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Research article

Severity of Computer Vision Syndrome in computer-using workers: assessment of the association with Healthy Lifestyle and Dry Eye condition

Severidad del Síndrome Visual Informático en trabajadores usuarios de computadores: evaluación de la asociación con Estilo de Vida Saludable y condición de Ojo Seco

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Abstract
Emerging risks at work can be caused by new information and communication technologies, such as computer use, which can generate new alterations to the health of workers such as Computer Vision Syndrome, which can be determined by sociodemographic factors, lifestyle, and dry eye condition. The objective of this work is to evaluate the association between Computer Visual Syndrome (CVS) severity with healthy lifestyle (EVS) and dry eye syndrome (OS) in workers computer users, through a quantitative, observational, cross-sectional study with analytical intentionality in a sample of 300 workers of a public higher education institution in Colombia 2022. The results show significant levels of correlation in the total Computer Vision Syndrome severity scores with total Healthy Lifestyle and Dry Eye. A review notes that physical activity and stress management differ significantly across levels of Computer Vision Syndrome severity. Dry eye symptoms, conditions, and actions vary significantly between levels of Computer Vision Syndrome severity. The findings support the proposal of an occupational health surveillance system to generate a healthy work environment, strengthening the ability of workers to acquire healthy lifestyles through health-promoting behaviors and address problems such as dry eye and Computer Visual Syndrome. This research provides an empirical contribution to the actions of the occupational safety and health management system related to the promotion of visual and ocular health, in addition to contributing to an operational definition of a healthy lifestyle that encourages the management of behaviors that promote the safety and health of the worker with respect to the syndrome.
Keywords: Computer Visual Syndrome, Occupational Safety and Health, Healthy Lifestyle, Dry Eye Syndrome, Severity CVS, Visual Health, Workers, Computer Users, Occupational Exposure.

Resumen
Los riesgos emergentes en el trabajo pueden ser provocados por las nuevas tecnologías de la información y la comunicación, como por ejemplo el uso del computador, que puede generar nuevas alteraciones a la salud de los trabajadores como lo es el Síndrome Visual Informático, el cual puede estar determinado por factores sociodemográficos, el estilo de vida, y el ojo seco. El objetivo de este trabajo es evaluar la asociación entre la severidad Síndrome Visual Informático con el estilo de vida saludable y el síndrome de ojo seco en trabajadores usuarios del computador, en un estudio cuantitativo, observacional, transversal y con intencionalidad analítica en una muestra de 300 trabajadores de una institución de educación superior pública en Colombia 2022. Los resultados evidencian niveles de correlación significativos en las puntuaciones totales de severidad del Síndrome Visual Informático con el total de estilo de vida saludable y ojo seco. Una revisión apunta que la actividad física y el manejo del estrés se diferencian significativamente en los distintos niveles de severidad del Síndrome Visual Informático. Los síntomas, condiciones y acciones del ojo seco varían significativamente entre los niveles de severidad del Síndrome Visual Informático. Los hallazgos soportan la propuesta de un sistema de vigilancia de salud en el trabajo para generar un entorno laboral saludable, fortaleciendo la capacidad de los trabajadores de adquirir estilos de vida saludables por medio de conductas promotoras de la salud y afrontar problemas tales como el ojo seco y el Síndrome Visual Informático. Esta investigación da un aporte empírico para las acciones del sistema de gestión en seguridad y salud en el trabajo relacionado con la promoción de la salud visual y ocular, además de contribuir a una definición operativa del estilo de vida saludable que incentive la gestión de conductas promotoras de la seguridad y salud del trabajador respecto al citado Síndrome.

Palabras Clave: Seguridad y Salud en el Trabajo, Estilo de Vida, Salud Visual, Trabajadores, Usuarios del Computador, Exposición Ocupacional

SUMMARY

Introduction

With the introduction of new information and communication technologies in the workplace, changes in the working population and the labor market, new forms of employment and their structure, workplaces are undergoing continuous changes that contribute to the emergence of new risks, challenges and difficulties for the safety and health of workers. An increasingly frequent risk is Computer Vision Syndrome (CVS), which needs to be known and managed from the viewpoint of Public Health and Occupational Safety and Health, (Rathore, 2017). According to the American Optometric Association, CVS is a set of problems resulting from focusing the eyes on a screen of any technological device, for a prolonged period and without rest (American Optometric Association, 2021.), while for Portello et al. (2012) and Blehm et al. (2005), this syndrome refers to the possible ocular and visual symptoms associated with computer exposure.

