Online Survey of Digital Eye Strain among Filipino Students and Professionals

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ABSTRACT

Background. Digital eye strain (DES) is a condition characterized by visual disturbance or ocular discomfort related to the inappropriate use of digital devices. Although DES affects a lot of individuals in other countries, there is a paucity of local data on the condition, considering that the Filipinos are the longest-duration internet users in the world.

Objective. This study determined the prevalence, distribution, and characteristics of digital eye strain among Filipino medical and undergraduate college students, and healthcare and information technology (IT) professionals who are engaged in digital device work.

Methods. This is a single-center, cross-sectional prevalence study. An online survey questionnaire was developed on the Google Forms platform, and data regarding demography, digital device use information, the DES symptoms questionnaire (adapted from the CVS-Q by Segui et al 2015), and awareness of DES and the 20-20-20 rule for prevention were collected. Chi-square and Fisher's exact tests were used, and a multivariate regression analysis model was developed to determine any association between the occurrence of DES and the various demographic variables.

Results. 326 of the 456 respondents scored 6 or above on the CVS Questionnaire and were determined to have DES. The overall prevalence rate of DES is 71%. Female respondents had a statistically higher prevalence of DES at 78% compared to 61.5% in males (p <0.0001, OR = 2.35). Those who spent more than 12 hours on their devices tended to experience DES more compared to those who spent less time (p-value = 0.004), but duration of daily use did not appear to be an independent risk factor (OR = 0.99). Participants with pre-existing eye conditions, mainly in the form of error of refraction, reported a statistically higher rate of DES (p = 0.023); astigmatism, in particular, appears to be an independent risk factor (OR = 2.13). The most frequently reported DES symptom was headache, while the most intense symptom, if present, was feeling that eyesight is worsening. About 73% of the respondents were aware of DES, but considerably fewer knew about the 20-20-20 rule (42%).

Conclusion. The prevalence of DES among Filipino students and professionals is higher than the rate reported in the literature. Female sex and the presence of pre-existing eye conditions are independent risk factors for developing DES. Digital eye strain can be considered in patients complaining of headache in the presence of work-related risk factors. Awareness of DES alone is not a protective factor from developing DES if behavioral modification in the form of the 20-20-20 rule and proper ergonomics are not observed.

Keywords: digital eye strain, computer vision syndrome, 20-20-20 rule

eISSN 2094-9278 (Online)
Published: September 15, 2026
https://doi.org/10.47895/amp.v60i17.13424

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INTRODUCTION

Digital eye strain (DES), also known as computer vision syndrome (CVS), is a condition characterized by visual disturbance or ocular discomfort related to the use of digital devices and resulting from a range of stresses on the ocular system, including glare, defocus, accommodation dysfunction, fixation disparity, dryness, fatigue, and discomfort.[1] The symptoms may be broadly classified into those linked to accommodative or binocular vision stress, and into external symptoms linked to dry eye.[2,3]

Although DES affects a huge number of individuals, its precise physiological basis remains unclear. To date, there are no available standard diagnostic criteria for DES, with some reports saying that computer vision syndrome should be a diagnosis of exclusion.[4] Several studies have given recommendations regarding the diagnosis of digital eye strain – DES may be identified and measured using one of several available questionnaires, while objective evaluation of specific parameters such as critical flicker–fusion frequency, blink rate and completeness, accommodative function and pupil characteristics may be used to provide indices of visual fatigue. In addition, the clinical history must include the number and type of devices being used, viewing distance and gaze angle for each device, amount of time used per device and other important parameters like font size, display contrast and screen brightness used during the task.

Related literature describing the prevalence of digital eye strain during the time of the COVID-19 pandemic is mostly based in other countries, with a few local studies done before the pandemic.[5-13] According to pre-pandemic figures available locally, digital eye strain symptoms are reported by 40-70% of the respondents, with cumulative duration of digital device use as the foremost risk factor.[11-13] There were, however, conflicting data regarding the prevalence of DES according to age and sex of the study participants.[1,2,4]

At present, there is no new data documenting the prevalence of digital eye strain in the Philippines specifically during and beyond the COVID-19 pandemic, when work-from-home arrangements and online class setups became widely accepted alternatives. The objective of this study is to determine the prevalence, distribution, and characteristics of digital eye strain among Filipino students and professionals who use digital devices regularly. Additionally, this study aimed to provide information on people's awareness of digital eye strain and preventive habits such as the 20-20-20 rule, which states that for every 20 minutes of digital device use, the eyes must be refocused to a distant target at 20 feet (6 meters) for 20 seconds to minimize risk of DES.

MATERIALS AND METHODS

Study Design

This single-center, cross-sectional descriptive study included 456 participants, evenly distributed among the various target subpopulations, namely: Filipino medical students, undergraduate college students, healthcare professionals, and information technology (IT) professionals, including those in software development and business process outsourcing.

Study Population

Participants were at least 18 years of age, able to understand the English language, consented to the study, and used digital devices on a regular basis for at least five days a week for at least six months prior to the conduct of the study. Ophthalmology residents-in-training and practitioners were excluded from the study to minimize bias from the mere-exposure effect or familiarity principle.

Data Collection

An electronic self-administered questionnaire was developed on the Google Forms platform. (See Appendix A) It included an introduction to the study, a section for informed consent, inclusion and exclusion criteria, basic demographic data, digital device use information, awareness of DES and its management, and the DES symptoms questionnaire, which was lifted from the CVS Questionnaire developed by Segui et al in 2015.[14] This was then circulated as a uniform resource locator (URL) link among the target population groups via social media channels and electronic mails and kept open until at least 100 participants for each main subpopulation was reached, employing a non-probability convenience sampling technique. The de-identified data were then summarized in a Microsoft Excel file for statistical treatment.

