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RESEARCH ARTICLE

Computer-digital Vision Syndrome Among University Students of Lima City

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Abstract:

Background:

Computer-digital vision syndrome (CVS) is a common occupational disease.

Objective:

This study aims to determine the frequency of CVS and its associated factors in students of a private university located in the north of Lima City.

Methods:

The study was an observational, descriptive, and cross-sectional one. The study variable was CVS, which was assessed using the Computer Vision Syndrome Questionnaire (CVS-Q).

Results:

The analysis was carried out on 709 participants with a mean age of 22.41 years (SD: 4.5; range: 16 to 60). The most frequently used devices were the smartphone and laptop, representing 96.8% (n=686) and 64.7% (n=459), respectively. Of the students exposed to the use of display devices, 58% (n= 413) had CVS. The CVS occurred more frequently in females (p= 0.003), in the 20 to 24-year-old age group (p= 0.022), and in students who were in the first and second academic year (p=0.071). CVS was also found more frequently in lens wearers (p<0.001), in students exposed to screens for 7 to 10 hours and 4 to 6 hours a day (p<0.001), and in students who used two and three electronic devices (p<0.001). CVS occurred mainly in students who used smartphones, and laptops (p<0.05).

Conclusion:

CVS is common among university students. The use of a variety of electronic devices, mainly smartphones and laptops, as well as the exposure time, plays an important role. Therefore, it is recommended to carry out prevention and promotion activities of vision care at the beginning of the academic period.

Keywords: Asthenopia, Eye fatigue, Fatigue visual, Eyestrain, Peru (Source. MeSH NLM), Syndrome.

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1. INTRODUCTION

The 21st century has given way to a global society increasingly dependent on a variety of technologies in personal, occupational, and institutional settings [1]. The use of electronic devices in the population is massive, mobile telephony is growing in a generalized way in both developed and developing countries, with an estimated 128.9 lines / 100 inhabitants and 103.8 lines / 100 inhabitants, respectively. Regarding the possession of computers, worldwide, 49.7% have at least one computer, 78% in Europe, 65.7% in America, and 10.7% in Africa. Television continues to be the technological equipment present in a high proportion of homes [2]. In Peru, 98.4% of households have at least one information and communication technology, in 97.7% of households, there is at least one member with a cell phone. In Lima, 45.8% of households have at least one computer, 61.7% have Internet service, and access in both cases is lower in the rest of the urban and rural areas [3].

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At the beginning of 2020, of the 7.75 billion total population, 67% (5.19 billion) are unique mobile phone users, 59% (4.54 billion) are Internet users, and 49% (3.8 billion) are active social media users. The average Internet user spends 6 hours and 43 minutes online every day, it varies by country, in the Philippines users spend an average of 9 hours and 45 minutes per day, compared to Japan where users spend only 4 hours and 22 minutes per day [4]. In Peru, 96% of the population with university education access the Internet, and 94.1% access the Internet through mobile phones [3].

The use of electronic devices has multiple benefits in our lives; however, they are not free from side effects and can affect health [5, 6]. Computer-digital vision syndrome (CVS), also referred to as digital eye strain, describes a group of the eye- and vision-related problems that result from prolonged computer, tablet, e-reader, and cell phone use [7].

The CVS is recognized by the International Labor Organization (ILO) within the group of occupational diseases [8]. CVS is a common problem, globally nearly 60 million people suffer from CVS; in Sri Lanka, the 1-year prevalence of CVS is 67.4% [9]. In the United States, it affects 65% of adults, and in Spain, the prevalence is 53% [10].

Among students, a high prevalence of CVS was observed, in which 95% reported at least one symptom during studying using computers [11]. In university students from Saudi Arabia, the acute and chronic presentation of CVS was 72% and 28% respectively [12].

In Peru, there are limited works on the CVS [13, 14]. On the other hand, the Covid-19 pandemic has generated a set of changes both in the work and academic context. In universities, face-to-face classes were replaced by virtual classes making use of electronic devices and therefore, greater exposure to screens, which is expected to increase the frequency of CVS. The objective of this study is to determine the frequency of computer digital vision syndrome and its associated factors in students of a private university located in the north of Lima City.

2. MATERIALS AND METHODS

2.1. Design

The study was an observational, descriptive, and cross-sectional. It was held between November and December 2020 at the University of Sciences and Humanities (UCH), located in the north of Lima City

2.2. Population and Samples

The population consisted of 2623 students registered in the second semester of 2020 at the UCH. Students from all faculties and all academic cycles participated, 661 from the Faculty of Health Sciences, 721 from the Faculty of Humanities and Social Sciences, 526 from the Faculty of Sciences and Engineering, and 715 from the Faculty of Accounting and Economic Sciences and Financial (Table **1**).

