Can electronic screens influence head and neck posture in adolescents? A systematic review

As telas eletrônicas podem influenciar a postura de cabeça e pescoço em adolescentes? Uma revisão sistemática

¿Pueden las pantallas electrónicas influir en la postura de la cabeza y el cuello en adolescentes? Una revisión sistemática

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ABSTRACT | This systematic review aims to identify whether electronic screens can influence head and neck posture in adolescents. This study was registered in PROSPERO and the databases used were EMBASE, LILACS, SciELO, PEDro, PubMed, and Scopus, with no language or publication date limitations. The keywords used were posture, neck, and adolescents. A total of 1,997 articles with duplicates were found, 1,858 articles were excluded after title reading and 65 after abstract reading. During the analysis of the full texts, 22 were excluded because they addressed individuals with an average age of less than 15 or more than 19 years, 10 did not refer to technology use, and three only evaluated symptomatic individuals, therefore, only four articles were reviewed. The methodological quality of the studies was defined according to the Newcastle Ottawa Quality Assessment Scale, with three being classified as good methodological quality and analyzing posture when using a computer, and one with poor quality that analyzed posture when using a smartphone. Therefore, regarding smartphone use, considerations are limited. Overall, computer use is not responsible for postural changes in the head and neck of adolescents; however, more studies are needed to confirm this conclusion.

Keywords | Posture; Screen Time; Adolescent; Head; Neck.

RESUMO | O objetivo desta revisão sistemática é identificar se as telas eletrônicas podem influenciar a postura de cabeça e pescoço em adolescentes. Foi registrada no International Prospective Register of Systematic Review (PROSPERO), e as bases de dados utilizadas foram EMBASE, LILACS, SciELO, PEDro, PubMed e Scopus, sem limite de idioma ou data de publicação. Os descritores utilizados foram postura, pescoço e adolescentes. Foram encontrados 1.997 artigos com duplicatas e foram excluídos 1.858 artigos pelo título e 65 pelo resumo. Durante a análise do texto na íntegra, 22 foram excluídos porque abordavam indivíduos com média de idade inferior a 15 ou superior a 19 anos, dez não faziam referência ao uso de tecnologia e três avaliavam apenas indivíduos sintomáticos, sendo assim, apenas quatro foram revisados. A qualidade metodológica dos estudos foi classificada de acordo com a Newcastle Ottawa Quality Assessment Scale, sendo que três foram classificados com qualidade metodológica forte e analisaram a postura frente ao uso do computador e um com qualidade fraca, que analisou a postura durante o uso do smartphone. Portanto, com relação ao uso do smartphone, as considerações são limitadas. De forma geral, o uso do computador não é o responsável pelas alterações posturais em cabeça e pescoço em adolescentes, entretanto, mais estudos são necessários para confirmar essa conclusão.

Descritores | Postura; Tempo de Tela; Adolescente; Cabeça; Pescoço.

RESUMEN | Esta revisión sistemática tiene el objetivo de identificar si las pantallas electrónicas pueden influir en la postura de la cabeza y el cuello en adolescentes. Se registró en el *International Prospective Register of Systematic Review* (PROSPERO), y las bases de datos utilizadas fueron EMBASE, LILACS, SciELO, PEDro, PubMed y Scopus, sin

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límite de idioma ni fecha de publicación. Se utilizaron los siguientes descriptores: postura, cuello y adolescentes. Se encontraron 1997 artículos con duplicados y se excluyeron 1858 artículos por título y 65 por resumen. Durante el análisis del texto completo, se excluyeron 22 artículos porque abordaban personas con edad media inferior a 15 o superior a 19 años, diez artículos no hacían referencia al uso de tecnología y tres evaluaban solamente personas sintomáticas, por lo tanto, solamente se revisaron cuatro artículos. Se clasificó la calidad metodológica de los estudios según la *Newcastle Ottawa Quality Assessment Scale*, de los cuales tres se clasificaron con calidad metodológica fuerte y analizaron la postura al usar la computadora y uno se clasificó con calidad débil, que analizó la postura al usar el teléfono inteligente. Por lo tanto, con respecto al uso del teléfono inteligente, las consideraciones son limitadas. De manera general, el uso de la computadora no es responsable de los cambios de postura en la cabeza y el cuello en adolescentes, sin embargo, se necesitan más estudios para confirmar esta conclusión.

Palabras clave | Postura, Tiempo de Pantalla; Adolescente; Cabeza; Cuello.

INTRODUCTION

Electronic media has become one of the pillars of modern life for social, educational, and occupational purposes. Thus, screentime of portable digital displays has increased[1] in every age group[2].

