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Revisión

# Contributions of educational interventions in the management of Computer Vision Syndrome: a review of the literature

## Aportes de las intervenciones educativas en el manejo del Síndrome Visual Informático: una revisión de literatura.

## Contribuições das intervenções educacionais no Manejo da Síndrome da Visão Computacional: uma revisão de literatura

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## Abstract

**Objective**: To identify health education interventions that have demonstrated improvements in the visual and ocular health of computer-using workers with Computer Vision Syndrome. **Method**: Bibliographic review of original articles in Spanish and English, published between 2017 and June 2022 in PubMed, Scopus, MEDLINE (EBSCO), Redalyc, and Ovid databases. **Results**: Out of 1,695 articles, 11 complied with the protocol. Of these, 90.90% were published from 2020 to June 2022 and India had the highest number of publications (27.27%). Most of the studies were experimental or quasi-experimental (36.36%), and for the qualitative synthesis they were classified in educational interventions with technology 54.54% (n=6) and those that handled traditional education 45.45% (n=5). **Conclusion**: Health education interventions were shown to contribute to the improvement of visual and ocular health of computer users with Computer Vision Syndrome. It is necessary to investigate and divulge results about the topic, which contribute to the processes of promotion of visual and ocular health, as well as in the prevention of Computer Vision Syndrome in the workplace.

**Keywords:** Health education; Literature review; Occupational health; Public health; Computer-using workers; Asthenopia.

## Resumen

**Objetivo**: Identificar intervenciones de educación para la salud que hayan demostrado mejoras en la salud visual y ocular de trabajadores usuarios de computadoras con Síndrome de Visión por Computador. **Método**: Revisión bibliográfica de artículos originales en español e inglés, publicados entre 2017 y junio de 2022 en las bases de datos PubMed, Scopus, MEDLINE (EBSCO), Redalyc y Ovid. **Resultados**: De 1.695 artículos, 11 cumplieron con el protocolo. De estos, el 90,90% se publicaron desde 2020 hasta junio de 2022 y la India tuvo el mayor número de publicaciones (27,27%). La mayoría de los estudios fueron experimentales o cuasi-experimentales (36,36%), y para la síntesis cualitativa se clasificaron en intervenciones educativas con tecnología 54,54% (n=6) y las que manejaban educación tradicional 45,45% (n=5). **Conclusión**: Se demostró que las intervenciones de educación en salud contribuyen a la mejora de la salud visual y ocular de los usuarios de computadora con Síndrome de Visión por Computador. Es necesario investigar y divulgar resultados sobre el tema, que contribuyan a los procesos de promoción de la salud visual y ocular, así como en la prevención del Síndrome de Visión por Computador en el ámbito laboral.

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**Palabras clave**: Educación para la salud; Revisión de literatura; Salud ocupacional; Salud pública; Trabajadores que usan computadoras; Astenopia.

## Resumo

**Objetivo**: Identificar intervenções de educação em saúde que demonstraram melhorias na saúde visual e ocular de trabalhadores usuários de computador com Síndrome de Visão de Computador. **Método**: Revisão bibliográfica de artigos originais em espanhol e inglês, publicados entre 2017 e junho de 2022 nas bases de dados PubMed, Scopus, MEDLINE (EBSCO), Redalyc e Ovid. **Resultados**: Dos 1.695 artigos, 11 estavam de acordo com o protocolo. Destes, 90,90% foram publicados de 2020 a junho de 2022 e a Índia apresentou o maior número de publicações (27,27%). A maioria dos estudos foi experimental ou quase-experimental (36,36%), e para a síntese qualitativa foram classificados em intervenções educativas com tecnologia 54,54% (n=6) e aquelas que tratavam da educação tradicional 45,45% (n=5). **Conclusão**: As intervenções de educação em saúde demonstraram contribuir para a melhoria da saúde visual e ocular de usuários de computador com Síndrome de Visão de Computador. É preciso investigar e divulgar resultados sobre o tema, que contribuam nos processos de promoção da saúde visual e ocular, bem como na prevenção da Síndrome da Visão do Computador no ambiente de trabalho.

**Palavras-chave:** Educação em saúde; Revisão da literatura; Saúde Ocupacional; Saúde pública; Trabalhadores que usam computador; Astenopia.