The sample size was calculated using n = [N * Za2 * p * q] / [d2 * (N-1) + Za2 * p * q], considering a confidence level of 95% (Za=1.96), N = 2623, p = 0.5, q = 0.5 and d=5%, with an expected proportion of losses of 10%. The minimum sample calculated was 372 students. In the period covered by the study, 717 participants were recruited.

All subjects who met the following criteria were included: students of both sexes, who voluntarily agreed to participate in the study, and who answered the virtual questionnaire adequately. Participants with incomplete data were excluded.

2.3. Study Variables

Computer vision syndrome (CVS): According to the American Optometric Association, Computer Vision Syndrome describes a group of the eye- and vision-related problems that result from prolonged computer, tablet, e-reader, and cell phone use. The most common symptoms associated with CVS are poor lighting, glare on a digital screen, improper viewing distance, poor seating posture, uncorrected vision problems, and a combination of these factors [7].

Comparison variables: Age, sex, use of glasses, technological devices used, and the number of hours/day dedicated to the use of such devices were considered.

2.4. Instruments and Measurement Techniques

The instrument used was the "Computer Vision Syndrome Questionnaire" (CVS-Q), developed and validated by Seguí *et al*. [15]. The CVS-Q was also validated in the Peruvian context [13], and applied to graduate university students [14].

CVS-Q assesses the frequency and intensity of 16 symptoms: burning eyes, itching, foreign body sensation, tearing, excessive blinking, eye redness, eye pain, eyelid heaviness, dry eye, blurred vision, double vision, difficulty focusing in near vision, increased sensitivity to light, colored halos around objects, feeling of seeing worse, and headache. The frequency is quantified as never = 0, occasionally = 1, often or always = 2. The intensity of the symptoms has been rated as moderate = 1 and intense = 2. The severity was determined from the product of the frequency and intensity, later the product was recorded as 0=0, 1 or 2=1, and 4=2. For the final score of the CVS, the sum of the recorded severity scores was used; scores of 6 or higher were considered to have CVS.

The technique used was the survey. The instrument used was a self-administered virtual questionnaire.

2.5. Procedure for Data Collection

CVS-Q was applied virtually through the Google Drive® platform. In the process of disseminating the link to access the questionnaire, we have received the support of the classroom delegates and coordinators of the different faculties of the university. The data of the participants was autogenerated automatically in Excel® format, anonymously.

Table 1. General characteristics of university students in the north of Lima City, 2020.

Characteristics	n	%
Total	**709**	**100**
Sex		
Female	370	52.2
Male	339	47.8
Age Group		
< 20	197	27.8
20 to 24	362	51.1
≥ 25	150	21.2
Academic Year		
First	218	30.7
Second	180	25.4
Third	158	22.3
Fourth	121	17.1
Fifth	32	4.5
Faculty		
Health Sciences	174	24.5
Humanities and social sciences	101	14.2
Science and Engineering	223	31.5
Accounting and Financial sciences	211	29.8
Wearing Glasses		
No	366	51.6
Yes	343	48.4
Glasses Type		
Glasses	305	43.0
Contact lenses	38	5.4
Reason for Wearing Glasses		
Improve visual defect	224	31.6
Avoid eyestrain	119	16.8
Number of Electronic Devices Used		
One	54	7.6
Two	221	31.2
Three	282	39.8
Four	117	16.5
Five	35	4.9

2.6. Statistical Analysis

The self-generated database was exported to the SPSS version 26 program. Before the analysis, the data was cleaned according to the study criteria. The valid data of the variables was distributed in frequency tables. The frequency of the CVS was estimated, and to establish its association with the comparison variables, the data was represented in crossed tables. To evaluate the association of the variables, the Chi-square statistic was used, considering p-value <0.05 as significant.

3. RESULTS

A total of 717 students of both sexes participated; eight were excluded due to incomplete data. The analysis was carried out with 709 participants with a mean age of 22.41 years (SD: 4.5; range: 16 to 60). Of the sample, 52.2% (n=370) were male, 51.1% (n=362) were between the ages of 20 and 24 years, and the majority were from the first and second academic year. Of the total participants, 48.4% (n=343) reported wearing glasses, of which 31.6% (n=224) improved a visual defect. According to gender, there was a significant difference in the use of glasses, 55.7% (n=206) in women and 40.4% (n=137) in men (p<0.001). Regarding the use of electronic devices, 39.8% (n=282) used three electronic devices, and 31.2% (n=221) two devices (Table **1**).

