investigated in students who reported musculoskeletal pain in the last three months: juvenile fibromyalgia, joint hypermobility syndrome, myofascial syndrome, tendinitis, bursitis, and epicondylitis.

Results: Inter-rater agreement between pretest and retest was 0.93. Musculoskeletal pain and syndrome were identified in 245/386(63%) and 55/245(23%), respectively. The median age was significantly higher in adolescents with musculoskeletal pain compared to those without this condition (14.69[11.9-22.5] vs. 14.41[10-18.8] years, p=0.018). The frequencies of computer use after 10pm (48% vs. 30%, p<0.001), internet use on weekends (6 hours [0-20] vs. 4[0-22],p=0.043), mobile phone use on weekends(8 hours[0-20] vs. 5[0-22], p=0.002), and mobile phone use after 10pm(83% vs. 69%, p=0.001) were significantly higher in the former group. Further comparisons between adolescents with and without musculoskeletal pain syndromes showed that female gender was significantly higher in the former group (74% vs. 27%, p<0.001). The internet use on weekdays (10 hours [0-24] vs. 5[0-20], p<0.001) was also significantly higher in adolescents with musculoskeletal syndrome.

Conclusion: Musculoskeletal pain was reported in approximately two-thirds of adolescents from a public school, and musculoskeletal syndromes occurred in one-quarter. Students with musculoskeletal pain were older and reported relevant use of digital media, while adolescents with musculoskeletal syndromes were predominantly female and reported important internet use on weekdays.

Keywords: adolescent; digital media; electronic device; musculoskeletal pain; musculoskeletal syndrome

Introduction

Media and electronic devices are relevant for entertainment and schoolwork in younger. An increasing exposure of the adolescent and young adults' generation to media is a worldwide phenomenon. The most recent publication of the "TIC Kids Online Brazil" survey showed that 93% of this population used internet.1 Digital media use (computers, internet, electronic devices, and mobile phones) may be associated with various health issues, particularly recurrent musculoskeletal pain, pain syndromes and repetitive strain injuries.

Musculoskeletal pain is the most frequent cause of recurrent non-inflammatory pain in adolescents, ranging from 30% to 65%. [2,3] The use of digital media is a risk factor for both musculoskeletal pain and musculoskeletal pain syndromes in healthy adolescents, and in those with chronic conditions (obese and asthma). [4,5] However, these reports included preferable analysis of subjects from private school with upper and upper/middle socio-economic classes.[4,6-8]

To our knowledge, there is no report that evaluate simultaneously digital media use, and the presence of musculoskeletal pain and musculoskeletal pain syndromes (joint hypermobility syndrome, juvenile fibromyalgia, myofascial syndrome, tendinitis, bursitis, and epicondylitis) in healthy adolescents and young adults, specifically students at public schools with low socioeconomic strata.

Therefore, the objective of the present study was to assess digital media use, pain and musculoskeletal syndromes in adolescents and young adults from a public school. We also evaluated the possible associations between the presence of musculoskeletal pain and musculoskeletal syndromes and: demographic data, physical education at school, and digital media patterns.

Materials and Methods

A cross-sectional study was conducted during October 2018 to February 2019 in healthy adolescents of a public school, situated on the outskirts of São Paulo city, Brazil. 400 adolescents and young adults (10-22 years old) were invited to take part in the study, and n=390 (97.5%) agreed to participate. Adolescents and young adults with acute or chronic musculoskeletal pain and injuries secondary to recent infectious, onco-hematological, genetic, endocrine, and traumatic conditions (n=0), as well as those who filled out the questionnaire improperly (n=4), were systematically excluded. Adolescent or parental refusal was not observed. Therefore, the final sample of the present study was n=386 adolescents and young adults.

Informed consent was obtained from all subjects and their legal guardians. The study was approved by the Ethics and Research Committee of our University Hospital (number 24661313.9.00000.0065).