# Introduction

Computer Vision Syndrome (CVS) is defined by the American Optometric Association as a set of eye and visual health problems that are related to prolonged and uninterrupted use of computers and VDT devices, such as tablets, e-readers, and cell phones (1). For the purposes of this research, workers will be considered as computer users.

According to Blehm et al., (2) the signs and symptoms of CVS are classified as visual, ocular, asthenopic and skeletal muscular. Among the most frequent signs and symptoms are visual fatigue or tiredness, ocular burning, tearing, headache and blurred vision. All of them can occur in different frequencies and intensities (3-9) and be caused by intrinsic or extrinsic factors (10).

CVS is one of the main occupational risks of the 21st century. Almost 60 million people suffer from it and one million new cases appear every year (11). Some authors estimate that between 50% and 75% of people who use computers present symptoms of CVS, thus influencing the reduction of productivity at work, the increase of the error rate in tasks, decrease of job satisfaction and of visual abilities (3,6,12-17).

Among the CVS characteristics, it is known to affect women more than men. In the samples analyzed by these studies, it was found to be suffered by administrative workers (71%) and education sector workers (57.5%). Furthermore, studies have found prevalence of CVS of up to 74.3% in Spain, and the influence of variables such as spent screen time and optical compensation types (progressive glasses or contact lenses) may alter its symptomatology (18-23).

According to the systematic review and meta-analysis conducted by Singh S et al. on interventions for the management of CVS, there was evidence of positive outcomes generated by interventions for the management of CVS. Some of them include optical aids, complementary medicine and nutritional supplementation, artificial tears, environmental modification, ergonomic adjustment, visual hygiene, and binocular vision training (24).

Although most business organizations are committed to health education (HE) in the workplace, to promote health as well as to prevent disease, there were no findings of educational interventions that have contributed to the management of CVS symptoms in computer users (25). From the approach of public health, according to Arroyo and Cerqueira (26), HE uses different methods, strategies, and actions to promote health applied at the individual or group level.

Understanding occupational health as part of public health education, seeks to promote in workers the development of knowledge, attitudes, and skills that will favor decision making for health care. Similarly, it also seeks to create healthy environments that will improve health and well-being conditions (27).

Consequently, the purpose of this study is to carry out a literature review to identify HE interventions related to the control of signs and symptoms of CVS in computer-using workers. The results obtained will support decision making regarding the visual health of workers in the workplace.

# Methodology

## Research design

A literature review was conducted to provide a comprehensive synthesis of published information on educational interventions for the management of CVS in computer-using workers. Such a review describes the published material provided by recent literature on the topic in question that may motivate discussion, identify an idea for research, or clarify some concepts (28,29).

To improve the integrity of the report, the criteria of the PRISMA guide (Preferred Reporting Items for Systematic Reviews and Meta - Analyses) (30) were followed. The procedures presented in this guide were the reference for the methodological model in this review (Figure 1).

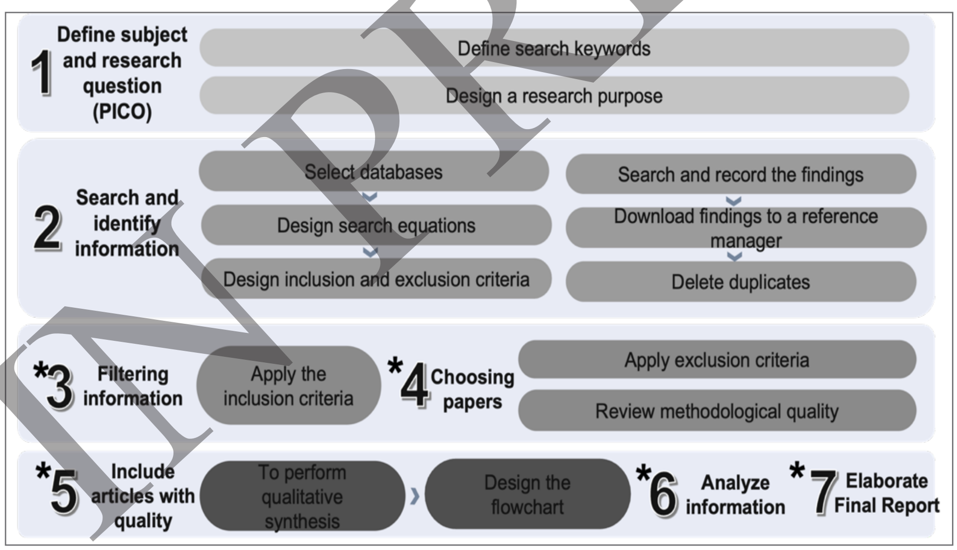


**Figure 1.** Methodological model of the systematic review according to the PRISMA guide (30).
**Note**: * Steps to be performed among peers
**Source**: Own elaboration based on the literature search process following the criteria of the PRISMA guide (30) 2022.