Some authors such as Blehm et al. (2005), Charpe & Kaushik (2009), Hedman (1988), Miranda et al. (1989), Sá (2010), Tamez et al. (2003), Taptagaporn and Saito (1993), estimate that between 50.00% and 75.00% of people who use computers present symptoms of CVS. Other studies conducted in Colombia with non-validated tools and optometric examinations demonstrate a high prevalence of CVS in the workplace (Chang-Míderos & Sanabria-Sánchez, 2019; García-Álvarez & García-Lozada, 2010; Reyes-Rincón, 2019).

Regarding evidence of the degree of severity of CVS in workers, there is a study conducted in radiologists in Saudi Arabia, the Mean CVS score was 7.50 (interquartile range: 4.00; 12.00), 69.10% presented a slight level of severity, 25.40% moderate and 5.50% severe. Also, two-thirds of the participants experienced CVS, and almost one-third of them had a score suggestive of moderate to severe CVS (Alhasan & Aalam, 2022). Another study from Sri Lanka found that most subjects with CVS had severe symptoms (57.90%), while 42.10% had symptoms of slight to moderately severe ($p < 0.05$); furthermore, they evidenced that those with severe CVS were on the job longer than those with slight to moderate CVS (Ranasinghe et al., 2016).

Among the intrinsic risk factors of CVS is Dry Eye Syndrome (DES) (Tsubota et al., 2017), which also affects well-being, quality of life, work productivity and socioeconomic burden, becoming a global public health problem. According to some DES prevalence studies, varied results have been found up to 68.00% in Palestine (Shanti et al., 2020), 35.84% in China (Long et al., 2020) and 10.00% in Arab Emirates (Aljarousha et al., 2021). On the other hand, computer use has also been found to decrease the number of blinks, leading to incomplete blinks, tear evaporation, and subsequently DES (Portello et al., 2013).

However, the excessive use of technologies is causing drastic changes in people's behaviors (Rivera-Tapia et al., 2018). Considering that the economically active population spends approximately one third of their time in the workplace (World Health Organization (WHO), 2017), and an average of six to eight per day hours in front of the computer (Mongrell, 2015; Health nutrition and well-being, 2013), flexible work patterns and the 24-hour economy increase the workload with complex tasks, feelings of isolation, and an imbalance between

work and personal life increasing the risk of stress and burnout (European Agency for Safety and Health at Work, n. d.), leaving aside the health-promoting behaviors that lead to Healthy Lifestyle (HLS).

In accordance with the above, authors such as Fagalde et al. (Fagalde et al., 2005), Cerecero et al. (Cerecero et al., 2009), Salinas J et al. (Salinas et al., 2014) and Portillo et al. (Portillo et al., 2008), have analyzed that behavioral risk factors evidence an inadequate lifestyle in economically active population. Other studies report that more than three hours of daily exposure to computers increases the prevalence of CVS and others report that being exposed for more than thirty hours per week for more than ten years increases somatic, depressive, and obsessive symptoms (Esparza-Córdoba, 2017).

During 2019 and 2020, studies reported that the second subsector with employed personnel who used the computer the most in Colombia was private higher education with 97.40% and 94.85% respectively (National Statistics Department, 2022), which makes them a high-risk population for acquiring CVS, DES and neglecting health promoting behaviors that can lead to HLS. Considering the degree of severity of CVS in computer user workers, as well as the attitudes towards health and actions they take to maintain a healthy lifestyle together with the degree of exposure in the workplace to activities that lead to the appearance of symptoms or performance of actions that contribute to the condition of DES, it is proposed to associate the Computer Visual Syndrome with the dimensions of Nola Pender's HLS and the DES syndrome of computer user workers of a public university in Colombia in a quantitative, observational, cross-sectional study with analytical intentionality.

Resolution scheme

1. Research problem

Is there evidence to establish a significant relationship between the degree of severity of CVS and the mean values of the dimensions of the HLS and DES scales?

2. Methodology

A quantitative, observational, cross-sectional study with analytical intentionality (Sampieri Hernandez et al., 2016), was conducted in a public university in Colombia from November 2021 to December 2022. Participants were selected if they fulfilled the criterion of using computers to perform their jobs. Workers ranged in age from 18 to 77 years with an average age of 43 years. Workers were invited to participate via e-mail from the human resources office of the educational institution.