Prolonged use of electronic devices can cause postural damage and the onset of musculoskeletal pain[3]. Furthermore, screentime is associated with increased neck and head flexion posture in children, especially in the sitting position[1]. Studies show that the prevalence of cervical pain in late youth is similar to that found in adults and as high as the prevalence of low back pain[4,5].

Smaller devices tend to promote greater neck flexion, which would increase muscle activity[6]. Hyperactivity and increased fatigability of the cervical flexor muscles[7,8] may be present in cervical dysfunctions[9,10]. The association of these devices with sitting time during classes and studies, in addition to sedentary lifestyle, could make individuals predisposed cervical alterations[11].

It is suggested that the typing of text messages with intensive use of smartphones may be a contributing factor to neck pain, possibly due to the greater head flexion angle when typing a message, as well as the maintenance of sitting posture for an extended time during school day[11].

Adolescent computer users showed greater neck flexion and increased pelvic tilt when compared to non-users[12]. Moreover, elevated computer time was associated with increased head and neck flexion among boys[13].

There is conflicting evidence of associations between prolonged postures, screentime, and musculoskeletal pain in adolescents[14-17]; thus, the conclusion that incorrect posture results in cervical pain remains uncertain, which highlights the need for further studies[18,19].

Therefore, this systematic review aims to identify whether electronic screens can influence head and neck posture in adolescents.

METHODOLOGY

Registration of the systematic review protocol

This review was previously registered in the International Prospective Register of Systematic Review (PROSPERO), with the identifier CRD42020208458. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were followed[20].

Search strategy and selection of studies

Observational studies, cohort studies, and case-control studies (control only) were included to assess head and neck posture. Clinical trials and reviews were excluded.

A search was performed on EMBASE, LILACS, SciELO, PEDro, PubMed, and Scopus databases without language or date of publication restrictions. A combination of the keywords *postura*, *pescoço* and *adolescente* and their correspondents in English (posture, neck and adolescent) was used. Two blinded, independent reviewers selected the studies, first by title, then by abstract, and then by full text reading. The data were recorded in an Excel spreadsheet and the disagreements were resolved with a third researcher, until reaching a consensus.

As an inclusion criterion, the studies should address asymptomatic adolescent students, according to the age criteria of the World Health Organization (15 to 19 years),

and investigate the posture of these adolescents in front of electronic screens. Studies in symptomatic patients or with any musculoskeletal or orthopedic injury to the neck, shoulder, face, and/or spine were excluded.

Data extraction and risk of bias

The methodological quality of the studies was independently assessed by two blinded reviewers using the Newcastle Ottawa Quality Assessment Scale for case-control studies[21,22], recommended by the Cochrane Collaboration. The score ranges from zero to nine, with higher scores indicating a lower risk of bias[21]. Quality rating is interpreted as good (score ≥7), fair (score ≥5) or poor (score <5)[23].

Additional data synthesized were: study design, sample size, method of postural evaluation, electronic device used, results, limitations, and highlights. The extracted data and evaluation divergences between reviewers were resolved in a second meeting with a third researcher.

RESULTS

Selection of studies

In total, 1,997 articles were found until April 2021 and, removing the inter-database duplicates, 1,962 remained. Then, 1,858 articles were excluded after title reading, leaving 104 articles for abstract reading and then 39 for analysis of the full text. Of these, 35 were excluded: 22 addressed individuals with a mean age below 15 or above 19 years, 10 did not refer to the use of technology, and three evaluated only symptomatic individuals (Figure 1).
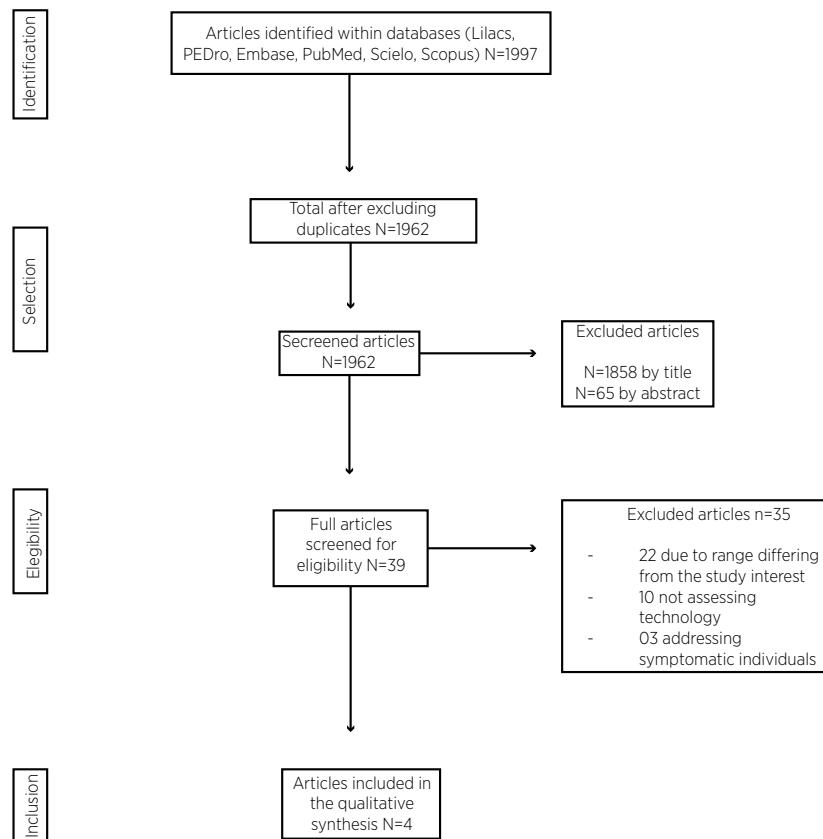