Outcomes and Statistical Analysis

The primary outcome of the study was the overall prevalence of digital eye strain among the sample population. Secondary outcomes of the study include the demographic characteristics of the study population and the prevalence and association, if any, of DES by sex, age, occupational factors (duration of digital device use per day, number of years of digital device use, type of digital content they use), presence of previous eye disease, and the use of corrective glasses, contact lens, or lubricating eye drops; the symptomatology of digital eye strain (type, intensity, frequency); and the respondents' awareness of digital eye strain and management options. Data were analyzed using the statistical software package Stata 13 (by StataCorp LLC, Texas, USA). Chi-square test (Fisher's exact test, when necessary) was used to study the significance of associations; *a p-value* of less than 0.05 was considered statistically significant. A multivariate regression analysis model was developed as well to determine which were independent risk factors for developing DES.

The DES symptoms and its severity were measured using the Computer Vision Syndrome Questionnaire (CVS-Q) developed by Segui et al.[14] The CVS-Q evaluates the intensity (moderate or intense) and frequency (never, occasionally, or always/often) of 16 eye strain-related

symptoms, including burning sensation, itching in the eyes, foreign body sensation, watering, excessive blinking, redness, eye pain, heaviness in the eyelids, dryness, blurring of vision, double vision, difficulty in near vision, intolerance to light, colored halos, worsening of vision, and headache. The CVS-Q has acceptable psychometric properties and has been proven valid and reliable for measuring ocular and visual symptoms related to computer use in the working population.[14] Initially utilized for computer or visual display terminal users, the use of CVS-Q has been expanded to evaluate DES in cellphone, tablet, and laptop users as well in various studies abroad.[5-10, 15-18]

Frequency was recorded as follows: *Never*, if the symptoms did not occur at all, which was given a score of zero (0); *Occasionally*, when the respondent experiences sporadic symptoms or only once a week, given a score of one (1) and, *Often or always*, when the respondent experiences it two or three (2 - 3) times in a week or almost daily, given a score of two (2). Intensity, on the other hand, was recorded as *Moderate*, given a score of one (1), or *Severe*, given a score of two (2).[14] An answer of "Never" under the "Frequency" heading was automatically assigned a score of zero (0) to its corresponding "Intensity" heading.

The total DES score was the summation of the severity scores for each of the 16 individual DES symptoms. The individual severity scores were computed as the *frequency score multiplied by the Intensity score* and were interpreted as follows: A product of zero entails a severity score of zero (0) for that symptom; a product of 1 or 2 entails a severity score of one (1); while a product of 4 entails a severity score of two (2). The lowest possible DES score was zero, and the highest possible was 32, with a score of at least 6 points needed to consider a respondent a sufferer of DES. CVS scores were further categorized as mild (CVS score = 6-12), moderate (CVS score = 13-18), and severe (CVS score = 19-32).[15]

Sample Size Calculation

The sample size was computed using the Cochran equation for computation of sample size for prevalence studies.

$$n = [Z^2P(1 - P)] / d^2$$

Confidence interval: 95% (Z = 1.96)
Expected prevalence: 45% (P = 0.45)
Precision: 5% of prevalence (d = 0.05)
n = 396

The expected prevalence of 45% was derived from the average prevalence from two single-center studies from the literature review, which used CVS-Q for determining the presence of DES.[5,9] Other studies reported higher prevalence rates (as high as 75%) but included all participants having at least one symptom, which may greatly overestimate the true burden of the condition.[6-8,10-13] At a confidence interval of 95% and precision of 5%, the computed sample size is 396, distributed among the four subpopulations (at least 100 each).

Ethical Considerations

Approval from the Research Ethics Board of the University of the Philippines Manila was obtained prior to commencement of the study and adhered to the tenets of the Declaration of Helsinki. The de-identified data from this research were only accessible to the principal investigator and a single statistician, and were kept in a password-protected folder.

The scope of the study was limited to the initial evaluation of participants via the questionnaire provided; no follow-up survey or additional data from all participants were required. However, those participants who were determined to suffer from DES symptoms were advised to seek consultation with their local ophthalmologist for further evaluation. They may also schedule an appointment with the Department of Ophthalmology and Visual Sciences of the Philippine General Hospital, the step-by-step procedure for which was provided as well on the last page of the survey form. (See Appendix B for research flowchart)

RESULTS

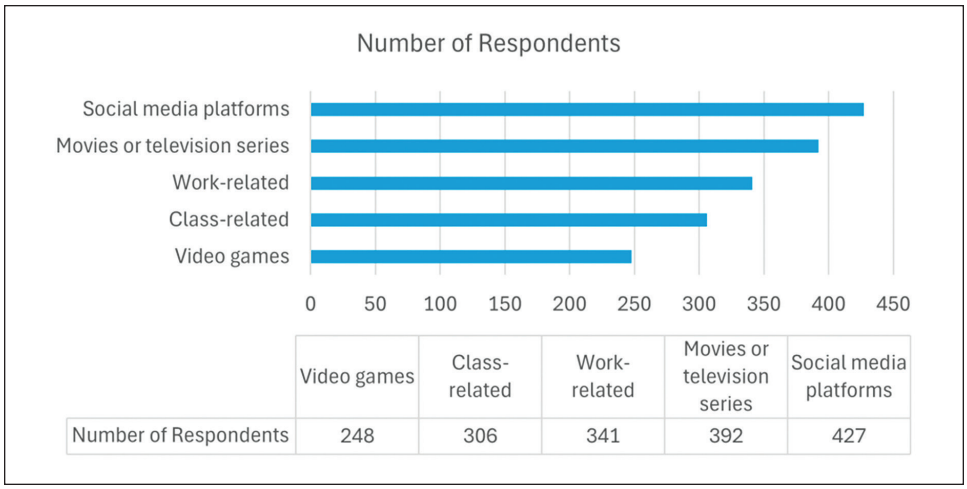
Four hundred seventy-two (472) responses were recorded from January to August 2023; of the 472, 16 were automatically excluded by the electronic form following set exclusion criteria (i.e., 10 were less than 18 years old, 6 were ophthalmology residents-in-training or practitioners), leaving 456 responses available for analysis. The participants were mostly females, accounting for 60% (n = 274) of the total count. An overwhelming majority of the respondents were young adults aged 18 to 39 years old (98%), while the remaining 2% were middle-aged adults aged 40 to 54 years old. The participants were mostly evenly divided into the four subpopulations in the study – undergraduate college students (23%), medical students (22.5%), health professionals (28%), and IT-BPO-Software development professionals (23%). Only a very small number of respondents did not fall under these categories (n = 16; 3%), which included those who work in human resources management and accounting. A summary of the demographic characteristics and prevalence of DES in each is shown in Table 1.