The selection criteria applied included workers over 18 years of age, born in Colombia, native Spanish speakers in Colombia, exposed to the computer at work and with a one-year history of exposure to the computer at work. Exclusion criteria considered included workers who in the last year had undergone refractive surgery to eliminate myopia, hyperopia, astigmatism or presbyopia, cataract surgery and workers who were receiving eye treatment (medications, ointments, eye drops, artificial tears) at the time of the study.

A census was applied via e-mail to the university's computer users, together with the invitation to participate in the study and the instruments to be filled out in a web application. In order to obtain a high precision of 99.00% confidence, the Linacre analysis was taken as a reference, where the minimum sample size range required for the validation of the instrument

should be between 250 participants up to 20 per number of items (Linacre, 1994). Regarding ethical considerations, the study was approved by the Ethics Committee of the CES University of Medellin (project 960, session 177 of 2021) and was conducted in accordance with the criteria established in the Declaration of Helsinki (World Medical Assembly, 1964). According to the informed consents, these were accepted through the virtual application where the instrument was located and sent by e-mail. In addition, the precepts of Law 1581 of 2012 on the treatment of personal data were complied with.

CVS severity is measured through the CVS-Q© instrument, a questionnaire designed and validated in Spain by Seguí et al. (Seguí et al., 2015) that assesses the frequency, intensity, and severity of sixteen symptoms of CVS with three response options for frequency (0: never, 1: occasionally, 2: often/always), and two response options for intensity (1: moderate or 2: intense). Severity is the result of multiplying frequency by intensity. Currently the adaptation and validation with Rasch analysis for use in Colombia is in the process of revision.

On the other hand, the Health Promoting Life Profile II (HPLP II) questionnaire was used for the measurement of lifestyle (Nola J. Pender et al., 2015), an instrument published in Spanish with an alpha reliability coefficient of 0.93, test-retest reliability of 0.86 and Cronbach's alpha coefficients from 0.70 to 0.87 (Jaimes & Díaz, 2014), and which has been used on several occasions in Colombian population (Galán-González & Guarnizo-Tole, 2019; Jaimes & Díaz, 2014; Salamanca-Ramos, 2015; Salazar-Torres et al., 2010). The HPLP II presents 52 items divided into the dimensions of health responsibility, physical activity, nutrition, interpersonal relationships, stress management and spiritual growth.

In relation to the DES condition was evaluated through the ODSI (Ocular Disease Surface Index) Questionnaire, a 12-item instrument that identifies the severity and classification of DES according to its symptomatology, designed by the Outcomes Research Group at Allergan Inc (Irvine, California), valid and reliable in Colombian population (Rico et al., 2015).

Data were analyzed using Statistical Package for Social Sciences (SPSS) software, version 29. The dependent variable in this study was CVS severity considering the total score divided into three levels. Descriptive analyses of the data were presented as percentages or means ± standard Deviations and confidence intervals. Tests of association between continuous variables were performed using Pearson's correlation coefficient and their statistical significance was evaluated. The evaluation of significant differences between continuous variables at each of the levels of the dependent variable was performed through the significance of the F statistic obtained from the application of the one-way ANOVA.

The distribution of CVS severity was analyzed according to its percentile ranges and three levels of severity were established: Low<=4 points; Medium between 5 and 9 and High 10 points or more. The CVS scale is made up of 52 items grouped into six dimensions: health responsibility, physical activity, nutrition, spiritual growth, interpersonal relationships, and stress management.

The items were rated on a Likert-type scale from 1 to 4, where never equals 1, sometimes 2, almost always 3, always 4. To obtain the rating for each dimension, each of the corresponding items was added together, and to obtain the HLS, all the items were added together, with a minimum score of 52 and a maximum score of 208.

We worked directly with the total score of each dimension to analyze in Detail the significance of each one in relation to the level of Severity of CVS.

In reference to the ODSI scale, the internal structure organized in three categories was considered: symptoms (items 1 to 5); actions (items 6 to 9) and conditions (items 10 to 12). The 12 items of the ODSI questionnaire were scored on a scale from 0 to 4, where 0 indicates

none of the time, 1 is part of the time, 2 equals half of the time, 3 is most of the time and 4 means all the time. The total ODSI score was calculated with the formula of: ODSI= [(sum of scores for all questions answered) × 100]/ [(total number of questions answered) × 4].

3. Writing plan

3.1 Computer Vision Syndrome (CVS)

Computer Vision Syndrome (CVS) is a set of ocular and visual health alterations experienced when performing near vision, specifically with the use of video terminal devices such as the computer (American Optometric Association, 2021).

