ARTICLE REVIEW

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Myopia caused by the use of electronic devices screen: a literature review

Miopia causada pelo uso de telas de aparelhos eletrônicos: uma revisão de literatura

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Abstract

Myopia is a common eye abnormality that occurs when the image of a distant object forms before the retina with the ciliary muscle at rest. Among the predisposing factors, genetics and the environment stand out, with the latter gaining importance nowadays, considering the growing increase in the use of electronic screens. In this literature review, the authors seek the relationship between myopia and the use of screens by quantifying and analyzing the conclusions of research related to this topic. Some meta-analyzes sought to point out the existence of an association between myopia and the use of screens. However, the need for further studies to prove this link was highlighted almost unanimously among the texts. This was due to the fact that it is not possible to adequately separate whether the evolution of myopia occurred via electronics or by stimulating the use of near vision, which is associated with the former.

Keywords: *Myopia; Vision disorders; Smartphone; Screen time; Risk factors*

Resumo

A miopia é uma anormalidade oftalmológica comum que ocorre quando a imagem de um objeto distante se forma anteriormente à retina, estando o músculo ciliar em repouso. Dentre dos fatores predisponentes destacam-se a genética e o ambiente, tendo este último ganhado importância atualmente, visto o crescente aumento no uso de telas eletrônicas. Nesta revisão de literatura, os autores buscam a relação entre miopia e o uso de telas por meio da quantificação e análise das conclusões das pesquisas relacionadas a esse tema. Algumas metanálises buscaram apontar a existência de associação entre a miopia e o uso de telas. Entretanto, a necessidade de mais estudos para comprovar esse vínculo foi destacada de forma quase unânime entre os textos. Isso se deu pelo fato que não é possível separar adequadamente se a evolução da miopia ocorreu pelos eletrônicos ou pelo estímulo do uso da visão para perto, que está associada aos primeiros.

Descritores: Miopia; Transtornos da visão; Smartphone; Tempo de tela; Fatores de risco

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Introduction

Myopia is a very common ophthalmologic abnormality featured by the formation of distant objects before the retina, when the ciliary muscle remains at rest. It most commonly happens due to increased axial length of the eye.[1] Such a situation reduces distant vision, requires refractive correction through glasses or contact lens using, or through surgery, depending on each case.

Myopia is a very common refractive error that affects more than 50% of the population in industrialized countries. Such a number reported steady growth in the number of cases over the years, mainly among young adults. [2]

Genetic is the main predisposing factor for it. [2,3] However, environmental factors, namely: great educational pressure and reduced hours spent outdoors, have become more relevant in myopia pathogenesis to explain the significant increase in its prevalence. [1,4-8]

Electronic-device screen using has been currently suggested as one of the environmental risk factors for myopia development. [5,9-11] The great technological development observed in the last two decades allowed children to have access to computers, cellphones and other devices at early age. In addition, individuals in all age groups spend significant amount of time in front of electronic device screens.[12] Likewise, time spent in outdoor environments, which is a protecting factor against myopia, due to the exposure to sunlight, has decreased. [1,4-8]

Nowadays, children and adolescents are changing desktop computer using for tablets and smartphones. The number of children in the age group 4 to 6 years, who have their own smartphones, increased from 23% to 30%.[13,14] Smaller screens on cellphones make most children and adolescents hold the device closer to their eyes, and the visual effort resulting from it makes it easier to lose visual focus for distant images. [1]

Computer using increases the risk of developing myopia because it favors axial length increase of the eye, mainly because of reading at short distances. [9] Likewise, longer periods of outdoor activities by people who live in highly urbanized environments have been related to shorter axial length of the eye. [6]

The consequences of new lifestyles resulting from technological innovation cause the so-called computer vision Syndrome, which consists of blurred and/or double vision, dry and irritated eyes, which, in the long term, leads to eye disorders, such as myopia.

Aims

The aim of the current study is to qualitatively assess and evaluate publications concerning electronic-device screen using and myopia development. Previous research that confirm or deny the close association between these two elements were quantified after their assessment, conclusion was drawn based on such an association.

Methods

The current study is a literature review about the association between electronic-device screen using and myopia. Articles published from 2010 to 2020, written in Portuguese, Spanish and English and were selected from the PUBMED, SciELO and Lilacs database, based on the keywords "Miopia" and "Uso de Telas" and on their equivalents in English: "Myopia" and "Use

Table 1
Assessment of studies reporting evidence of association between myopia and electronic-device screen using

Author	Study type	Study site	Age group	Assessed individuals
Hansen et al. 2020[8]	Prospective cohort	Denmark	Mean age 16.6 years	1.443
Lee et al. 2013[10]	Quantitative	Taiwan	18-24 years	5.145 male military recruits
Guan et al. 2019[11]	Population research	Rural China	S/I	19.934 elementary school students
Fernández-Montero et al. 2015[13]	Cohort	Spain	Mean age of 38.5 years	17.217

S/I- Not informed

Table 2
Assessment of studies that did not report any evidence of association between myopia and electronic-device screen using

Author	Study type	Study site	Age group	Assessed individuals
Enthoven et al. 2020[5]	Prospective cohort	Rotterdam	6-9 years	5.074 children
Lanca et al. 2020[15]	Systematic review	S/I	3-19 years	49.789
Huang et al. 2015[16]	Systematic review and meta-analysis	S/I	6-18 years	25.025
Dirani et al. 2019[17]	Literature review	S/I	S/I	S/I
Huang et al. 2019[18]	Cross-sectional	Nanjing, China	S/I	1.153 university students

S/I: Not informed.

of Digital Devices".