About 75% of the 456 respondents have been using a digital device regularly for at least 5 years, while 17% have been using it for 3 to 4 years. Shown in Figure 1 are the various activities for which digital devices were used by the respondents – on top of the list is browsing through various social media platforms at 93%, followed by watching movies or television series at 86%. Work and class-related activities came in at 75% and 67%, respectively, while about half of the respondents use them for playing video games.

Table 1. Baseline Demographic Characteristics and Prevalence of DES*

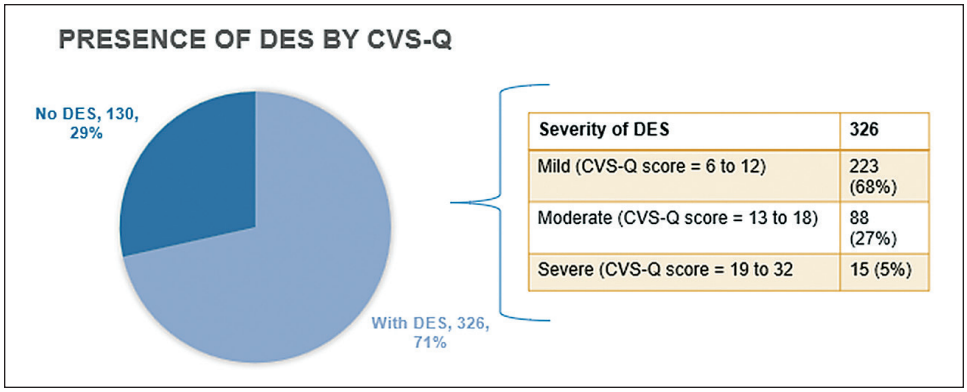
N = 456	With DES (%)	No DES (%)	*p*-value
Sex			<0.0001
Males	112 (61.5%)	70 (38.5%)	
Females	214 (78%)	60 (22%)	
Age group			0.547
18 to 39 years old	318 (71%)	128 (29%)	
40 to 54 years old	8 (80%)	2 (20%)	
Occupational role			<0.0001
Health professional, intern, hospital staff	73 (57.5%)	54 (42.5%)	
IT, Software development, BPO employees	77 (74.8%)	26 (25.2%)	
Medical student	70 (70%)	33 (30%)	
Undergraduate student, or non-medical graduate student	92 (86%)	15 (14%)	
Others (Human resources, accounting)	13 (86.7%)	2 (13.3%)	
Usual number of hours of device usage (pre-pandemic)			0.008
Less than 1 hour	0 (0)	3 (100%)	
1 to 4 hours	85 (69%)	38 (31%)	
5 to 8 hours	139 (69.5%)	61 (30.5%)	
9 to 12 hours	51 (72.9%)	19 (27.1%)	
More than 12 hours	51 (85%)	9 (15%)	
Usual number of hours of device usage (during pandemic)			0.004
Less than 1 hour	0 (0)	2 (100%)	
1 to 4 hours	11 (45.8%)	13 (54.2%)	
5 to 8 hours	107 (71.33%)	43 (28.67%)	
9 to 12 hours	109 (70.8%)	45 (29.2%)	
More than 12 hours	99 (78%)	28 (22%)	
Years of digital device usage			0.869
Less than a year	5 (62.5%)	3 (37.5%)	
1 to 2 years	19 (73%)	7 (27%)	
3 to 4 years	58 (74.4%)	20 (25.6%)	
5 years and above	244 (70.9%)	100 (29.1%)	
Presence of diagnosed eye condition			0.023
With diagnosed eye condition	143 (77.3%)	42 (22.7%)	
No known eye condition	183 (67.5%)	88 (32.5%)	
Use of spectacle correction			0.002
Yes	212 (76.8%)	64 (23.2%)	
No	114 (63.3%)	66 (36.7%)	
Use of eye lubricants			0.095
Yes	71 (78.7%)	19 (21.3%)	
No	255 (69.8%)	111 (30.2%)	
Knowledge of digital eye strain			0.624
Yes	243 (72%)	94 (28%)	
No	83 (69.7%)	36 (30.3%)	
Frequency of breaks from screen time			0.086
Every 20 minutes*	129 (65.8%)	67 (34.2%)	
Every 30 minutes to <1 hour	67 (80.7%)	16 (19.3%)	
Every hour to <2 hours	73 (73.7%)	26 (26.3%)	
Every 2 hours or more	49 (71%)	20 (29%)	
Others	8 (88.9%)	1 (11.1%)	
Duration of breaks from screen time			0.036
Less than 20 seconds	14 (73.7%)	5 (26.3%)	
At least 20 seconds*	153 (69.9%)	66 (30.1%)	
At least a minute	94 (81%)	22 (19%)	
Others	65 (63.7%)	37 (36.3%)	
Distance from screen			0.039
At least 1 meter (or 3 feet) away	120 (73.2%)	44 (26.8%)	
At least 2 to 3 meters (or 6 to 10 feet) away	106 (77.4%)	31 (22.6%)	
At least 6 meters (or 20 feet) away*	99 (64.3%)	55 (35.7%)	

**20-20-20 rule components*



	Video games	Class-related	Work-related	Movies or television series	Social media platforms
Number of Respondents	248	306	341	392	427

Figure 1. Most common activities by respondents requiring use of digital devices.