Social and economic classes were evaluated by the Brazil Economic Classification Criteria of the Brazilian Association of Research Companies (ABEP), 2018.[9]

An individual, confidential, and self-administered survey about pain and electronic media use was answered by adolescents and young adults. This standardized questionnaire was previously reported by our group.[8] All students completed a questionnaire covering the following aspects: demographic data; practice of physical activity and sports; availability, consumption pattern, and types of media used. Painful symptoms of the musculoskeletal system presented in the last three months were also evaluated. The questionnaire was applied during the period of one school class (maximum duration of 50 minutes). Pretest and retest of the questionnaire were carried-out with a 30-day interval in 25 subjects in October 2018 to assess the reliability of the subjects' answers.

A specific musculoskeletal physical examination was also carried out, in a private environment of school class, by two trained physicians. This physical examination was performed in students who reported any complaint of pain in the musculoskeletal system in the last three consecutive months. The following musculoskeletal pain syndromes and repetitive strain injuries were systematically investigated: juvenile fibromyalgia, joint hypermobility syndrome, myofascial syndrome, tendinitis, bursitis, and epicondylitis. Juvenile fibromyalgia was diagnosed by widespread pain for at least three months and presence of at least 11/18 tender points examined bilaterally, by the American College of Rheumatology criteria.[10] Joint hypermobility was defined according to Beighton's criteria, and joint hypermobility syndrome as the presence of joint hypermobility associated with pain in the musculoskeletal system and the presence of 5 of the 9 criteria.[11] Myofascial syndrome was diagnosed in the presence of at least one active trigger points assessed bilaterally in specific muscles or muscular groups, and soft tissues stress injuries (tendinitis, bursitis, and epicondylitis), as previously described.[4-8]

The sample size provided power of 80% to find differences greater than 11.6% in the frequency of different digital devices use in adolescents and young adults with and without musculoskeletal pain (Graphpad StatMate 1.01, GraphPad Software, Inc., CA, USA). Continuous variables were presented as median (maximum and minimum value) or mean ± standard deviation. Categorical variables were presented as frequency and percentage. Kappa index was administered to evaluate the reliability of the questionnaire between the pretest and the retest. Comparisons between medians (variation) and mean ± standard deviation were calculated using the Mann-Whitney U test or the t-test, respectively. For categorical variables, differences were calculated using Fisher's exact test or chi-square test. P values ≤ 0.05 were considered statistically significant.

Results

The agreement between pretest and retest (Kappa index) was 0.93, demonstrating excellent reliability in the subject' responses.

The study sample consisted of n=386 teens, and n=186 (48.1%) were females According to the ABE's Brazil economic classification criteria, all adolescents and young adults belonged to lower and lower/middle socio-economic classes.

Regarding use of electronic media devices, 73% of the adolescents and young adults used computers (including desktops, laptops, and tablets), 70.9% played electronic games, 95.8% used the internet and 93.5% had a mobile phone. According to electronic games, the most used platform was "PlayStation" (34.5%), mobile phone (32%) and computer (desktop, laptop or tablet, 17.5%). The most reported position for students that played electronic games was "sitting on couch/chair", in 28% of them. The positions "sitting on bed" and "sitting on floor" were reported in 25.7% and 15.2%, respectively.

The presence of musculoskeletal pain in the last three months was reported by n=245/386 subjects (63%). The musculoskeletal pain locations were back (n=142, 58%), neck (n=89, 36%), wrists and hands (n=88, 36%), shoulders and arms (n=78, 32%) and hips and legs (n=68, 28%).

Sociodemographic data of the adolescents and young adults who reported musculoskeletal pain in the last three months were shown in Table 1. The median of current age was significantly higher in subjects with musculoskeletal pain versus those who did not report any pain [14.69 (11.9–22.5) vs. 14.41 (10–18.5) years, p=0.018]. The frequency of physical education at school was significantly lower in adolescents and young adults who reported pain (73% vs. 83%, p=0.033) (Table 1).

Table 2 comprised the characteristics of use of computers (desktops, laptops, tablets), electronic games, internet, and mobile phones in adolescents and young adults with musculoskeletal pain versus adolescents without pain. The frequencies of computer use after 10 pm (48% vs. 30%, p<0.001) and mobile phone use after 10 pm (83% vs. 69%, p=0.001) were significantly higher in adolescents who reported musculoskeletal pain versus those who did not report any pain. The medians of internet use on weekends [6 (0–20) vs. 4 (0–22) hours/day, p=0.043], internet use on weekdays [6 (0–24) vs. 5 (0–20) hours/day, p=0.016], mobile phone use on weekends [8 (0–20) vs. 5 (0–22) hours/day, p=0.002] and mobile phone use on weekdays [10 (0–24) vs. 5 (0–20) hours/day, p<0.001] were significantly higher in subjects with

musculoskeletal pain compared to subjects without musculoskeletal pain (Table 2).