Among the participating students, the most frequently used devices were the Smartphone and laptop, representing 96.8% (n=686) and 64.7% (n=459), respectively. Other devices such as computers, televisions, and tablets were used in a lower percentage. Regarding the exposure time, 45.6% (n=323) were exposed to some information and communication technologies (ICT) between 7 and 10 hours and 30.2% (n=214) between 4 and 6 hours. Of the students exposed to display devices, 58% (n=413) had digital computer vision syndrome. Likewise, among the most frequently reported ocular and extraocular symptoms were burning, headache, tearing, increased

sensitivity to light, and itching (Table **2**). Symptoms such as heavy eyelids, blurred vision, double vision, difficulty focusing for near vision, feeling that sight is worsening, and headache occurred more frequently among women ($p<0.05$); according to age, tearing, and excessive blinking appeared mainly between 20 and 24 years old ($p<0.05$).

Regarding the factors associated with computer vision syndrome. The CVS was more frequent in females, 56.9% (n=235) versus 43.1% (n=178) in males (p=0.003), it was also more frequent in the age group of 20 to 24 years (50.4%), compared to other age groups (p=0.022). Students from the accounting and financial sciences, and science and engineering faculties presented CVS in a higher percentage (p=0.005), as did the students who were in the first and second academic years (p=0.071). The participants who wore glasses presented CVS in a higher proportion, 63.4% (n=262) compared to 36.6% (n=151) who did not use glasses ($p<0.001$). According to the number of hours exposed to the use of ICT, CVS occurred in a higher proportion among users from 7 to 10 hours and 4 to 6 hours a day ($p<0.001$). Likewise, CVS also appeared in a higher percentage of students who used two and three devices ($p<0.001$) (Table **3**).

When evaluating the type of device used, it was found that students who used a smartphone and laptop had a higher frequency of CVS. In Smartphone users, CVS was present in 95.4% (n=394) (p=0.016), and among laptop users in 69.7% (n=288) (p=0.001). The electronic devices that had the least presence of CVS were tablet, computer, and television (p=0.05) (Table **4**).

Table 2. Electronic devices used and the presence of computer digital vision syndrome (CVS) among university students in the north of Lima City, 2020.

An Electronic Device Used and CVS	n	%
Total	**709**	**100**
Electronic Device Used		
Smartphone	686	96.8
Tablet	140	19.7
Laptop	459	64.7
Computer	352	49.6
Television	348	49.1
Hours/Day Exposed to Devices		
1 a 3	33	4.7
4 a 6	214	30.2
7 a 10	323	45.6
>10	139	19.6
Presence of CVS		
No	296	41.7
Si	413	58.3
Ocular and Extraocular Symptoms		
Burning	63	8.9
Headache	63	8.9
Tearing	60	8.5
Increased sensitivity to light	54	7.6
Itching	51	7.2
Eye redness	39	5.5
Blurred vision	38	5.4
A feeling of a foreign body	37	5.2
Excessive blinking	25	3.5
Feeling that sight is worsening	25	3.5
Difficulty focusing for near vision	23	3.2
Heavy eyelids	22	3.1
Colored halos around objects	22	3.1
Eye pain	17	2.4
Dryness	10	1.4
Double vision	8	1.1

Table 3. Computer-digital vision syndrome according to the characteristics of university students in the north of Lima City, 2020.

Characteristics	CVS Absent		CVS Present		p-value
	n	%	n	%	
Total	**296**	**100**	**413**	**100**	**-**
Sex					
Female	135	45.6	235	56.9	0.003
Male	161	54.4	178	43.1	
Age Group					
< 20	93	31.4	104	25.2	0.022
20 to 24	154	52.0	208	50.4	
≥ 25	49	16.6	101	24.5	
Faculty					
Health Sciences	86	29.1	88	21.3	0.005
Humanities and social sciences	50	16.9	51	12.3	
Science and Engineering	89	30.1	134	32.4	
Accounting and financial sciences	71	24.0	140	33.9	
Academic Year					
First	107	36.1	111	26.9	0.071
Second	74	25.0	106	25.7	
Third	62	20.9	96	23.2	
Fourth	43	14.5	78	18.9	
Fifth	10	3.4	22	5.3	
Wearing Glasses					
No	215	72.6	151	36.6	< 0.001
Yes	81	27.4	262	63.4	
Hours/Day Exposed to Devices					
1 a 3	19	6.4	14	3.4	< 0.001
4 a 6	70	23.6	144	34.9	
7 a 10	171	57.8	152	36.8	
>10	36	12.2	103	24.9	
Number of Electronic Devices Used					
One	20	6.8	34	8.2	< 0.001
Two	64	21.6	157	38.0	
Three	123	41.6	159	38.5	
Four	65	22.0	52	12.6	
Five	24	8.1	11	2.7	

4. DISCUSSION

Among college students exposed to electronic devices, 58% had digital computer vision syndrome. These findings are consistent with the results obtained in graduate students from a private university in Lima, where CVS was found in 61% of the students [14]. CVS is a common problem. In Saudi Arabia, 97.3% of health science students had at least one CVS symptom [16]. In computer users, the prevalence of CVS is 69.5% (95% CI: 65.6 to 73%) [17].