Severity of DES	326
Mild (CVS-Q score = 6 to 12)	223 (68%)
Moderate (CVS-Q score = 13 to 18)	88 (27%)
Severe (CVS-Q score = 19 to 32	15 (5%)

Figure 2. Distribution of respondents with DES according to severity.

About 41% of the respondents (n = 185) reported the presence of a previously diagnosed eye condition, primarily errors of refraction, but the type is unspecified in this study (myopia or hyperopia, with or without astigmatism; n = 175). The remaining 10 participants reported the presence of cataract, strabismus, diabetic retinopathy, or retinal detachment.

Asked if they have been wearing corrective eyeglasses or contact lenses, 60% (n = 276) of the respondents answered in the affirmative. This number far exceeds the number of participants who were previously diagnosed with an error of refraction. Only 20% of the respondents reported the use of lubricating eye drops.

Out of the 456 participants, 74% (n = 337) reported that they were at least aware of the condition called digital eye strain, while 26% (n = 119) claimed to have no prior knowledge of the condition. With regard to the 20-20-20 rule, 43% or 196 participants got the correct frequency of breaks at every 20 minutes, while almost half (48.0%, n = 219) of the participants selected the correct duration for the breaks, recommended for at least 20 seconds. Only about one third of the participants (34.1%, n = 154) were able to correctly choose at least 20 feet or 6 meters as the ideal distance to which eyes must be diverted during breaks from digital device use.

Three hundred twenty-six (326) of the 456 respondents scored 6 or above on the CVS Questionnaire, which is the score cutoff in determining those with DES. This gave us an overall prevalence of 71.5%. This was then categorized as mild, moderate, and severe DES, with prevalence rates at 68%, 27%, and 5%, respectively, as shown in Figure 2.

In terms of sex distribution, female respondents had a higher prevalence of DES at 78% compared to 61.5% in males. The difference was statistically significant with a p-value of <0.0001; on multivariate regression analysis shown in Table 2, female sex was determined to be an independent risk factor, with an odds ratio of 2.35 (95% CI 1.36 – 4.06, p = 0.002). On the other hand, age was not significantly associated with dry eye prevalence, with those aged 18 to 39 years at 71%, and those aged 40 to 54 years at 80% (p = 0.547).

The frequency distribution of DES significantly differed across occupational roles, with a p-value <0.0001; DES prevalence is highest among the undergraduate students at 86%, and lowest among the group of health professionals,

Table 2. Multivariate Logistic Regression Analysis Model

Variable as Factor for DES severity	Odds Ratio	Standard Error	z	P > |z|	95% CI
Female sex	2.35	0.66	3.05	0.002	1.36 – 4.06
Young adult age range (18 to 39 years old)	0.97	0.88	-0.03	0.977	0.17 – 5.76
Job category					
Health professional, intern, hospital staff	0.21	0.13	-2.57	0.01	0.06 – 0.69
IT, Software development, BPO employees	0.57	0.32	-1.01	0.31	0.19 – 1.70
Medical student	0.69	0.41	-0.63	0.52	0.21 – 2.19
Undergraduate student, or non-medical graduate student	1.25	0.70	0.40	0.69	0.41 – 3.76
Awareness of DES	0.68	0.19	-1.30	0.19	0.38 – 1.21
Hours of digital device use pre-lockdown	1.45	0.25	2.19	0.03	1.03 – 2.04
Hours of digital device use since lockdown	0.99	0.19	-0.06	0.95	0.68 – 1.42
Hours of digital device use	0.86	0.16	-0.81	0.42	0.59 – 1.24
Presence of eye condition					
Near- or far-sightedness	0.97	1.03	-0.03	0.976	0.12 – 7.88
Astigmatism	2.13	2.23	0.71	0.48	0.27 – 17.1
Use of corrective glasses	0.94	0.28	-0.20	0.85	0.52 – 17.0
Use of lubricating eye drops	1.20	0.36	0.60	0.55	0.66 – 2.17

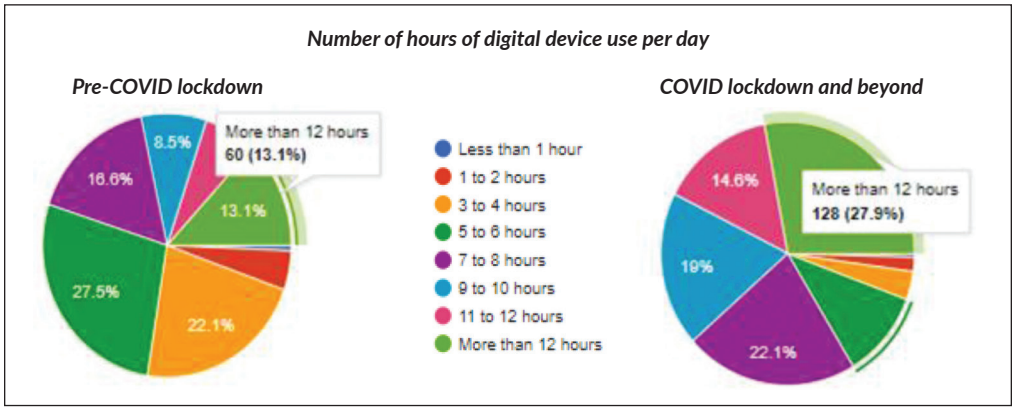


Figure 3. Comparison of daily duration of digital device use pre-COVID versus during COVID lockdown and beyond.

interns, and hospital staff at 57.5% (OR: 0.21, 95% CI 0.065-0.692, p = 0.010). Among those working in IT-related jobs, the prevalence rate is 74.8%, while medical students at 70%.