## Definition of the research question

The formulation of the research question was designed under the PICO (Patient, Intervention, Comparison, Outcome) format. The definition was supported by the need for information related to CVS and the usefulness of building a theoretical frame of reference to reflect the information in scientific publications about HE interventions that have been shown to improve the visual and ocular health of computer-using workers (Table 1) (31).

**Table 1**. PICO format

| | |
|---|---|
| Population | Computer-using workers with CVS |
| Intervention | HE Interventions |
| Comparison | Not Applicable |
| Outcomes / results | Improvements demonstrated by health education interventions in CVS |
| Research question | Which HE interventions have been shown to improve the visual and eye health of computer-using workers with CVS? |

**Source**: study data

Considering the PICO question, the purpose, theoretical framework, and the research question, the keywords of the search strategies were chosen (31). In addition, the different words related to the topic were identified, and verb tenses and variants of the keywords, synonyms and related terms were analyzed. Readings of other articles related to the topic, dictionaries, standard thesaurus, databases, and thematic headings were performed (32).

Subsequently, the keyword search was reduced to MeSH (Medical Subject Heading) terms: computers, computer terminals, occupational groups, education, health education, asthenopia; DeCS (Descriptors in Health Sciences): computer terminals, occupational groups, education, health education, asthenopia; and free terms: computer workers, workers, education computer vision syndrome, computer vision symptom, which are not restricted to a thesaurus and assuming some databases could omit information from the search for not using the appropriate terms (32).

Search and identification of Information

Given that the subject of the review is Health Sciences, five databases related to this content were selected in August 2022: PubMed, Scopus, MEDLINE (EBSCO), Redalyc and Ovid (33). The search was conducted considering the strategies presented in Table 2. In addition, a manual search for papers was performed following Schlosser's method (34).

**Table 2**. Search strategy.

| Database | Search equation |
|---|---|
| **PubMed** | (Computer Vision Syndrome OR Computer Vision Symptom OR asthenopia) AND (computer OR computer terminals) AND (occupational groups OR worker) AND (education OR health education) |
| **Scopus** | ALL ( ( ( "Computer Vision Syndrome" AND ( computer OR workers AND computer ) AND ( education OR "health education" ) ) ) ) |
| **MEDLINE (EBSCO)** | ( ( "Computer Vision Syndrome" AND ( computer OR workers AND computer ) AND ( education OR "health education" ) ) ) |
| **Redalyc** | (Computer Vision Syndrome OR asthenopia) AND (computer*) AND (workers) AND (education*) |
| **Ovid** | ((((((("Computer Vision Syndrome") OR ("Computer Vision Symptom*")) OR (asthenopia)) AND (computer)) OR (“computer terminals”)) AND ("occupational groups")) AND (education*)) OR ("health education*") {Incluyendo términos limitados relacionados} |

**Source**: study data

To design the search strategies, the keywords in Table 2 were considered. Different combinations were executed using AND and OR logical operators, which made it possible to locate the position of two or more words in the equation and in the record. Reserved symbols were also used to express some specificities such as quotation marks for compound words that should be treated literally and round brackets in order to sort the sense of the operations and avoid inadequate combinations between them (35).

The information search was obtained by specificity and was restricted to MeSH and DeCS terms. Search by sensitivity was applied where keywords were not restricted to a thesaurus. Both approaches were performed earlier according to the requirements of the databases (31,36). In addition, the proper order criterion of the equation was designed by the authors, including "Computer Vision Syndrome" as the first keyword to improve the search results.

Once the articles were identified, they were downloaded to the Zotero© reference manager and organized in an Excel© table by each database, title, year, and author, and duplicates were subsequently eliminated.