Regarding the signs and symptoms of CVS, authors state that they do not always occur with the same frequency in people who use the computer, the most frequent being: visual fatigue, burning eyes, tearing, headache and blurred vision (Blais, 1999; Chu et al., 2011; Hedman, 1988; Montalt & Torregrosa, 1999; Rossignol et al., 1987; Sá, 2010; Wolkoff et al., 2005). The factors that cause CVS symptoms are different therefore their management should be individual (Castillo-Estepa & Iguti, 2013).

There are several risk factors that contribute to CVS that can be intrinsic or extrinsic. Among the intrinsic ones, i.e., those specific to the worker, are gender, age, suffering from systemic diseases, the use of some drugs, cosmetics, and contact lenses, as well as Dry Eye Syndrome (DES) (Tsubota et al., 2017). On the other hand, there are extrinsic ones, such as prolonged computer use, considering that the probability of workers suffering from CVS increases with the time of computer exposure per day (Taino et al., 2006; Ye et al., 2007) and not taking breaks (Speeg-Schatz et al., 2001; Ye et al., 2007).

Although there is no evidence that CVS symptoms lead to permanent eye damage in addition to visual impairment, it causes inefficiency in the workplace. Therefore, CVS is a growing public health problem that can significantly affect workers' quality of life and work productivity (Charpe & Kaushik, 2009).

3.2 Healthy Lifestyle (HLS)

Healthy Lifestyle (HLS) is a construct that has been used generically, as a way of life expressed in the spheres of behavior and customs, adapted by housing, possessions, relationship with the environment and interpersonal relationships (Montoya, 2010). According to the World Health Organization (1998), the HLS is a way of life based on behavioral patterns, which is subject to the interrelation between the characteristics of each person, social relations, and socioeconomic and environmental conditions (p.27).

Interest in the study of Healthy Lifestyle (HLS) peaked in the 1980s. According to Montoya LRG (Montoya, 2010), there is no internationally accepted definition of HLS, but most authors explain it as a group of voluntary and involuntary behavior patterns that affect health. In contrast, in Nola Pender's (2015) Model of Health Promotion, and from the context of health, LS "defines discretionary activities that are a regular part of the pattern of daily life and significantly influence health status" (p. 93).

According to Pender the Health Promoting Behaviors (HPBs) lead to an HLS for positive health outcomes, wellness, and a productive life; according to the author, HPBs are summarized in the dimensions of responsibility in health, nutrition, physical activity, stress

management, interpersonal relationships, and spiritual growth, which are defined by Nola J. Pender et al. (2015) as follows:

- Health responsibility: is that active sense of personal responsibility for one's own well-being, based on the premise that all people are free to make their own decisions about maintaining or changing health behavior practices. (p. 51).
- Nutrition: is the main determinant of good health. Adequate assessment of the nutritional status of individuals is always necessary to establish a baseline for effective health promotion planning. (p. 86).
- Physical activity: contributes to the physical and psychological health status of individuals through high-level functioning; decreases the risks of chronic diseases, improves mood and self-esteem (p. 84).
- Stress management: stress is a threat to people's physical, psychological, and social health, which must be managed by one's coping measures, which represent those continuous efforts to manage specific internal and external demands that exceed personal resources (p. 88-89).
- Spiritual growth: is the capacity of individuals to develop the inner self to its fullest potential (p. 90).
- Interpersonal relationships: provides psychological and material resources to benefit an individual's ability to cope with daily life situations (p. 200).

3.3 Dry Eye Syndrome (DES)

In 2014, the Asian Dry Eye Society defined DES as a multifactorial disease characterized by an unstable tear film that causes various symptoms and/or visual impairment and may possibly be accompanied by damage to the surface of the eye. This description brings together the definitions that various experts were establishing between 1996 and 2007 but emphasizing an importance on the tear film and subjective complaints (Tsubota et al., 2017).

DES can cause ocular symptoms such as foreign body sensation, redness, light sensitivity, pain and tearing as a result of corneal irritation (Javadi & Feizi, 2011). Multiple occupational factors are implicated in DES, but the ones repeatedly mentioned come from working with VDTs in what some researchers have called CVS (Wolkoff, 2010), and in office jobs and related to environmental conditions (Madhan, 2009).

Currently, DES is one of the leading causes of admission to ophthalmology. There are several factors causing the increase in the prevalence of DES in the world, such as the increased use of video terminals such as computers and cell phones, aging and stressful environment. Therefore, early diagnosis and identification of risk factors for prevention and treatment is important (Garg et al., 2006, 2022).