Unsurprisingly, we saw a rise in the number of hours spent in front of a digital device during and after the COVID lockdown due to the transition to online and home-based setups in both the education and employment sectors. The number of respondents spending more than 12 hours a day more than doubled from 13% to 28% (Figure 3).

It was also noted that those who spent more than 12 hours a day on their digital devices tend to experience DES symptoms more compared to those who spent less time, with a p-value of 0.004; however, multivariate analysis did not identify this as an independent risk factor (OR 0.99, 95% CI 0.685-1.423, p = 0.954). We also saw that the duration of digital device use in years was independent of DES status since there was no statistically significant difference among the different groups (p = 0.869).

The presence of a pre-existing eye condition predisposed to the development of DES, with a p-value of 0.023; multivariate regression analysis showed that it is an independent risk factor, with an odds ratio of 1.6 (95% CI 1.1-2.5, p = 0.03). The use of spectacles or contact lenses was associated with DES (p = 0.002), while the use of eye lubricants was not significantly associated (p = 0.095).

The respondents' awareness of digital eye strain is not associated with a higher or lower rate of the condition, with a p-value of 0.624. With regard to awareness of the 20-20-20 rule and its components, the frequency distribution of DES differed significantly across duration of breaks from screen use (p = 0.036) and distance from digital screen (p = 0.039), but not for frequency of screen time breaks (p = 0.086). The rate of DES ranges from 63.7 to 88.9% across all response groups, regardless of their ability to identify the correct frequency, duration, or distance.

In terms of the most frequently reported digital eye strain symptoms, headache topped the list with 82% (374 responses), followed by tearing (315, 71.7%), increased sensitivity to light (313, 69.9%), blurred vision (298, 67.9%), and itching (296, 64.9%). Among the different symptoms, the following were considered to be the most intense when present: feeling that sight is worsening (out of 253, 22.1% reported severe symptoms, 77.9% moderate), headache (out of 374, 21.4% reported severe symptoms, 78.6% moderate), blurred vision (out of 298, 20.1% had severe symptoms, 79.9% moderate), increased sensitivity to light (out of 313, 18.5% reported severe symptoms, 81.5% moderate), and difficulty focusing for near vision (out of 189, 15.9% had severe symptoms, 84.1% moderate). Figures 4 and 5 summarize the DES symptoms in terms of frequency and intensity.

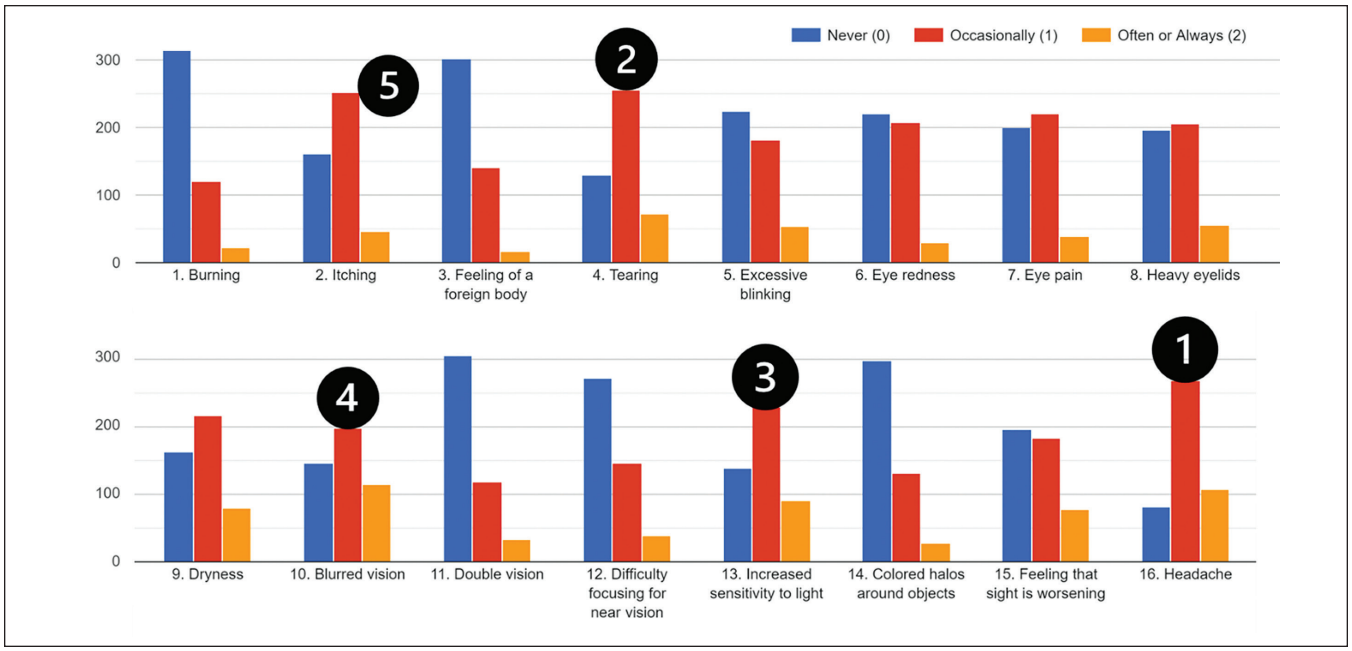


Figure 4. Frequency of each specific DES symptom, with top 5 most frequently experienced symptoms labeled from 1 to 5 (N = 456).