Figure 1. Flowchart with the different phases of the systematic review

Overview of included studies

Out of the four selected studies, three were prospective longitudinal and one was a case-control[24]. Two assessed body posture only regarding desktop computers[25,26], one assessed head and neck posture based on desktop and laptop computer use[27], and one assessed head and neck posture regarding smartphone use[24]. No study on posture that analyzed tablet computer use was found. Table 1 presents a detailed characterization of the studies.

Table 1. Summarization of the analyzed articles (n=4)

Author (Year) Study type Final classification (CF)	Sample	Objective	Resource used for posture assessment	Electronic screen type	Results
Briggs et al.[27] (2007) Longitudinal prospective study FC: good (8/9)	11 participants (eight boys and three girls)	To quantitatively analyze the sitting posture of children interacting with a book and a laptop/desktop computer, and to test the hypothesis that different postures are adopted according to the type of information technology used.	Videographic – Peak Motus Motion Analysis System	Use of desktop and laptop computer.	Reading a book resulted in a more flexed posture for high and low cervical flexions than using technological devices.
Brink et al.[25] (2009) Longitudinal prospective study FC: good (7/9)	104 participants (55 boys and 49 girls) Three-month-follow-up: 98 (51 boys and 47 girls) Six-month-follow-up: 93 (48 boys and 45 girls)	To determine whether sitting postural alignment and psychosocial factors contribute to the development of upper quadrant musculoskeletal pain in students working on desktop computers.	Photographic Posture Analysis Method (PPAM)	Use of desktop computer.	No difference was found between the high neck flexion angles of high school students with pain and those without pain.
Brink et al.[26] (2014) Longitudinal prospective study FC: good (8/9)	194 participants (116 boys and 78 girls).	To describe the variability of five postural angles in asymptomatic students while working on desktop computers and report the relation between posture, angles, age, sex, height, weight, and computer use.	3D Posture Analysis Tool (3D-PAT)	Use of desktop computer.	No association was found between computer use and posture, and between sex and posture. Greater use of the computer outside the school environment was identified. Trunk flexion was found to be the most variable measured postural angle, and that increased low neck flexion was significantly associated with weight gain.
Mohammed[24] (2020) Case-control study FC: poor (4/9)	40 participants (28 girls and 12 boys) Control: smartphone exposure time <4hs/day Case: exposure time >4hs/day	To determine the impact of smartphone use on head posture and upper limb capacity in adolescents and the correlation between them.	Evaluation by photogrammetry-analysis with AutoCAD	Smartphone use.	There was a higher angular measurement of high cervical flexion, lower craniovertebral angle, and greater shoulder protrusion in the group with greater exposure to the smartphone.

Methodological quality

The case-control study[24] was classified with poor methodological quality (Table 2), for not defining the case adequately, not scoring in the comparability criteria, not verifying exposure, and for the non-response rate being considered high. As shown in Table 2, the other three are prospective studies and were classified as having strong methodological quality[25-27], with two[26,27] receiving two points in the comparability criterion. The other study[25], on the other hand, no longer received a point in the selection criterion.