4. Research results

A total of 300 Colombian public university students participated in the study. The mean age in years (±DE) was 43 (±12) with a wide range between 18 and 77 years, the Mean was 42 years. Of the total, 61.70% corresponded to the female sex and 32.30% to the male sex. 46.00% of the group was 40 years old or younger. Of the group, 41.00% registered low severity levels, and approximately 60.00% registered moderate to high severity levels (table 1).

Table 1. ***Sample studied, distributed by sex, age, and CVS severity level***

Severity level		Sex		Age		
		Male	Female	<=40 years	> 40 years	Total
<= 4 Low	f	53	70	61	62	123
	%	17,7	23,3	20,3	20,7	41,0
5 - 9 Medium	f	33	57	39	51	90
	%	11,0	19,0	13,0	17,0	30,0
+10 High	f	29	58	38	49	87
	%	9,7	19,3	12,7	16,3	29,0
Total	f	115	185	138	162	300
	%	38,3	61,7	46,0	54,0	100,0

Source: own preparation.

Considering the total score, CVS severity presents a mean score of 6.70 with a high DE of 5.09 points, a wide range equivalent to 25 points and an CI for the mean varying between 6.13 and 7.28 points. About 25.00% of women have severity values above 11 points and 50.00% of those over 40 years of age have scores between 3 and 10 points (table 2).

The HLS results are more homogeneous, registering a mean of 141.43 points and a DE of 20.83, indicating low variability in the set of measures. Women register the highest values in the set and 25.00% of those under 40 years of age score below 128 points. The total ODSI scale has a mean of 21.83 with a moderate DE of 7.80 points and CI 95% for the mean ranging from 20.94 to 22.72. 21.00% of the group scores above 21 on the ODSI scale. Of those over 40 years of age, 25.00% scored above 26. 24.00% of workers of both sexes scored below 15 points.

Table 2. ***Descriptive Statistics: Total Severity, HLS and DES Scores***

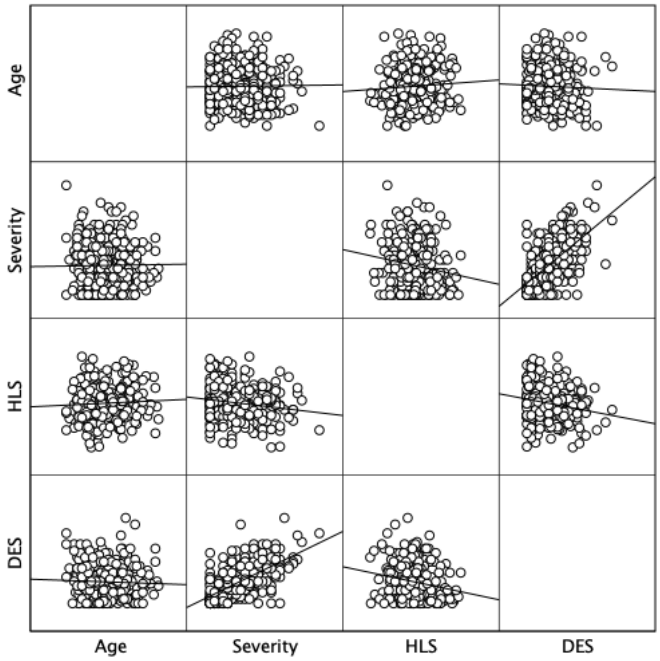
		Sex		Age		CI 95%
		Male	Female	<=40	>40	lb-ub
	Median	6,27	6,97	6,55	6,83	(6,13-7,28)
Severity	SD	4,93	5,18	5,20	5,00	
Mean=6,70	Max	20,00	25,00	25,00	20,00	
Median=6	Min	,00	,00	,00	,00	
SD=5,09	Pc25	3,00	3,00	3,00	3,00	
	Pc75	10,00	11,00	10,00	10,00	
	Median	141,05	141,66	140,59	142,14	
HLS	SD	21,43	20,45	21,74	20,00	(139,07-143,79)
Mean=141,43	Max	195,00	201,00	201,00	195,00	
Median=141,50	Min	86,00	85,00	85,00	97,00	
SD=20,80	Pc25	126,00	128,00	128,00	128,00	
	Pc75	153,00	153,00	153,00	153,00	
	Median	21,73	21,89	22,16	21,54	
DES	SD	7,91	7,75	7,77	7,83	(20,94-22,71)
Mean=21,83	Max	48,00	51,00	44,00	51,00	
Median=21	Min	12,00	12,00	12,00	12,00	
SD=7,80	Pc25	15,00	15,00	16,00	15,00	
	Pc75	27,00	26,00	27,00	26,00	

SD: Standard Deviation; CI: Conficent Interval; lb: lower bound ub: upper bound
Source: own preparation.