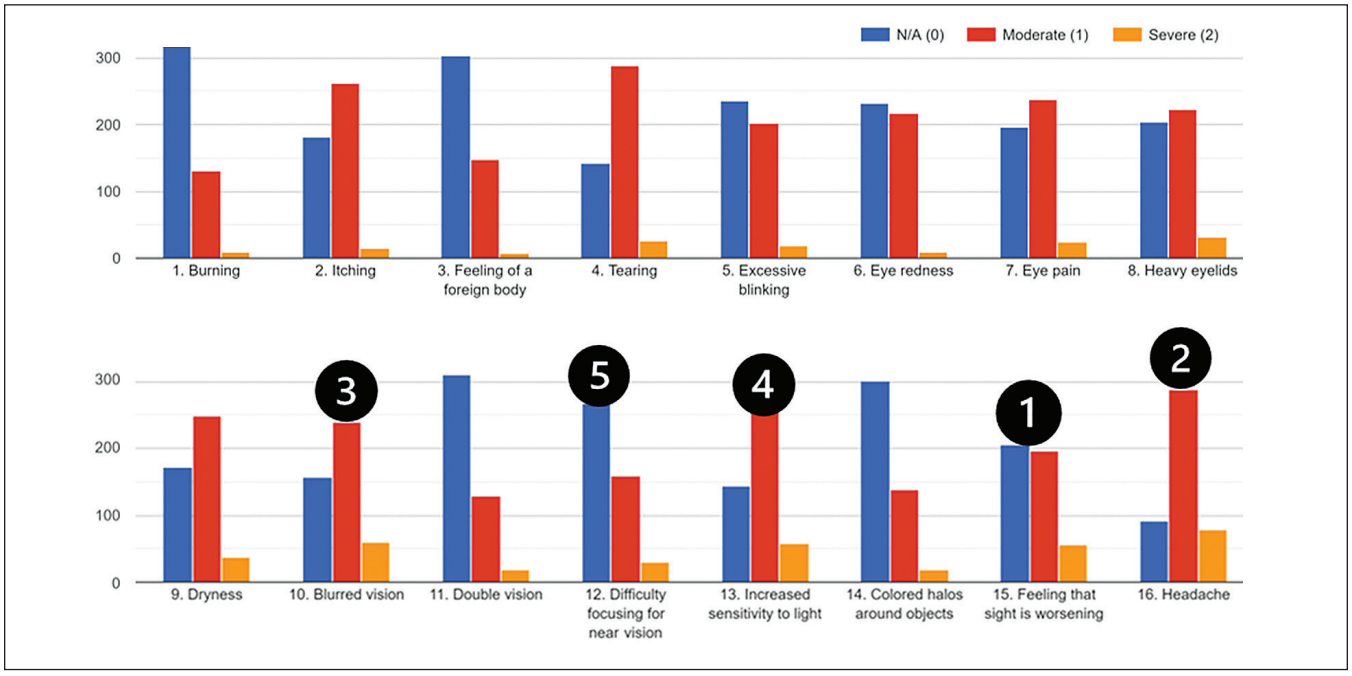


Figure 5. Intensity of each specific DES symptom, with top 5 most intense symptoms when present, labeled from 1 to 5 (N = 456).

DISCUSSION

To our knowledge, this is the first local study on digital eye strain utilizing a validated questionnaire with a single overall symptom score to determine the presence of DES in various population groups during and beyond the COVID-19 pandemic period. Overall prevalence of DES in this study is 71%, which is higher than other published studies that also utilized the CVS-Q form by Segui et al.[14]

Ganne et al. reported that among adults 18 years old and above in India, the overall prevalence of DES was 50.6% in students and 33.0% in the general population.[9] Alqarni AM et al. reported a prevalence rate of 68.53% among medical students, which is about the same as in this study at 70%.[16] Mohan et al. also used CVS-Q in school-aged children (mean age of 13 + 2.45 years, DESK-1 study) in India, and found a 50.23% prevalence rate, while in Thailand, Chattinnakorn et al. reported a prevalence of 42.2% in the same age group.[5,17] The higher rate among Filipinos could be explained partly by the fact that Filipinos are the longest-duration internet users in the world, averaging about nine hours and 45 minutes a day online, and that there were 85.16 million internet users in the Philippines at the start of 2023, when internet penetration stood at 73.1%[18,19]

Cabrera and Lim Bon Siong reported in 2010 that 67% of Filipino call center agents experienced eye strain from computer use.[11] A higher rate of 74.8% among the same type of workers was noted in this study. This highlights the increasing burden on ocular health due to continuous digitization over the past ten years.