### Inclusion and exclusion criteria

The following were established as inclusion criteria: first, original articles written in English or Spanish; second, published between January 2017 and June 2022; third, search terms could be found anywhere in the text; fourth, the study population corresponded to computer-using workers; and finally, studies that included an educational intervention, whether it was a program, strategy, activity, or workshop to improve the visual and ocular health of workers with CVS.

On the other hand, the following were defined as exclusion criteria: first, review papers; second, manuscripts in preprint status; third, citations, conferences, encyclopedias or dissertations; fourth, papers written in languages other than those defined in the inclusion criteria; fifth, papers on translation, adaptation and/or validation of instruments; sixth, the study population were not workers; seventh, the target population were workers but not computer users; eighth, papers that did not answer the research question and/or the general objective; and finally, papers of low technical-scientific quality.

### Data analysis

To determine compliance with the inclusion and exclusion criteria, two of the authors independently read the titles, abstracts, and keywords to ensure reproducibility of the search and selection of papers. Discrepancies were resolved by consensus or referral to a third reviewer.

Papers that satisfied the inclusion criteria were selected for full-text reading.

The data collected were analyzed and organized according to their chronology through an Excel matrix by database, title, author, year of publication, country where the study was conducted, and type of educational intervention. For the purposes of this paper, the articles were classified as studies with educational interventions with or without the use of technology.

At this stage, several researchers blindly and independently carried out the article selection flowchart. As a result, the number of papers selected, those included and excluded by each phase of the PRISMA methodology are indicated, as well as a brief description of the reason for the decision. This procedure ensured the reproducibility of the study selection (37). If reproducibility was not found, the discrepancy was resolved by consensus or by reference to a third party who did not participate in the process in the first instance.

To carry out the documentary synthesis and generate conclusions, each of the authors independently executed an analytical process of the information extracted and synthesized from the different sources. Finally, recommendations and a list of bibliographical references were made.

## Analysis

Out of 1,695 articles, 11 complied with the protocol and their respective qualitative synthesis was carried out following the paper selection process in figure 2. According to the year of publication, 90.90% (n=10) of those studies found were published from 2020 to June 2022, and 2021 was the year with the highest frequency of published articles with 54.54% (n= 6).