An evaluation of the level of association between these variables through Pearson's correlation coefficient is shown in figure 1. Considering the r values for Age in relation to the variables HLS, DES and Severity, low and non-significant results were obtained (r=0.059,

p=0.305; r=0.041, p=0.477; r=0.014, p=0.805). On the other hand, the correlation of HLS with DES and Severity was low and inversely proportional and statistically significant at the 1% level (r=-0.201, p=0.000; r=-0162, p=0.005). Similarly, the correlation between DES and Severity was high and directly proportional and statistically significant (r=0.635, p=0.000).

Figure 1. ***Correlation matrix between Severity CVS, age, HLS and DES.***

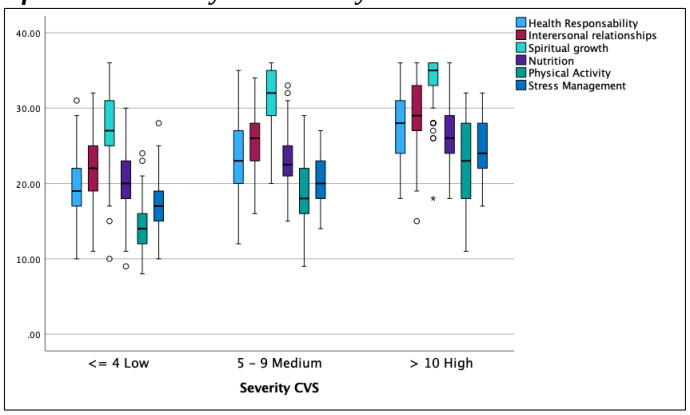


Source: own preparation.

Figure 2 shows the behavior of the HLS scale scores in relation to the severity levels of CVS considering each of the dimensions. We observe that on average workers score higher in the dimensions related to attitudinal aspects towards health and well-being such as spiritual growth (represented by mean values around 30 points) and health responsibility (mean values in this subscale around 25 points). At the other extreme is the physical activity dimension with the lowest mean scores of the set around 15 points and stress management, slightly higher, around 20 points. An even and uniform distribution is observed in the different dimensions of the HLS across the different levels of CVS Severity.

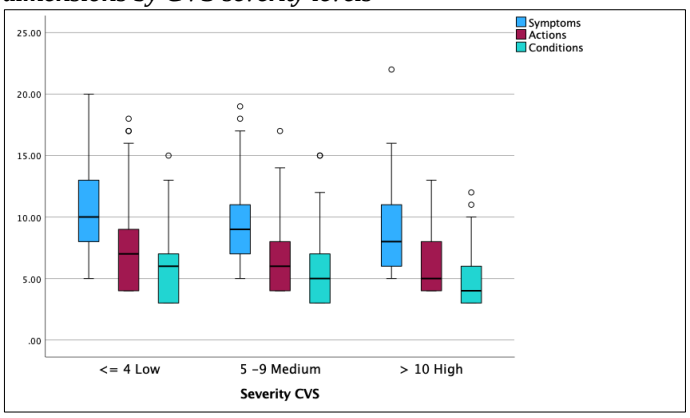
In relation to the DES (Figure 3), a greater concentration of cases with higher scores is observed as the severity level rises on the scale. Symptoms are the variables with the highest incidence and ascend progressively from 5 points at the low severity level and exceed 20 points at the high severity level. Environmental conditions dimension contributes the least to the severity level condition as far as the DES is concerned. Users consider that activities or actions such as reading, driving, working with a computer, or watching TV contribute moderately to the presence of the DES condition.

Figure 2. ***Dimensions of the HLS scale by CVS severity levels***



Source: own preparation.

Figure 3. ***ODSI scale dimensions by CVS severity levels***



Source: own preparation.

When evaluating the presence of statistically significant relationships we found that globally the CVS, HLS and DES scales present p-values less than 0.05 confirming that the means in the different levels of CVS severity in these scales differ significantly at the 5.00% level (p=0.004 for ESV and p<0.001 for DES) (table 3).