Headaches are the most frequently reported digital eye strain symptom, similar to several previous studies, followed by tearing, increased sensitivity to light, blurred vision, itching, and dryness.[5,6,9-11,16] Among the different symptoms, eye dryness is the most intense when present, followed by headache, feeling that sight is worsening, blurred vision, and increased sensitivity to light, which correlates with literature as well.[5,6,9-11,16]

This study corroborated the result of previous studies showing that DES is more common among females than males, with a prevalence rate of 78.1% compared to 61.5%.[6,8,15,16] Females are twice as likely to experience severe DES compared to males and being female appears to be an independent risk factor, with multivariate logistic regression analysis showing an odds ratio of 2.34 (p-value = 0.002, 95% CI 1.356 – 4.065). A study conducted by Guillon & Maissa proposed a higher tear film evaporation rate in women, especially among those older than 45 years old, which is suggestive of hormonal involvement.[20] This increased tear film evaporation rate can lead to increased eye dryness and other associated symptoms such as blurred vision and itching, which are also common among people suffering from DES. Overall, sex steroids (androgens, estrogens) and thyroid hormones are said to play major roles in the regulation of the health of the ocular surface and adnexal tissues.[21]

The results showed that the number of hours of digital device use per day is significantly associated with DES, with those spending more than 12 hours on the screen reporting more DES symptoms; this is similar to all other previous studies.[5-11,15-17] However, multivariate regression analysis failed to show it as an independent risk factor. Additionally, the duration of use of digital devices in years is not significantly associated with DES in this study. This could mean that having used digital devices for less than a year is not a guarantee that a person will not develop the condition, and that using them for more than 5 years will necessarily lead to DES. Other factors such as how the devices were used, such as viewing distance and angle, font size, screen brightness and contrast, body ergonomics, ambient room lighting, temperature and humidity should be considered.

The presence of a pre-existing eye condition is an independent risk factor in this study, consistent with the study by Ganne et al., with error of refraction, type unspecified, as the most common diagnosis.[9] Throughout the digital task, there is a need to achieve and maintain a clear and single vision of relatively small targets, emphasizing the importance of having the retinal image focused appropriately. Thus, the presence of uncorrected refractive errors leads to an increase in ocular stimulus to accommodate and target blur, leading to DES symptoms.[2] A surprising finding in this study is the discrepancy in the number between those who reported the presence of a previous diagnosis of an error of refraction (n = 175) and those who are using spectacles or contact lenses (n = 276). Possible explanations could be that a lot of the respondents were wearing eyeglasses but were not formally diagnosed with an error of refraction by an ophthalmologist or an optometrist, or were using non-prescription spectacles or contact lenses.

The presence of digital eye strain is independent of the respondents' awareness of the condition; having prior knowledge about it does not translate to behaviors preventive of digital eye strain. This is also the case for knowing the correct components of the 20-20-20 rule for prevention of digital device use. More must be done to raise awareness about DES and the specific ways to prevent or manage this condition.

In this study, no association was found between DES and age using multiple logistic regression analysis, which may partly be explained by the very limited age range, owing to the population groups targeted in the study. On review of the literature, age grouping is usually controlled, precluding inter-age comparisons; it is important to note, however, that DES affects individuals regardless of age, as evidenced by its high prevalence in both studies involving children and adults.[5-13,15-17]

This study has several limitations inherent to its design. First, the possibility of recall bias cannot be dismissed in self-report types of studies; people who are already suffering from digital eye strain symptoms are more likely to participate in the study and describe their symptoms in detail. This,

however, also ensures that all of those who answered the survey forms had online access and regular digital device exposure.

Second, this study employed convenience and quota sampling; no randomization was performed as the authors would like to acquire as much data as possible to establish a more representative prevalence rate. Since the study is open access via a Google Form link that was distributed among all possible target population groups in various forms of social media and electronic mail, the findings can still be generalized to the Filipino adult population.

Lastly, the study only evaluated respondents' awareness of the 20-20-20 rule and its components and checked its association with the presence of DES; it did not attempt to check any association with actual practice of the 20-20-20 rule, which was deemed difficult to determine accurately with this study design.

It is recommended in future studies to prospectively examine the association of DES with ergonomic factors such as viewing distance and angle, frequency and duration of breaks, contrast and illumination settings of digital devices, and type of device. Another possible area of research is the correlation of the presence of DES and its severity with dry eye disease, another common and related condition, using objective testing parameters. Notably, Talens-Estarelles et al in 2023 evaluated the effects of taking breaks based on the 20-20-20 rule in a small sample of 29 symptomatic computer users using a laboratory setup with eye blink and gaze detection software. The study concluded that the 20-20-20 rule was effective in reducing DES and dry eye symptoms, although it was not sufficient to prevent DES altogether, and that the improvement in symptoms was barely sustained one week after discontinuation.[22]

CONCLUSION

Digital eye strain is a highly prevalent ocular condition affecting people of all ages. The prevalence of DES among Filipino students and professionals in this study is considerably higher than the average rate reported in studies done abroad. At higher risk are females, those who spend more hours using a digital device, and those with pre-existing eye conditions such as astigmatism. Patients complaining of headaches, especially when work-related, must be evaluated for digital eye strain, as it is the most frequently reported symptom. Patient education regarding proper ergonomics and the regular practice of the 20-20-20 rule may help prevent or mitigate this condition.

Statement of Authorship

All authors certified fulfillment of ICMJE authorship criteria.

Author Disclosure

All authors declared no conflicts of interest.

Funding Source

The study was funded by the authors.

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APPENDIX

A. Data Collection Form

Answering this survey form implies consent to participate. Would you like to proceed?
[ ] I am adequately informed and voluntarily give my consent to participate in this study. *(Continue to next section)*
[ ] I do not want to participate in this study. *(Go to end)*

Exclusion Criteria
[ ] I am less than 18 years of age
[ ] I am an ophthalmology resident-in-training or practitioner
[ ] None of the above applies to me

Demographic Profile

Email Address:

1. Sex
   [ ] Male
   [ ] Female

2. Age range
   [ ] 18 to 39 years old
   [ ] 40 to 54 years old
   [ ] 55 to 64 years old
   [ ] 65 years old and above

3. I am currently a _____.
   [ ] Medical student
   [ ] Undergraduate student, non-medical graduate student
   [ ] Health professional, intern, hospital staff
   [ ] BPO employee handling online accounts (later modified to *IT, Software development, BPO employees*)
   [ ] None of the above. Specify _____.