Table 2. Newcastle Quality Rating Scale – Ottawa

Criteria for methodological quality Cohort		Briggs et al. (2007) Cohort	Brink et al. (2009) Cohort	Brink et al. (2014) Case-control	Mohammed (2020)
Selection	Criterion 1	1	1	1	0
	Criterion 2	1	1	1	1
	Criterion 3	1	1	1	1
	Criterion 4	1	1	1	1
Comparability	Criterion 5	1	1	1	0
	Criterion 6	1	0	1	0

(continues)

Table 2. Continuation

Criteria for methodological quality Cohort		Briggs et al. (2007) Cohort	Brink et al. (2009) Cohort	Brink et al. (2014) Case-control	Mohammed (2020)
Outcome/Exposure	Criterion 7	0	1	1	0
	Criterion 8	1	0	1	1
	Criterion 9	1	1	0	0
Total (9)		8	7	8	4
Quality		Good	Good	Good	Poor

Note: 0: not met; 1: criterion met; for case-control studies, Criterion 1: adequate case definition; Criterion 2: representativeness of cases; Criterion 3: selection of controls; Criterion 4: definition of controls; Criterion 5: study controls for age/sex; Criterion 6: study controls for any additional factor; Criterion 7: verification of exposure; Criterion 8: same method of assessment for cases and controls; Criterion 9: non-response rate. For cohort studies, Criterion 1: representativeness of the cohort; Criterion 2: selection of the unexposed cohort; Criterion 3: determination of exposure; Criterion 4: outcome of interest; Criterion 5: study controls for age/sex; Criterion 6: study controls for any additional factor; Criterion 7: determination of outcome; Criterion 8: sufficient follow-up; Criterion 9: adequacy of follow-up to cohorts

Posture

Regarding postural analysis tools, two studies evaluated postures by simple photogrammetry[24,25], one study evaluated them by 3D photogrammetry[26] and one study by videography[27].

Also, three studies[25-27] evaluated postures during the sitting position: Briggs et al.[27] evaluated head tilt, gaze and neck angles; Brink et al.[25] evaluated head tilt and neck angle; and Brink et al.[26] evaluated head tilt, neck angle, and craniocervical angle. Only one study evaluated head tilt, neck angle, and craniocervical angle in the standing position[24] during smartphone use.

For Briggs et al.[27], reading a book resulted in a more flexed posture of high and low neck than using technology. In the study by Brink et al.[25], no difference was found between the high cervical flexion angles for subgroups regarding sex or symptomatology.

Moreover, Brink et al.[26] found no association between computer use and posture and no correlation between sex and posture, in addition to finding that trunk flexion is the most variable postural angle measured and that increased low neck flexion was significantly associated with weight gain.

On the other hand, Mohammed[24] found greater angular measurement of high cervical flexion, smaller craniovertebral angle, and greater shoulder protrusion in the group with greater smartphone exposure.

DISCUSSION

This systematic review aimed to identify whether electronic screens can influence head and neck posture in adolescents. Considering that 1,997 articles were selected (including duplicates) and 39 were read in full, to leave only four that could be included in this review, and despite the existence of a small number of publications in the area, most articles presented good methodological quality.

The criterion used to evaluate the articles was previously recommended by the literature[28], and the inter-rater agreement for the methodological classification of the articles was high (kappa:0.92), demonstrating that the evaluation process can be considered reliable.

This review considered changes in head and neck posture in adolescents in relation to computer and smartphone use. A systematic review on the topic found in the literature[29] evaluated the prevalence and risk factors for musculoskeletal complaints associated with the use of portable mobile devices (smartphones and tablets), preventing a comparison in relation to the dynamic posture in front of computers and laptop computers.

Overall, computer use is not responsible for postural changes, as book reading[27] resulted in a more flexed posture than technological devices for high and low cervical flexions, possibly due to the difference in the height at which the book is placed on the surface for reading in relation to the viewing height of a screen.

The articles by Brink et al. of 2009[25] and 2014[26] suggest that computer use leads to dynamic postural change due to body adjustments for the individual to remain in front of the computer, considering the position of the screen and its peripherals at the time of use of the device, but they do not make it clear whether this momentary posture will cause a static postural change.

Although a study[24] found greater angular measurement of high cervical flexion, smaller craniovertebral angle, and greater shoulder protrusion in the group with greater exposure to smartphone, this was the only evidence of worse postures when using a smartphone. Furthermore, this article score poor regarding methodological quality, despite the static evaluations performed while standing, it was the only one in which the smartphone was the electronic device considered.

There are some limitations to this systematic review. Although an extensive literature search was carried out, some studies may not have been found, in addition, unpublished or non-peer-reviewed studies were not searched. Still, there are other forms of methodological evaluation of studies.

CONCLUSION

There is very limited evidence that the use of technology is the cause of postural changes in the head and neck. Although this systematic review analyzed a small number of studies, it was found that the computer is not responsible for postural changes in the head and neck in adolescents, so further studies on the subject are encouraged.

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