

# The Correlation between Visual Display Terminal (VDT) Use and Premature Presbyopia among The Office Workers

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## Abstract

**Introduction:** The increased use of Visual Display Terminals (VDTs) allows close work with continuous screen gazing during working hours. Close work forces the eyes to accommodate resulting in contraction of the ciliary system. This sustained contraction will lead to ciliary system weakness, making close work a risk factor for premature presbyopia.

**Methods:** The research design was cross sectional. It was conducted on employees of health centers in Bekasi district who were under 40 years old with more than 1 year of service as employees and had used VDT for at least 1 year. Employees filled out an interview form voluntarily then the answers would be verified according to presbyopia and finally measured the amplitude of accommodation for respondents who met the presbyopia criteria. The research was carried out throughout December 2023. The collected data were statistically processed using the SPSS 26 application tool.

**Results:** Of the 100 respondents who filled out the interview form and then verified and measured, 22 people (22%) had premature presbyopia. Age (p-value 0.014), type of VDT (p-value 0.049) and habit of working with VDT for 1 hour non-stop (p-value 0.016) were associated with premature presbyopia because they had a p-value <0.05. Based on multivariate test, the factor of working with 1 hour non-stop VDT was the only factor with p-value 0.018 and OR 3.78995% CI 1.255-11.445.

**Conclusion:** There is an association of VDT use with the incidence of premature presbyopia in office workers by 22%. With the most significant influence owned by the factor of working with VDT 1 hour non-stop.

**Keywords:** visual, display, terminal, presbyopia, accommodation, amplitude

## Abstrak

**Latar belakang:** Peningkatan penggunaan Visual Display Terminal (VDT) memungkinkan pekerjaan jarak dekat dengan menatap layar secara terus menerus selama jam kerja. Pekerjaan jarak dekat memaksa mata berakomodasi sehingga terjadi kontraksi pada sistem siliaris. Kontraksi yang berkelanjutan ini akan menyebabkan kelemahan sistem siliar sehingga pekerjaan jarak dekat menjadi faktor risiko presbiopia prematur.

**Metode penelitian:** Desain penelitian adalah cross sectional. Dilakukan terhadap pegawai puskesmas di kabupaten Bekasi yang usianya di bawah 40 tahun dengan masa kerja sebagai pegawai lebih dari 1 tahun dan telah menggunakan VDT minimal 1 tahun. Karyawan mengisi formulir wawancara secara sukarela kemudian jawabannya akan diverifikasi sesuai dengan presbiopia dan terakhir mengukur amplitudo akomodasi untuk responden yang memenuhi kriteria presbiopia. Penelitian dilaksanakan sepanjang bulan Desember tahun 2023. Data yang terkumpul diolah secara statistik dengan menggunakan alat aplikasi SPSS 26.

**Hasil:** Dari 100 responden yang mengisi formulir wawancara selanjutnya dilakukan verifikasi dan pengukuran, didapatkan 22 orang (22%) mengalami presbiopia prematur. Faktor usia (p-value 0,014), jenis VDT (p-value 0,049) dan kebiasaan bekerja dengan VDT 1 jam non stop (p-value 0,016) berhubungan dengan presbiopia prematur karena memiliki p-value < 0,05. Berdasarkan uji multivariat didapatkan bahwa faktor kerja dengan VDT 1 jam nonstop merupakan satu-satunya faktor dengan p-value 0,018 dan OR 3,78995% CI 1,255-11,445.

**Kesimpulan:** Ada hubungan penggunaan VDT dengan kejadian presbiopia prematur pada pekerja kantoran sebesar 22%. Dengan pengaruh paling signifikan dimiliki oleh faktor bekerja dengan VDT 1 jam non stop.