4. Have you heard of digital eye strain or computer vision syndrome?
   [ ] Yes
   [ ] No

5. How often do you think you need to take a break from screen time to prevent digital eye strain?
   [ ] Every 20 minutes
   [ ] Every 30 minutes
   [ ] Every hour
   [ ] Every 2 hours
   [ ] None of the above. Specify _____.

6. What is the recommended duration of the aforementioned breaks from screen time?
   [ ] Less than 20 seconds
   [ ] At least 20 seconds
   [ ] At least a minute
   [ ] None of the above. Specify _____.

7. What is the recommended distance at which you must divert and fixate your eyes to during the aforementioned breaks when you are using a digital device?
   [ ] At least 1 meter (or 3 feet) away
   [ ] At least 2 to 3 meters (or 6 to 10 feet) away
   [ ] At least 6 meters (or 20 feet) away
   [ ] None of the above. Specify _____.

8. What is your usual number of hours of digital device usage (smartphone, laptop, desktop, tablet/iPad) per day before the lockdown was implemented? You may review your device usage history for a more accurate response.
   [ ] Less than 1 hour
   [ ] 1 to 2 hours
   [ ] 3 to 4 hours
   [ ] 5 to 6 hours
   [ ] 7 to 8 hours
   [ ] 9 to 10 hours
   [ ] 11 to 12 hours
   [ ] More than 12 hours

9. What is your usual number of hours of digital device usage (smartphone, laptop, desktop, tablet/iPad) per day since the lockdown was implemented? You may review your device usage history for a more accurate response.
   [ ] Less than 1 hour
   [ ] 1 to 2 hours
   [ ] 3 to 4 hours
   [ ] 5 to 6 hours
   [ ] 7 to 8 hours
   [ ] 9 to 10 hours
   [ ] 11 to 12 hours
   [ ] More than 12 hours

10. For how many years have you been using digital devices regularly for your classes or work?
    [ ] Less than a year
    [ ] 1 to 2 years
    [ ] 3 to 4 years
    [ ] 5 years and above

11. For which activities have you been using digital devices?
    [ ] Work-related
    [ ] Class-related
    [ ] Social media platforms
    [ ] Video games
    [ ] Movies or television series
    [ ] Others, specify: _____

12. Have you been previously diagnosed by an ophthalmologist with an eye condition? Choose among the following.
    [ ] No
    [ ] Yes. Choose from the following:
        [ ] Nearsightedness or farsightedness, astigmatism
        [ ] Cataract
        [ ] Glaucoma
        [ ] Eye deviation or cross-eye or lazy eye
        [ ] Disease of the cornea
        [ ] Disease of the retina or back of the eye
        [ ] Others, specify: _____

13. Have you been wearing corrective eyeglasses or contact lenses?
    [ ] No
    [ ] Yes. Since when? _____

14. Have you been using lubricating eye drops (examples include artificial tears such as Hypromellose, Carboxymethylcellulose, and brand names Tears Naturale, Genteal, Optive, Systane, Cellufresh, and only the blue-colored variants of Eye Mo and Visine [generic is Hypromellose])?
    [ ] No
    [ ] Yes. Since when? _____

Computer Vision Syndrome Questionnaire (CVS-Q)

Indicate whether you experience any of the following symptoms during the time you use a digital device at work or in class in the past six months. For each symptom, mark the appropriate circle.

First, the frequency, that is, how often the symptom occurs, considering that:
NEVER = the symptoms do not occur at all; score of zero (0)
OCCASIONALLY = sporadic episodes or once a week; score of one (1)
OFTEN OR ALWAYS = 2 or 3 times a week or almost every day; score of two (2)

Second, the intensity of the symptom: MODERATE (score of 1) or INTENSE (score of 2).

Remember, if you indicated NEVER for frequency for a certain symptom, mark not applicable (N/A, score of 0) under the corresponding intensity.

		Frequency			Intensity	
		Never (0)	Occasionally (1)	Often or always (2)	Moderate (1)	Intense (2)
1	Burning					
2	Itching					
3	Feeling of a foreign body					
4	Tearing					
5	Excessive blinking					
6	Eye redness					
7	Eye pain					
8	Heavy eyelids					
9	Dryness					
10	Blurred vision					
11	Double vision					
12	Difficulty focusing for near vision					
13	Increased sensitivity to light					
14	Colored halos around objects					
15	Feeling that sight is worsening					
16	Headache					

The total DES score is a summation of the severity scores for each of the 16 individual DES symptoms.

The individual severity scores are computed as: Frequency score x Intensity score, and is interpreted as follows:

A product of zero entails a severity score of zero (0) for that symptom.
A product of 1 or 2 entails a severity score of one (1).
A product of 4 entails a severity score of two (2).
Lowest possible DES score is zero and the highest possible is 32, with a score of at least 6 points needed to consider a respondent a sufferer of DES.

A score of 6 or higher is considered diagnostic of Digital Eye Strain. The respondent is advised to observe the 20-20-20 rule for digital device use (i.e, for every 20 minutes of near work or digital device use, rest eyes for at least 20 seconds by looking at a target at least 20 feet or 6 meters away), and to consult an eye doctor for a more comprehensive evaluation and advice. If the respondent would like to schedule an appointment with the Department of Ophthalmology and Visual Sciences of the Philippine General Hospital, an online consultation request must first be booked at its website, http://pghopd.up.edu.ph, and advice regarding the date of the phone consult must be followed.

B. Research Flowchart