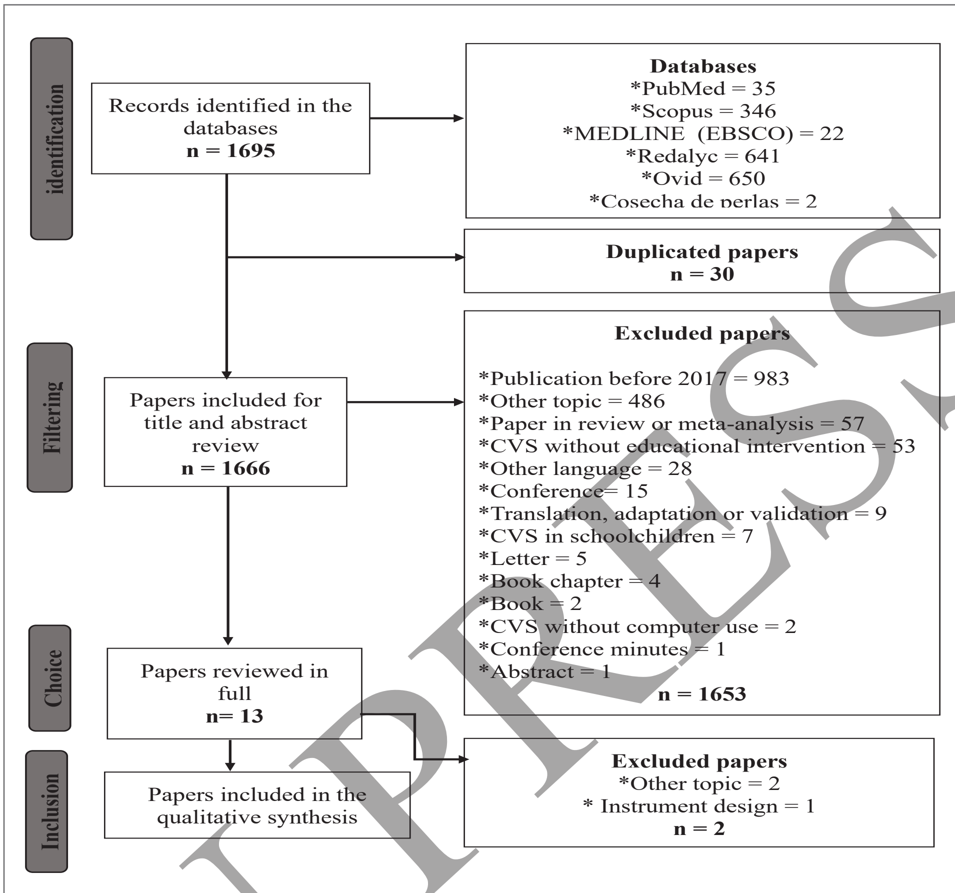


**Figure 2**. Flow chart for paper selection
**Source**: study data



Based on a frequency analysis, a sustained number of publications on educational interventions for the improvement of the signs and symptoms of CVS in the adult computer-using working population was evidenced from 2019 (Table 3).

In relation to the country where the study was conducted, the countries with the highest number of publications were India with 27.27% (n=3), Iran with 18.18% (n=2), and Saudi Arabia, Switzerland, China, Malaysia, Republic of Korea, and Spain with 9% for each country (n=1). According to the above and the search protocol, Asia was the continent with the highest frequency of publications.

Based on the type of study, most of the articles evaluated used experimental or quasi-experimental designs 36.36% (n=4), followed by randomized controlled trials 18.18% (n=2).

For the qualitative synthesis, the studies were divided into two groups, those that considered an educational intervention with application of technologies 54.54% (n=6) and those that did not use technologies 45.45% (n=5). Table 4 shows that digital application, brochures, and verbal communication were the most used tools to educate, each with 27.27% (n=3).

**Table 3.** Features of the selected articles considering year, country, and type of study.

| Author | Title | Year | Country | Type of study |
|---|---|---|---|---|
| Arshad et al. (38) | Prevalence of asthenopia among computer operators in Central India and effectiveness of educational intervention | 2019 | India | Longitudinal educational intervention |
| Alghamdi y Saif H.(39) | Impact of an educational intervention using the 20-20-20 rule on Computer Vision Syndrome. | 2020 | Saudi Arabia | Experiential intervention |
| Aegerter et al. (40) | On-site multi-component intervention to improve productivity and reduce the economic and personal burden of neck pain in Swiss office-workers (NEXpro): protocol for a cluster-randomized controlled trial. | 2020 | Switzerland | Randomized controlled trial |
| Anggrainy et al. (41) | The effect of trick intervention 20-20-20 on computer vision syndrome incidence in computer workers. | 2020 | China | Quasi-experimental with nonequivalent control group design |
| Rajendraprasa et al. (42) | Carboxymethyl Cellulose versus Hydroxypropyl Methylcellulose Tear Substitutes for Dry Eye Due to Computer Vision Syndrome: Comparison of Efficacy and Safety. | 2021 | India | Prospective, randomized, comparative, and open-label study |
| Hwang et al. (43) | Design guidelines of a computer-based intervention for computer vision syndrome: Focus group study and real-world deployment. | 2021 | Republic of Korea | Focus group and implementation study |
| Othman et al. (44) | Digital Healthy Lifestyle Application for UUM Computer User. | 2021 | Malaysia | Preliminary research, requirements gathering and analysis, prototype development and prototype validation. |
| Heydarabadi et al. (45) | Effect of educational intervention based on the extended parallel process model on the adoption of behaviors preventing physical injuries from working with computers among female employees. | 2021 | Iran | Quasi-experimental |
| Mohan Kumar, et al. (46) | Effectiveness on knowledge about computer vision syndrome among medical coding trainee in medical coding training institute in urban Chennai, Tamil Nadu - A cross- sectional study. | 2021 | India | Cross-sectional |
| Seguí-Crespo et al.(47) | Randomised controlled trial of an accommodative support lens designed for computer users. | 2021 | Spain | Double-blind prospective randomized controlled trial |
| Barkhordarzad et al. (48) | Effects of an ergonomic intervention program based on the PRECEDE–PROCEED model for reducing work-related health problems and exposure risks among emergency medical dispatchers. | 2022 | Iran | Quasi-experimental |

**Source**: study data



Considering the results of the review, the analysis focused on two situations: the first related to education with the application of technologies and the second with education without the use of technology.