It is likely that the change in classes from face-to-face to virtual mode has generated an increase in the use of electronic devices and a longer exposure time to screens. Likewise, factors such as inadequate lighting, inadequate posture, and glare emitted by the screens of digital devices could have contributed to the development of CVS.

The CVS was detected mainly among women, in students belonging to the age group of 20 to 24 years, students from science-engineering and accounting financial faculties, and students who were in the first and second academic year. In the present study, the sample was predominantly made up of women and young people between 20 and 24 years of age.

On the other hand, students from the aforementioned faculties have greater exposure to these devices both in classes and in preprofessional practice. Students from other fields, such as the health sciences, find themselves in a different scenario since they participate in virtual classrooms and spend more time engaging in preprofessional practise while spending less time in front of screens. In the case of the students of the first year, they do not carry out preprofessional practices; therefore they have a greater number of virtual classes. The students who wear glasses and those who used two to three electronic devices had a higher frequency of CVS. Likewise, a higher percentage of CSV was found in students who used smartphones and laptops.

Table 4. Computer-digital vision syndrome according to the type of electronic device used by university students in the north of Lima City, 2020.

Characteristics	CVS Absent		CVS Present		p-value
	n	%	n	%	
Total	**296**	**100**	**413**	**100**	-
Smartphone					
No	4	1.4	19	4.6	0.016
Yes	292	98.6	394	95.4	
Tablet					
No	218	73.6	351	85.0	< 0.001
Yes	78	26.4	62	15.0	
Laptop					
No	125	42.2	125	30.3	0.001
Yes	171	57.8	288	69.7	
Computer					
No	136	45.9	221	53.5	0.047
Yes	160	54.1	192	46.5	
Television					
No	100	33.8	261	63.2	< 0.001
Yes	196	66.2	152	36.8	

The major factors associated with CVS were either environmental (improper lighting, display position, and viewing distance) and/or dependent on the user's visual abilities (uncorrected refractive error, oculomotor disorders, and tear film abnormalities) [18]. The fact that in our study women had a higher frequency of CVS may indicate the preexistence of an eye problem, or they were the ones who most perceived ocular and extraocular symptoms. The main contributor to computer vision syndrome symptoms appears to be dry eye [19], and the prevalence of dry eye in women is higher compared to men [20].

In Saudi Arabia, CVS was reported mostly in female students and eyeglass wearers [16]. Workers who wear contact lenses and are exposed to the computer for more than 6 h a day are more likely to suffer CVS than nonlens wearers working at the computer for the same amount of time (OR = 4.85; 95% CI, 1.25-18.80; p = 0.02) [21]. Due to their easy portability, both smartphones and laptops are the devices most used by students. Advances in technology have led to the increased use of hand-held devices [18].

The CVS is a frequent entity in university students, so it requires intervention and preventive measures regarding the work environment and devices. The 20/20/20 guideline is recommended for use with electronic devices like computers and calls for 20 minutes spent in front of the screen followed by 20 seconds of fixed-point observation at a distance of 20 feet [22]. We take into consideration the study's cross-sectional design, the fact that only students from one university participated, and the fact that the results were derived from a virtual self-report as limitations. The use of glasses among students is high and appears to improve a visual defect; however, these defects were not confirmed. The use of glasses may have been to protect or alleviate symptoms caused by exposure to electronic device screens, and not necessarily to correct a visual defect. The strength of the study lies in the adequate size of the sample, whose results can approximate the real magnitude of the problem in the university population.

CONCLUSION

In university students, there is a high frequency of digital computer-digital vision syndrome, and they occur mainly in women, in students of the first year of study, and those who use two to three electronic devices. The electronic devices associated with the CVS were smartphones and laptops. Vision care prevention and promotion activities are recommended at the beginning of the academic period.

LIST OF ABBREVIATIONS

CVS = Computer-digital Vision Syndrome

CVS-Q = Computer Vision Syndrome Questionnaire

ILO = International Labor Organization

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The research protocol was evaluated and approved by the Ethics Committee of the University of Sciences and Humanities (ID Code-118-20, CEI Act No. 118-2020).

HUMAN AND ANIMAL RIGHTS

No animals were used for studies that are the basis of this research. All human procedures followed were in accordance with the guidelines of the Helsinki Declaration of 1975.

CONSENT FOR PUBLICATION

Informed consent was obtained from all participants of this study.

STANDARDS OF REPORTING

STROBE guidelines were followed in this study.

AVAILABILITY OF DATA AND MATERIALS

The data supporting the finding ofThe data that support the findings of this study are available from the corresponding author [J.M.] on special request.

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None.

CONFLICT OF INTEREST

The authors declares no conflict of interest financial or otherwise.

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Declared none.

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