Table 3. ***ANOVA of one factor Dimensions of HLS and DES by CVS Severity levels***

		Severity CVS			
		<= 4 Low	5 - 9 Medium	> 10 High	F p value
HLS	**Mean**	**145,99**	**139,56**	**136,92**	**0,004**
	Sd	**21,58**	**20,44**	**18,89**	
Health Responsability	Mean	23,95	22,47	22,71	0,104
	Sd	5,71	5,38	5,29	
Interpersonal Relationships	Mean	26,28	25,57	24,63	0,067
	Sd	5,33	4,89	4,82	
Spiritual growth	Mean	31,45	30,57	29,95	0,088
	Sd	4,77	5,02	4,98	
Nutrition	Mean	23,39	22,73	22,99	0,555
	Sd	4,57	4,60	4,12	
Stress management	Mean	21,40	20,23	19,77	0,004
	Sd	4,76	4,23	4,06	
Physical activity	Mean	19,52	17,99	16,86	0,022

	Sd	5,85	5,94	5,21	
DES	**Mean**	**16,94**	**22,24**	**28,30**	**<0,001**
	Sd	**4,97**	**6,43**	**7,54**	
Symptoms	Mean	7,13	9,76	12,51	<0,001
	Sd	2,16	2,55	3,62	
Actions	Mean	5,66	6,91	8,40	<0,001
	Sd	2,57	3,05	3,17	
Conditions	Mean	4,15	5,58	7,39	<0,001
	Sd	1,79	2,64	2,62	

Source: own preparation.

A detailed analysis for the six dimensions that make up the HLS scale indicates that the dimensions that correspond to attitudinal aspects towards health, that is: Responsibility in Health, Interpersonal Relationships and Spiritual Growth did not present statistically significant differences, $p=0.104>0.05$ for Responsibility in Health, $p=0.067>0.05$ for Interpersonal Relationships and $p=0.088>0.05$ for Spiritual Growth. Similarly, the behaviors related to eating habits were not significant, $p=0.555>0.05$. However, the dimensions related to the physical and emotional management of workers were statistically significant, i.e., $p=0.004<0.05$ for stress management and $p=0.022<0.05$ for physical activity. In relation to DES, the three dimensions: symptoms, actions and conditions were statistically significant with p-values<0.05.

According to the results obtained in this study, it is important to know from the researched literature some of the variables that may be associated with CVS: for Portello et al. (2012), Sá et al. (2010), Porcar et al. (2018) are found in the context, sociodemographic, health, occupational factors and the HLS, for Sá et al. (2010) are organizational characteristics and psychosocial factors and, for Ranasinghe et al. (2016) state that the duration of occupation, daily computer use, pre-existing eye disease, non-use of a display terminal filter (Visual Display Terminal or VDT), use of contact lenses and knowledge of ergonomic practices. On the other hand, according to Dessie et al. (2018) the variables of monthly income, occupation, daily computer use, regular health interruptions, knowledge and pre-existing eye diseases are associated with the presence of syndrome, while for Assefa et al. (2015) and Garcia Alvarez et al. (2010) not resting every 20 minutes while using the computer.

On the other hand, according to the factors associated with CVS and its severity, a study of computer office workers in Sri Lanka found that some workers with severe CVS had a longer time in the occupation (5.5 ± 5.9 years) than those with mild-moderate CVS (4.4 ± 5.5 years) ($p < 0.001$), the knowledge of ergonomic practices of those with mild-moderate CVS was greater (score-6.6 ± 1.6) than in those with severe CVS (score-5.9 ± 2.0) ($p < 0.05$) and the angle of gaze at the computer screen was significantly greater in those with severe CVS (33.4 ± 14.2) than in those with mild-moderate CVS (30.8 ± 15.5) ($p < 0.05$) (Ranasinghe et al. , 2016).

Among other findings, in Saudi Arabia, duration of occupation (OR: 1.04) and pre-existence of eye disease (OR: 1.54) were found to be significantly associated with the presence of severe CVS. Most subjects with CVS had severe symptoms (57.90%), while 42.10% had mild to moderately severe symptoms ($p < 0.05$). (Alhasan & Aalam, 2022).

According to WHO, mortality from non-communicable diseases (NCDs) is the result of changes in people's LEV in recent years, which have negatively affected health in terms of inadequate eating habits, decreased physical activity and increased tobacco use (World Health Organization & FAO, 2003, p1). Thus, according to the relevant findings of this study, there

was evidence of a significant association of two dimensions of Nola Pender's HLS (physical activity and stress management) and DES status with the degree of severity of CVS.