## Education with the application of technologies

The new Information and Communication Technologies (ICT) have generated a great impact on the forms of social relationships affecting all fields and spheres of life. Specifically in the scenario of public health, eHealth has become an indispensable tool in health services or to support population interventions (49).

**Table 4.** Papers selected for qualitative analysis, considering the strategies, tools used in education and category of analysis.

| Author | Title | Year | Country | Type of study |
|---|---|---|---|---|
| Arshad et al. (38) | Prevalence of asthenopia among computer operators in Central India and effectiveness of educational intervention | 2019 | India | Longitudinal educational intervention |
| Alghamdi y Saif H.(39) | Impact of an educational intervention using the 20-20-20 rule on Computer Vision Syndrome. | 2020 | Saudi Arabia | Experiential intervention |
| Aegerter et al. (40) | On-site multi-component intervention to improve productivity and reduce the economic and personal burden of neck pain in Swiss office-workers (NEXpro): protocol for a cluster-randomized controlled trial. | 2020 | Switzerland | Randomized controlled trial |
| Anggrainy et al. (41) | The effect of trick intervention 20-20-20 on computer vision syndrome incidence in computer workers. | 2020 | China | Quasi-experimental with nonequivalent control group design |
| Rajendraprasa et al. (42) | Carboxymethyl Cellulose versus Hydroxypropyl Methylcellulose Tear Substitutes for Dry Eye Due to Computer Vision Syndrome: Comparison of Efficacy and Safety. | 2021 | India | Prospective, randomized, comparative, and open-label study |
| Hwang et al. (43) | Design guidelines of a computer-based intervention for computer vision syndrome: Focus group study and real-world deployment. | 2021 | Republic of Korea | Focus group and implementation study |
| Othman et al. (44) | Digital Healthy Lifestyle Application for UUM Computer User. | 2021 | Malaysia | Preliminary research, requirements gathering and analysis, prototype development and prototype validation. |
| Heydarabadi et al. (45) | Effect of educational intervention based on the extended parallel process model on the adoption of behaviors preventing physical injuries from working with computers among female employees. | 2021 | Iran | Quasi-experimental |
| Mohan Kumar, et al. (46) | Effectiveness on knowledge about computer vision syndrome among medical coding trainee in medical coding training institute in urban Chennai, Tamil Nadu - A cross- sectional study. | 2021 | India | Cross-sectional |
| Seguí-Crespo et al.(47) | Randomised controlled trial of an accommodative support lens designed for computer users. | 2021 | Spain | Double-blind prospective randomized controlled trial |
| Barkhordarzad et al. (48) | Effects of an ergonomic intervention program based on the PRECEDE–PROCEED model for reducing work-related health problems and exposure risks among emergency medical dispatchers. | 2022 | Iran | Quasi-experimental |

**Source**: study data



One of the eHealth strategies are the applications, also called Apps for health or mobile health,(49) which work on cell phones, tablets, or computers, and are generated by mobile technology developers, individuals, or organizations. These apps aim to facilitate tasks or assist in daily operations and management. The interaction between the user and the application is established through touch devices (7,50-52).

Health applications are very promising, bringing a new vision of the conception of health care for both the professional and the patient. They aim to empower the person who manages the application, giving him/her the ability to make decisions and exercise control over his/her personal life, essential in the promotion of health, modifying life habits, and other practices in favor of health.(53,54)

There are some systems studied before 2017 that have contributed to the management of CVS in computer users in the workplace such as EyeGuardian(55), EyePhone(56), BlinkBlink(57) and EyeProtector(58). However, according to the protocol of the present study, four studies used an application as an educational tool for CVS intervention: Anggrainy et al(41) with Eye Care - Protect Your Vision, Hwang et al(43) with LiquidEye, Aegerter et al(40) with Physitrack® and Othman et al(44) with a prototype of a digital application.

The Eye Care - Protect Your Vision application used in the first study analyzed by Anggrainy et al.(41) was designed as a tool to remind the worker every 20 minutes to rest for 20 seconds by either focusing vision on an object for up to 20 feet (6 meters) or closing the eyes. So, the participant's computer would beep every 20 minutes accompanied by the pop-up of notifications reminding them to rest.

The findings of Anggrainy et al.(41) show that the number of CVS symptoms experienced by the intervention group decreased after application for five days. These results prove the veracity of the causation network theory introduced by MacMahon and Pugh in 1970, who stated that knowledge of a single component can sometimes be used as a preventive measure(59).