Musculoskeletal pain syndrome was identified in n=55/245 (23%) of the adolescents and young adults: joint hypermobility syndrome in n=19/245 (8%), tendinitis n=18/245 (7%), myofascial syndrome n=17/245 (7%), and fibromyalgia n=7/245 (2.8%).

Table 3 included sociodemographic data on subjects with musculoskeletal syndrome versus subjects without musculoskeletal syndrome. Females were significantly higher in students with musculoskeletal syndrome versus those without musculoskeletal syndrome (74% vs. 27%, p<0.001) (Table 3).

Table 4 included the characteristics of use of computers (desktops, laptops, tablets), electronic games, internet, and mobile phones in adolescents and young adults with musculoskeletal syndrome versus subjects without syndrome. The median of internet use on weekdays was significantly higher in students with musculoskeletal syndrome compared to those without musculoskeletal syndrome [10 (0–24) vs. 5 (0–20) hours/day, p<0.001] (Table 4).

Variables	**With musculoskeletal pain** (n=245)	**Without musculoskeletal pain** (n=141)	**P**
Demographic data			
Current age, years	14.69 (11.9-22.5)	14.41 (10-18.5)	**0.018**
Sex			
Female	127 (52)	59 (42)	0.072
Lower socioeconomic class	128 (52)	72 (51)	0.833
Education, years	9 (7-12)	9 (7-12)	**0.043**
Physical education at school	179 (73)	117 (83)	**0.033**

Table 1: Sociodemographic data in adolescents with musculoskeletal pain versus adolescents without musculoskeletal pain.

Results are presented in n (%) and median (minimum-maximum value).

Variables	**With musculoskeletal pain** (n=245)	**Without musculoskeletal pain** (n=141)	**P**
Computer			
Number of days/use	7 (1-7)	5 (1-7)	0.078
Use on weekends, hours/day	2 (0-18)	2 (0-16)	0.576
Use on weekdays, hours/day	3 (0-12)	3 (0-12)	0.626
Computer use after 10 pm	118 (48)	42 (30)	**<0.001**
Electronic games			
Use	172 (70)	102 (72)	0.727
Use on weekends, hours/day	2 (0-16)	2 (0-18)	0.853
Use EG on weekdays, hours/day	3 (0-16)	2 (0-20)	0.611
Use after 10 pm	101(41)	57(40)	0.704
Internet			
Use	237 (97)	133 (94)	0.606
Use on weekends, hours/day	6 (0-20)	4 (0-22)	**0.043**
Use on weekdays, hours/day	6 (0-24)	5 (0-20)	**0.016**
Use after 10 pm	192 (78)	99 (70)	0.144
Mobile phone			
Use	230 (94)	131(93)	0,862
Mobile phone use on weekends, hours/day	8 (0-20)	5 (0-22)	**0.002**
Mobile phone use on weekdays, hours/day	10 (0-24)	5 (0-20)	**<0.001**
Mobile phone use after 10 pm	203 (83)	97 (69)	**0.001**

Table 2: Characteristics of use of computers (desktops, laptops, tablets), electronic games (EG), internet and mobile phones in adolescents with musculoskeletal pain versus adolescents without musculoskeletal pain.

Results are presented in n (%) and median (variation), h=hours. EG=electronic games

Variables	With musculoskeletal syndrome (n=55)	Without musculoskeletal syndrome (n=331)	P
Demographic data			
Current age, years	14.59 (12.4-18.1)	14.78 (11.9-22.5)	**0.399**
Gender			
Female	41 (74)	90 (27)	**<0.001**
Lower socioeconomic class	25 (45)	104 (31)	**0.360**
Education, in years	8 (7-12)	9 (7-12)	**0.111**
Physical education at school	42 (76)	140 (42)	**0.607**

Table 3: Sociodemographic data in adolescents with musculoskeletal syndrome versus adolescents without this syndrome.