Thirty-nine articles were found in the selected databases, 9 of them were selected after they were read. Articles were classified into two categories, based on their findings: 1) Studies showing some evidence of association between myopia and electronic–device using, and 2) Studies without concrete evidence of association between myopia and electronic–devices using.

Results

There were 4 studies showing some evidence of association between myopia and electronic-devices using (Table 1). The first research was an investigation carried out with male military recruits in the age group 18 to 24 years, in Taiwan - it encompassed 5,145 participants, in total. The second study was a cohort study carried out in Spain with 17,217 university students at mean age of 38.5 years. The third study assessed 19,934 elementary school students in rural schools in China. The fourth study was a prospective observational study carried out with 1,443 participants at mean age of 16.6 years.

The remaining 5 articles were classified into the second category, namely: studies with no concrete evidence of association between increased number of myopia cases and growing use of electronic devices (Table 2).

The first assessed study was a systematic review which had assessed 15 studies, carried out with 49.789 children in the age group 3 to 19 years. The second study was a systematic review and meta-analysis that have assessed 27 studies carried out with 25.025 children in the age group 6 to 18years. The aim of the third study was to identify and highlight the main risk factors for myopia development. The fourth study was a prospective cohort study that had assessed 5.074 children in the age group 6 to 9 years. The fifth study assessed 1.153 students in China.

Discussion

Studies showing some evidence of association between myopia and electronic–device using

Assessment performed by Lee at al. with male military recruits in the age group 18 to 24 years has proven the presence of greater axial length of the eye caused by computer using, which would lead to a greater risk for myopia development or worsening. [10]

In addition, their study assessed different impacts on vision due to reading in and using a computer. The first factor (reading) is related to low light and small fonts, whereas computer using concerns different accommodation patterns since the eye is subjected to blinking images. [10] Such differences point out that, although the two activities depend on near vision, they can cause different impacts on vision because of different accommodation patterns.

Another study, conducted with university students in Spain, reported myopia progression increase equivalent to the amount of hours spent in digital devices per week.[13] However, the study pointed out its own limitations, since data on the number of hours spent in front of electronic device screens was collected from reports by the students themselves, about it. Therefore, it is not possible properly distinguishing whether myopia evolution resulted from electronic–device using or from using near vision associated with such a use.

Study conducted by Guan et al. with 19.934 elementary school students in China's rural area measured children's visual acuity and assessed the impact on it caused by free time spent outside and of electronic–device using, based on questionnaires. [11]

There was clear association between prolonged electronic device using (more than 60 minutes) and children's vision decline. The study also reported the protective role of time spent outdoors in myopia progression, mainly at noon, when there is greater light intensity.

The aim of the prospective observational cohort study by Hansen et al. with 1.433 Danish students in the age group 16 and 17 years was to associate myopia prevalence with electronic screen using and with low physical activity rates, based on questionnaires. [8]

There was correlation between electronic device using and myopia development, mainly if such a use lasts longer than six hours, a week. Still, it was observed that the risk of disturbed vision doubles when it is associated with prolonged electronic screen using and with low exercising.

Studies with no concrete evidences of association between myopia development and electronic device using:

Lanca et al. conducted a systematic review about association between myopia development and electronic device using, which encompassed 15 studies: nine cross-sectional and six cohort studies.[15] The studies assessed 49.789 children in the age group 3 to 19 years and summarized the main statistical data available about myopia and electronic screen using. Seven on the fifteen studies concluded that there is association between myopia development and electronic screen using. However, one of the studies has acknowledged the need of developing further research to prove such an association. [15]

The systematic review with meta-analysis conducted by Huang et al. advocated for association between short-distance activities and myopia in children. [16] The review encompassed twelve cohort studies and fifteen cross-sectional studies carried out with 25.025 children in the aged group 6 to 18 years. Activities such as reading, studying, using the computer, writing, playing videogame, among others, were classified as short-distance activities. [16] However, the quantitative and qualitative balance of relevant articles on the topic remains insufficient to consolidate strong evidence of it.

The study performed by Dirani et al. stated that increase in short distance activities and reduced outdoor practices are the two main environmental risk factors for myopia development.[17] In addition, the study also pointed out the need of further research to quantify the effects of electronic device using on myopia.

Enthoven et al. conducted a prospective cohort study in 2020 and showed association between myopia development and short distance activities. The study was called "generation R" and encompassed a 5.074 children born in Rotterdam, between 2002 and 2006. [5]

The study performed with 1.153 university students in Naquin, China, aimed at assessing myopia prevalence and risk factors related to it, in the selected sample.[18] Data were collected from questionnaires that have assessed demographic information, family history of myopia and environmental factors, such as outdoor activities and the use of smartphones or computers.

The research has reported that having at least one parent with myopia is a risk factor for developing it.[18] In addition, myopia prevalence in students who spend at least two hours a day in outdoor activities is significantly lower than in the ones who do not do it. However, no significant association between myopia development and electronic screen using was found.

Conclusion

Only four of the nine assessed articles showed close association between electronic device using and myopia progression, but data in these studies was limited, since information was provided by questionnaires. However, time spent in outdoor activities is a protective factor against such a vision disorder.

The correlation between electronic screen using and myopia development requires further studies and analysis in order to be proven, although computer using and the use of other electronic devices were already defined as having the potential to damage that vision. Such an outcome results from the fact that it is not possible to properly distinguishing whether myopia evolution derives from electronics using or from the use of short-distance vision, which is also associated with electronics using.

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