On the other hand, the LiquidEye application belonging to the second research analyzed by Hwang et al.(43) was intended to achieve worker eye rest to minimize and prevent CVS-related symptoms by providing an intermediate screen with a full-screen black and white window, by managing prolonged computer usage time.

In contrast to other articles, Hwang et al.(43) studied, by means of the focus group technique, the effective elements for user interface in computer interventions in workers with CVS, discussing its advantages and disadvantages. The importance of the focus group lies in being able to know the perceptions, feelings, and thoughts of the subjects involved(60) allowing in this case to highlight educational needs on the CVS.

Another particularity in the study of Hwang et al (43) consisted of the participants visiting a laboratory to receive information about how to download the LiquidEye application on personal computers and to verify whether it worked correctly. There is evidence that laboratory practice as a didactic strategy promotes greater autonomy and participation in the educational activity (61).

Users who experienced LiquidEye over fourteen days evidenced that the statistically significant elements were: the strategy's instruction page explaining the need for eye rest, how to use the app and providing health information related to CVS, the setting of rest period goals, and the feedback on eye rest (43).

Other authors who used an app to educate include Aegerter et al.(40) This study combined workstation ergonomics, group health promotion information workshops, exercise, and the Physitrack® app to improve adherence to intervention with respect to productivity, prevalence and incidence in neck pain and headache in Swiss office workers (40).

Since 2012, Physitrack® has offered a free, modern, evidence-based solution available for download on a smartphone, tablet, or desktop computer. This tool allows people to take control of their rehabilitation in an interactive and informative way, easily accessing prescribed exercises, tips and instructions, and instructional exercise videos, through training reminders and feedback (40,62).

In contrast to the study by Anggrainy et al. (41), Aegerter et al.(40) (third study) proposed to investigate the impact of a multicomponent intervention using the Physitrack® app as an educational tool to contribute to adherence. Although the results of this research are not yet available, it is expected to have an impact on the individual, their workplace, as well as public and private policy by providing evidence for the treatment and prevention of neck pain and headache in office workers.

In the fourth study found, authors Othman et al. (44)

published preliminary research on the collection and analysis of requirements, development, and validation of prototypes of a digital application to contribute to a healthy lifestyle among a university community using computers in Malaysia, which may trigger eye fatigue and symptoms related to CVS.

To design the prototype, a literature review, user surveys, and comparative analysis were required to obtain user requirements to be considered in the design of the application. Among the prototype design requirements, the majority of respondents stated that the application should be interactive, easy to use, attractive, and have useful content (44).

Similar to the study by Aegerter et al. (40), Othman et al. (44) have not yet run the intervention with the final application. However, two professors with experience in multimedia teaching and research validated the prototype, confirming that it provides users with appropriate and engaging multimedia elements, giving the user freedom and flexibility and promoting motivation to use the application.

Among other tools for the teaching-learning process are videos, through which it is possible to deliver information and promote the participation of the target population. Multimedia information with images and videos is currently being incorporated in the learning process, having a high impact in replacement of traditional texts (63,64).

In accordance with the above, in the fifth article identified for this category, by executing an intervention based on a video teaching program with PowerPoint presentations lasting approximately 45 minutes about the generalities of CVS, Mohan et al. (46) found that most participants had an adequate level of knowledge about CVS.

Other technology tools used to educate in public health include the use of SMS (Short Message Service) or text messages (65-67). This tool was used by Heydarabadi et al. (68) who investigated the effect of the extended parallel process model on female workers in integral service health centers, sending a daily educational SMS for four weeks to the cell phone.(45) .This model, developed by Kim Witt in 1992, is used to provide health messages and prevent diseases and high risk behaviors (68).

Among the findings of the intervention by Heydarabadi et al (68) it was observed that the changes were greater in the efficacy group that received educational content through self-efficacy messages compared to the control group. This contributed to the acquisition of confidence in the participants' abilities and, therefore, in the exhibition of healthy behaviors.

To conclude this category, it is important to highlight as a strength that ICTs have favored the development of the HE of workers with CVS, providing tools that support this process. The benefits are based on the possibility of using applications, videos, and text messages, accompanied by images, sounds, and other attractive elements for the user, which allow greater participation, exchange, and collaborative work.