Results are presented in n (%) and median (minimum–maximum value).

Variables	With musculoskeletal syndrome (n=55)	Without musculoskeletal syndrome (n=331)	P
Computer			
Number of days/uses	7 (1-7)	7 (0-7)	0.718
Use on weekends, hours/day	1 (0-12)	2 (0-18)	0.478
Use on weekdays, hours/day	3 (0-12)	3 (0-12)	0.874
Computer use after 10 pm	26 (47)	93 (28)	0.239
Electronic games			
Use, days	4 (1-7)	5 (1-7)	0.362
Use on weekends, hours/day	2 (0-18)	2 (0-16)	0.374
Use on weekdays, hours/day	2 (0-16)	3 (0-16)	0.257
Use after 10 pm	18 (32)	85 (25)	0.695
Internet			
Use, days	7 (1-7)	7(1-7)	0.213
Use on weekends, hours/day	8 (0-18)	5 (0-20)	0.167
Use on weekdays, hours/day	10 (0-24)	5 (0-20)	**<0.001**
Use after 10 pm	45 (81)	151 (45)	0.551
Mobile phone			
Use on weekends, hours/day	8 (10-16)	8 (0-20)	0.552
Use on weekdays, hours/day	10 (0-24)	9 (0-20)	0.388
Use after 10 pm	49 (89)	157 (47)	0.460

Table 4: Characteristics of usage of computers (desktops, laptops, tablets), electronic games, internet and mobile phones in adolescents with musculoskeletal syndrome versus adolescents without this syndrome.

Results are presented in n (%) and median (variation), h=hours. EG=electronic games

Discussion

The present study demonstrated that musculoskeletal pain was reported in approximately two-thirds of adolescents from a public school, and musculoskeletal syndromes occurred in one-quarter. Students with musculoskeletal pain were older and reported relevant use of digital media, while adolescents with musculoskeletal syndromes were predominantly female and reported important internet use on weekdays.

Our study identified a high frequency of musculoskeletal pain in students that using digital media. Indeed, a recent systematic review that assessed the prevalence and risk factors for musculoskeletal complaints associated with the use of portable devices, including adolescent population, identified musculoskeletal symptoms from ranging 1.0% to 67.8 %.[12] In another study, Silva et al.[13] studied the prevalence of musculoskeletal pain in adolescents public schools from a northeastern Brazilian state and its association with the use of video games and computers, and identified musculoskeletal pain in 65.1% of adolescents. A similar frequency of musculoskeletal pain (61%) was also observed by Queiroz et al. [8], who evaluated teens from a private school in the city of São Paulo. Another recent systematic review on musculoskeletal complaints related to mobile phone use, including analyses of adolescent population, showed musculoskeletal pain from 8.2% to 89.9% in users of this technology.[14]

In addition, musculoskeletal pain, usually underdiagnosed, is a well-known cause of pain and functional disability, and may interfere with adolescents' performance and productivity in everyday activities. In fact, pain in the upper limbs, shoulders, and neck has already been associated

with lower education levels, absenteeism, and compromised recreational activities. [15,16] In the present study, the most frequent sites of musculoskeletal pain reported by students were back (58%), neck (36%), wrists and hands (36%).

It is important to emphasize that our study evaluated the use of different media devices and that most of the recently published studies on the association of musculoskeletal pain and the use of electronic devices are restricted to the evaluation of smartphones and mobile phones in general.[12,14,17,18] In these studies, the neck region is most commonly reported as the site of pain, with prevalence ranging from 17.3% to 67.8%.[12,14]

Neck pain may be related to anterior posture of the head while using electronic devices. Furthermore, the increase neck flexion angle while using an electronic device seems to be a risk factor for this musculoskeletal pain, and flexing the head frontward to varying degrees dramatically increases weight loads on the cervical spine.[12,17,18] The increased prevalence of back pain in the teens was also evidenced by Bento et al.[19], identifying 46.7% of back pain among adolescents associated with the pattern of electronic devices use, particularly laptops, tablets, and mobile phones.