Firstly, and according to physical activity, in a recent study conducted in Argentina with 25 patients with chronic disease, no evidence of significant association was found between physical activity variables with CVS (p=0.176). (Piedrahita & Rodriguez, 2020).

According to the WHO, in 2010, about 23.00% of adults were sufficiently active, being higher in high-income countries; according to this, it is concluded that the decrease in physical activity is due in some part to inactivity during leisure time, sedentary lifestyle in the workplace and at home (World Health Organization, 2018, p.1).

On the other hand, the 2015 National Nutritional Status Survey of Colombia states that approximately half of Colombian adults perform 150 minutes per week of moderate physical activity as suggested by the WHO. However, four out of ten women and six out of ten men apply this preventive recommendation (Colombian Ministry of Health, 2015, p.1).

Secondly, it was found that stress management presented a significant difference with respect to CVS. However, so far, there is only evidence of a significant relationship between work stress and CVS symptoms in care and administrative workers of a health company, 2021 (p=0.00<0.05) (Moreno-Yauri, 2021).

According to the report on psychosocial risks in Europe, 25.00% of workers presented work stress during all or most of their time, and a similar percentage referred a negative affectation of work towards their health (European Agency for Safety and Health at Work & European Foundation for the Improvement of Living and Working Conditions, 2014).

Similarly, according to the First Central American Survey on Working Conditions and Health, in the Americas more than one in ten respondents reported feeling stress, sadness or loss of sleep due to concerns about working conditions (Organización Iberoamericana De Seguridad Social et al., 2010). And in Colombia, according to the first National Survey on Working and Health Conditions of the General System of Professional Risks of 2007 conducted among workers, 28.40% of women rated their stress level at a level between 7 and 10, with 10 being a lot of stress, compared to 24.70% of men (Ministry of Social Protection et al., 2007).

Finally, in this study DES was found to be associated with CVS, a situation contrary to the results by Piedrahita & Rodriguez (2020) in Argentina where the findings did not show a significant association between them (p=0.781) (Piedrahita & Rodriguez, 2020). Different studies have evidenced that several related factors, such as age and sex, are strongly related to the development of DES, with a higher frequency in women and older adults (Malet et al., 2014; Stapleton et al., 2017). Similarly, several risk factors, such as current alcohol consumption, prolonged use of video terminals, such as the use of, computer, use of contact lenses, low humidity, and environmental pollution, contribute significantly to the increased prevalence of DES (Long et al., 2020).

DES is the main diagnosis associated with the ocular symptoms of CVS, but in some cases ocular dryness is caused by environmental factors that lead to increased tear evaporation and the other ocular symptoms of the syndrome. Therefore, it is important to understand that the symptoms of dry eye and dry eye syndrome are different, as the diagnosis of DES can only be made by an eye care professional (Castillo-Estepa & Iguti, 2013).

Although DES is one of the main symptoms of CVS, it is not a symptom that is always present. In a study conducted in Palestine with 300 nurses, the percentage prevalence of DES among was 62.00% with an ODSI score of >13 (mild to moderate or severe). Here, nurses who wore contact lenses, worked at night and in the intensive care unit were more likely to report

significantly higher ODSI scores. In addition, gender, smoking, and computer use were not found to be statistically associated with dry eye disease (Allayed et al., 2022).

In another research conducted in India, CVS was found to reduce flicker frequency, resulting in symptoms like evaporative DES. In addition, it was found that ODSI score showed a positive correlation with screen time with a p value of $p<0.001$, showing that the longer the screen time, the more symptomatic the person is (Chaudhary et al., 2023).

Conclusions

There is evidence of a statistically significant relationship between the degree of severity of CVS and the mean values of the stress management and physical activity dimensions of the HPLP II scale, as well as the DES measured with the ODEI. It is essential to investigate the subject with other types of designs, on a large scale and in different contexts at the national level, to explore other associated factors of CVS and thus take appropriate measures in its prevention to reduce the burden of the disease.

In addition, it was recommended that the university design a public health surveillance system specifically for the CVS, directed from the university's Occupational Social Security Management System. The possibility of designing and executing a public health surveillance system specifically for CVS is proposed, so that from the promotion of health it aims to generate a healthy work environment. In this way, the capacity of workers to acquire healthy life habits to face problems related to HLS, DES and CVS is strengthened, encouraging health-promoting behaviors such as health responsibility, stress management, proper nutrition, assertive interpersonal relationships, physical activity, and spiritual growth. On the other hand, disease prevention is directed to avoid the onset of CVS, reducing risk factors, and mitigating the consequences.

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