Hence the importance of interdisciplinary work between those who design the application, those who structure its content, and those responsible for informing or directly educating the worker, as well as the literature review of successful experiences and generalities of the subject. The challenge remains to continue with these types of interventions and to develop skills in the use of ICTs so that the target population acquires the necessary knowledge and contributes to their visual and ocular health.

## Education without the use of technology

Brochures and billboards are a common and traditional educational tool intended to increase the population's knowledge of a disease and to avoid misinformation sources (69). However, it is essential that the content of the brochures be carefully structured to maximize the chance that the information is communicated in an understandable and accessible way to the patient (70).

In relation to the above, studies by Alghamdi and Saif H. (39), Arshad et al. (38) and Barkhordarzadeh et al.(48) observed the use of brochures as an educational tool, and also found that one of them was unsuccessful in the management of CVS. In the first study by Alghamdi and Saif (39), the intervention group received information about CVS and a brochure of tips about how to decrease CVS symptoms by using the 20-20-20 rule. In addition, a sticker was placed on each computer monitor to remind users about the rule and to blink more frequently.

Unfortunately, the article does not show the specific content of the brochure that was used in the intervention. However, the findings show that twenty days after the educational intervention with these tools, patients who reported complaints of dry eye symptoms reported significant changes and a slight reduction in CVS symptoms (39).

A second study by Arshad et al. (38) also evidenced a significant change in symptoms and relief measures for CVS using brochures as an educational tool in 150 office employees for three months in India. The brochures explained the 20-20-20 rule, computer screen location, screen brightness adjustment, frequent blinking, presence of humidifier, correct posture, anti-glare screens, and optimal room lighting.

Regarding education on the 20-20-20 rule, the results of Anggrainy et al. (41), Arshad et al. (38) and Alghamdi and Saif (39) are consistent with those reported by the American Optometric Association, which suggests that following the 20-20-20 rule in daily up-close activities could eliminate CVS symptoms despite using different education tools (71).

In contrast to the previous results, in the third study analyzed by Barkhordarzadeh et al.(48) no significant changes in visual symptoms were observed despite the installation of billboards and distribution of brochures. The educational intervention also included five theoretical and practical face-to-face trainings of up to two and a half hours, sending reminders with 91 photos, 15 videos and animations and 20 messages, and solving doubts and concerns in a personalized format.

The use of educational brochures can sometimes be a useful Information, Education and Communication (IEC) tool for health as it was in the studies of Alghamdi and Saif (39) and Arshad et al. (38) However, other authors continue to emphasize counseling, instruction, and training of participants during interventions.

Rajendraprasad et al (42) advised participants to blink voluntarily and frequently and to follow the 20-20-20 rule. On the other hand, Seguí-Crespo et al (47) instructed participants to wear glasses in every task with electronic displays reminding them every month. The impact of these actions is not very clear, however, both contributed to the CVS-related objectives of each research.

According to the above, among the advantages of intervening in the working community with CVS through strategies without technology are the direct treatment that allows empathy, direct knowledge of the learning needs as well as the knowledge of the target population, flexibility, and the ability to solve doubts and concerns at the time of the intervention. However, some interventions such as Barkhordarzadeh et al (48) showed no impact on the target population. Therefore, the challenge remains to use other strategies and additional technological tools that contribute to the impact on HE.

## Conclusions

- There are HE interventions related to the use of technological tools that demonstrated to improve the visual and ocular health of computer user workers such as digital applications, and others that without technology showed favorable results such as verbal communication.
- Currently, mobile applications are a complementary trend used as a complementary tool in the teaching-learning process in the workplace. These tools are oriented to the transmission of knowledge in an easy, practical, and dynamic way, all thanks to the interactivity of the application, and a high acceptance by the target population.
- However, despite the evidence collected regarding the positive impact of technology on the teaching-learning process, by itself it does not fulfill the educational objective, and it is at this point where technology-free education strategies would complete the intervention processes.
- Therefore, research is needed that includes mixed educational interventions with technology and traditional education, allowing computer user workers to achieve visual and ocular health and prevent CVS. In addition, the divulgation of evidence on IEC strategies and tools could support researchers or stakeholders who make use of them in promotion and prevention programs in companies.

### Conflicts of interests.

The authors declare that they have no conflict of interest.

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