Different factors, including sociodemographic, behavioral and personal factors such as gender, age, socioeconomic status, physical exercise, type and pattern of electronic device usage, activities performed with such devices, such as texting or internet browsing, and other factors such as posture and ergonomics are considered as associated factors for musculoskeletal pain related to electronic devices.[20-25] We reinforced previous study identified that students with musculoskeletal pain were older and reported relevant use of digital media, particularly in those using computers and mobile phones after 10 pm and among them that used the internet and mobile phones for longer periods, on weekdays and weekends, while adolescents with musculoskeletal syndromes were predominantly female and reported important internet use on weekdays.

This research has methodological strengths. The assessment of self-reporting in the standardized questionnaire was important, and this instrument included photos of different body areas to indicate the location of musculoskeletal pain. The use of a questionnaire with excellent test–retest reliability was also relevant for this, minimizing memory bias. Another strength of the study was a specific physical examination of the musculoskeletal system by the trained researcher, identifying joint hypermobility syndrome (8%), tendonitis (7%), myofascial syndrome (7%), and fibromyalgia (2.8%). In this study, the exclusion of recent causes of musculoskeletal pain — particularly infectious, rheumatological, oncological and traumatic ones — was also relevant, since these conditions can induce recurrent and chronic pain, even in patients with mild changes on physical examination.

However, this study has limitations. Other issues related to musculoskeletal pain and musculoskeletal pain syndromes, such as emotional disturbances, sleep abnormalities, use of heavy school bags (more than 10% of the adolescent's weight), ergonomic assessment, and other risk behaviors have not been studied. Additionally, self-reporting of electronic device usage is likely to include a moderate amount of time, restricted to the three months prior to the assessment. New and continuous studies are needed to evaluate ergonomics, such as body posture and the configuration of the place of predominant use of multiple electronic devices among this population group.

Acknowledgments: Our gratitude to Ulysses Doria-Filho for the statistical analysis support.

Authorship criteria: All named authors approved the final draft of the manuscript, approved the submission to the Journal, and be willing to take responsibility for it in its entirety.

Authors' contribution: All the authors contributed substantially to the conception and design of the study and in the analysis and interpretation of data. All authors revised the work critically and approved the final version.

Ethics Committee name and study protocol number: CEP/CONEP number 24661313.9.00000.0065

Funding: This study was supported by grants from Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq 304984/2020-5 to CAS), Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP 2015/03756-4 to CAS) and by Núcleo de Apoio à Pesquisa "Saúde da Criança e do Adolescente" da USP (NAP-CriAd) to CAS.

Financial Disclosure: The authors have no financial arrangements with a company whose product figures prominently in the submitted manuscript or with a company making a competing product.

References

1. Comitê Gestor da Internet no Brasil. Tic Kids Online Brasil: Pesquisa sobre o Uso da Internet por Crianças e Adolescentes no Brasil – 2021. Available at: https://cetic.br/media/docs/publicacoes/2/20221121120124/tic_kids_online_2021_livro_eletronico.pdf (Accessed on June 5, 2023)
2. Huguet A, Tougas ME, Hayden J, Mcgrath PJ et al. (2016). Systematic review with meta-analysis of childhood and adolescent risk and prognostic factors for musculoskeletal pain. Pain 157:2640-2656
3. Roth-Isigkeit A, Thyen U, Stöven H, Schwarzenberger J, Schmucker P. (2005). Pain among children and adolescents: restrictions in daily living and triggering factors. Pediatrics 115:152-162
4. Jannini SN, Dória-Filho U, Damiani D, Silva CA. (2011). Musculoskeletal pain in obese adolescents. *J Pediatr* 87:329-333
5. Nastri MMF, Lourenço B, Queiroz LB, Silva LEVD, Lourenço DMR, et al. (2022). Idiopathic musculoskeletal pain, musculoskeletal pain syndromes, and use of electronic devices in adolescents with asthma. *J Pediatr (Rio J).*;98(3):270-275.
6. Zapata AL, Moraes AJ, Leone C, Doria-Filho U, Silva CA. (2006). Pain and musculoskeletal pain syndromes in adolescentes. *J Adolesc Health* 38:769-771
7. Zapata AL, Moraes AJ, Leone C, Doria-Filho U, Silva CA. (2006). Pain and musculoskeletal pain syndromes related to computer and video game use in adolescents. *Eur J Pediatr*. 165(6):408-414
8. Queiroz LB, Lourenço B, Silva LEV, Lourenço DMR, Silva CA. (2018).Musculoskeletal pain and musculoskeletal syndromes in adolescents are related to electronic devices. *J Pediatr (Rio J).* 94(6):673-679
9. ABEP - Associação Brasileira de Empresas de Pesquisa – Critério de classificação econômica Brasil 2018. Available at:

http://www.abep.org/criterio-brasil (Accessed on June 10, 2020)