**Kata kunci:** visual, display, terminal, presbiopia, amplitudo, akomodasi

## Introduction

A visual display terminal (VDT) or Visual display unit (VDU) is a device for the visual presentation of electronically stored information data. This device consists of a display screen with a processing unit for the presentation of the data and a keyboard for control functions and data input. VDT is a unit that works integrated, may be separate or can also be integrated with other computer units.<sup>1</sup> The American Optometric Association (AOA) states that VDT is not only a computer but includes all devices that use monitor screens such as smartphones, tablets, e-readers and other work monitors.<sup>2</sup>

In general, the consequences of using VDT cause complaints among workers known as: *Computer Vision Syndrome* (CVS) or Digital Eye Strain (DES). People who work long hours in front of a screen at close range have the potential to experience visual complaints in addition to extraocular complaints. Double vision, blurring, and difficulty focusing are complained of by many computer workers. Research from Chimeke et al showed 45.7% of respondents complained about this.<sup>3</sup>

Blehm et al (2005) grouped the effects caused by the use of VDT into 4 major groups. This collection of CVS symptoms consists of one group of extraocular complaints and 3 groups of intraocular complaints. Intraocular complaints are divided into eye fatigue complaints, ocular surface complaints and visual complaints where presbyopia (impaired near vision) is included.<sup>4</sup>

A study conducted by Maikuri in 2012 in Kenya, reported that out of 52 respondents aged before 40 years, 23% had premature presbyopia (early presbyopia).<sup>5</sup> Presbyopia assessment of computer and smartphone users was carried out in Punjab Pakistan. Shamaila said that from active smartphone and computer users collected in Pakistan in 2019, it was noted that around 35% of research participants suffered from presbyopia. The majority of presbyopia sufferers use glasses for near vision for 1-3 years.<sup>6</sup> Reports related to presbyopia and digital devices were also released by Sujata Priyambada (2019), showing that 12.03% of patients experienced premature presbyopia. It was further explained that of the premature presbyopia, 61.13% were female and 38.87% male. The highest risk factor is close viewing as much as 30.5%. Sujata's research also looked at the contribution of cell phone use where it was reported as much as 37%.<sup>7</sup>

The purpose of this study was to determine the

relationship between VDT exposure in workers with premature presbyopia and the influencing factors.

## Theoretical

Continuous close work forces the eye to remain accommodated and the ciliary muscle is maintained in contraction. The reduced amplitude of accommodation is the result of accommodation fatigue. Accommodations have been shown to change with smartphone and tablet use, with decreased amplitude and increased lag. This is similar to what happens with computer use.<sup>8</sup> Continuous close work causes eye strain which will cause weakness of the ciliary muscle thereby reducing its ability to contract.<sup>9</sup>

## Research methods

The research design is observational analytic using cross sectional design. The research was conducted in the Bekasi Regency area with a population of all Puskesmas workers who work using the Visual Display Terminal.

The criteria for respondents are age less than 40 years, working with VDT for more than 1 year. Respondents did not have congenital eye disease, former eye trauma or malignancy of the eye. Respondents did not have a history of consuming drugs in the long term.

The independent variables are factors that include workers such as age, gender, length of service, type of VDT, time of work with VDT, length of VDT work per day, habit of working 1 hour non-stop VDT and total screen time. The dependent variable is the incidence of premature presbyopia in VDT workers. Data analysis was performed using statistical methods using the SPSS 26 application.

Respondents fill out the interview form, the results will be processed statistically. Several respondents who answered according to presbyopia will be further verified and respondents who do not comply with presbyopia in this verification are automatically excluded from the presbyopia group.

Measurements consisted of far vision acuity using a Snellen sheet, near vision using a reading card, and measuring the amplitude of accommodation using the Royal Air Force (RAF) ruler (fig.1). Measurement of the amplitude of accommodation using the Push up and Pull away method is carried out after the eye has received



Figure 1. RAF Ruler and trial lens

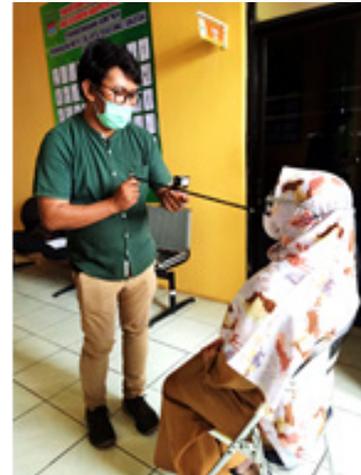


Figure 2. Accommodation measurement with RAF Ruler

correction if there is a decrease in vision (fig.2). The results of the RAF ruler measurements show the value of the accommodation amplitude after being calculated by the Hofstetter average formula.