10. Wolfe F, Smythe HA, Yunus MB, Bennett RM, Bombardier C, et al. (1990).The American College of Rheumatology 1990 Criteria for the Classification of Fibromyalgia. Report of Multicentre Criteria Committee. *Arthritis Rheum.* 33:160-172
11. Beighton PH Horan F. (1969). Orthopedic aspects of the Ehlers-Danlos syndrome. *J Bone Joint Surg* 51:444-453
12. Xie Y, Szeto G, Dai J. (2017). Prevalence and risk factors associated with musculoskeletal complaints among users of mobile handheld devices: A systematic review. Appl Ergon 59:132-142
13. Silva GR, Pitangui AC, Xavier MK, Correia-Júnior MA, Araujo RC. (2016). Prevalence of musculoskeletal pain in adolescents and association with computer and videogame use. J Pediatr 92:188-196
14. Zirek E, Mustafaoglu R, Yasaci Z, Griffiths MD. (2020). A systematic review of musculoskeletal disorders related to mobile phone usage. Musculoskeletal Science and Practice 102196
15. Hakala PT, Saarni LA, Punamäki RL, Wallenius MA et al. (2012). Musculoskeletal symptoms and computer use among Finnish adolescents - pain intensity and inconvenience to everyday life: a cross-sectional study. *BMC Musculoskelet Disord* 22:13-14
16. Rose K. (2000). The effect of neck pain and headaches on the academic performance of college students. *Journal of the Neuromusculoskeletal System* 8(4):118–23.
17. Berolo S, Wells RP, Amick III BC. (2011). Musculoskeletal symptoms among mobile hand-held device users and their relationship to device use: a preliminary study in a Canadian university population. Appl Ergon 42:371–378.
18. Kalirathinam D, Manoharlal MA, Mei C, Ling CK, Sheng TWY, et al. (2017). Association between the usage of smartphone as the risk factor for the prevalence of upper extremity and neck symptoms among university students: a cross-sectional survey based study. Research *Journal of Pharmacy and Technology* 10:1184–1190.
19. Bento TPF, Cornelio GP, Perrucini PO, Simeão SFAP, de Conti MHS, et al. (2020). Low back pain in adolescents and association with sociodemographic factors, electronic devices, physical activity and mental health. *J Pediatr (Rio J).* 96(6):717
20. Toh SH, Coenen P, Howie EK, Straker LM. (2017).The associations of mobile touch screen device use with musculoskeletal symptoms and exposures: A systematic review. *PloS one.* 12(8):e0181220
21. Saueressig IB, Oliveira VMAd, Xavier MKA, Santos LRAd, Silva KMA, et al. (2015). Prevalence of musculoskeletal pain in adolescents and its association with the use of electronic devices. *Revista Dor.* 16(2):129–135.
22. Diepenmaat AC, van der Wal MF, de Vet HC, Hirasing RA. (2006). Neck/shoulder, low back, and arm pain in relation to computer use, physical activity, stress, and depression among Dutch adolescents. Pediatrics 117:412-416
23. Smith L, Louw Q, Crous L, Grimmer-Somers K. (2009). Prevalence of neck pain and headaches: impact of computer use and other associative factors. Cephalgia. 29(2):250-257.
24. Jacobs K, Hudak S, McGiffert J. (2009).Computer-related posture and musculoskeletal discomfort in middle school students. Work. 32(3):275-283.
25. Boström M, Dellve L, Thomée S, Hagberg M. (2008). Risk factors for generally reduced productivity--a prospective cohort study of young adults with neck or upper-extremity musculoskeletal symptoms. Scand *J Work Environ Health* 34:120-32.

DOI:10.31579/2690-1919/564