## Results

Table 1 shows that the age group is more than 35 years, the female sex predominates with 90%, the most years of service for employees are more than 4 years, the most types of VDT are laptops/notebooks, the tenure of VDT is more than 4 years, the length of time VDT has worked more than 4 hours per day. The habit of working non-stop for 1 hour with VDT has the same number of respondents, namely 50%. Total screen time is more than 8 hours. Meanwhile, the history of hypertension and diabetes mellitus was very small, namely 8% and 2% respectively.

From this study, the results of Premature Presbyopia were found in 22 people (22%). The stages that were passed were from the results of the interview followed by verification of answers that were in accordance with presbyopia and then direct measurements were taken.

Table 2 contains the percentage of extra-ocular complaints (asthenopia). The most non-visual complaints experienced by respondents were complaints of watery eyes as much as 73%. Then the second sequence is headaches and shoulder aches (64%), then the last is complaints of dry eyes (45%).

The relationship between extraocular and non-visual complaints with the incidence of premature

presbyopia can be seen in table 3. There is a *p-value* which indicates a relationship if  $<0.05$  and a Pearson value which indicates the strength of the relationship if the value is closer to 1. In Table 3 can be seen the three complaints, only hyperlacrimation has a *p-value*  $<0.05$ , namely 0.032. This analysis supports the results in table 2 which shows that most of the respondents who had premature presbyopia complained of watery eyes. With these results it can be concluded that hyperlacrimation has a relationship with premature presbyopia even though the relationship is weak because the Pearson value is only 0.214.

Individual visual subjective complaints related to presbyopia can be seen in Table 4. The most complaints were needing additional light when reading lowercase letters (41%) and complaints with the fewest respondents were keeping the paper/writing away when reading, which was as much as 10%.

The correlation between visual complaints felt by respondents and the incidence of premature presbyopia can be seen in table 5. Complaints of piling up newspaper letters, difficulty reading food packaging, straining eyes when reading, desk calendar letters piling up, eye jamming after reading, late focusing, needing additional light while reading and glare at the monitor screen has a relationship with premature presbyopia because each of these complaints has a *p-value* of less than 0.05. The most significant relationship was shown by complaining of the need for light when reading small print, *the p-value* was 0.00, even though the Pearson value was only 0.343 which indicated sufficient strength of the relationship.

**Table 1.** Sociodemographic description of respondents

Variable		n	%
Age	<35 years	41	41%
	≥35 years	59	59%
Gender	Man	10	10%
	Woman	90	90%
Employee working period	< 4 years	19	19%
	≥ 4 years	81	81%
VDT type	Desk computer/ PC	36	36%
	Laptops/notebooks	64	64%
Years of Service with VDT	≤ 4 years	35	35%
	> 4 years	65	65%
VDT working hours per day	≤ 4 hours	20	20%
	> 4 hours	80	80%
VDT works 1 hour non-stop	Not	50	50%
	Yes	50	50%
Total screen time 12 hours	< 8 hours	23	23%
	≥ 8 hours	77	77%
Hypertension	Not	92	92%
	Yes	8	8%
Diabetes mellitus	Not	98	98%
	Yes	2	2%

**Table 2.** Percentage of extraocular and non-visual complaints

Characteristics		N	%
Headache and Shoulder Pain Complaints	Not	36	36%
	Yes	64	64%
Dry Eye Complaints	Not	55	55%
	Yes	45	45%
Watery Eye Complaint	Not	27	27%
	Yes	73	73%

**Table 3.** Linear correlation of extraocular and non visual complaints

		Headache Shoulder pain	Dry eyes	Hyperlacrimation
Premature	Pearsons	0.018	0.150	0.214
Presbyopia	<i>p-Value</i>	0.860	0.135	0.032

**Table 4.** Percentage of visual complaints

Characteristics		N	%
Complaints of seeing newspaper letters pile up	Not	78	78
	Yes	22	22
Difficulty reading fine print on food packages	Not	72	72
	Yes	28	28
Strains the eyes while reading the letter	Not	86	86
	Yes	14	14
Keep paper / writing away when reading	Not	90	90
	Yes	10	10
Desk calendar letters look stacked	Not	73	73
	Yes	27	27
Eyes block when reading close long	Not	72	72
	Yes	28	28
Late focus on changes in reading distance	Not	66	66
	Yes	34	34
Need additional light when reading small print	Not	59	59
	Yes	41	41
Monitor screen is too bright	Not	72	72
	Yes	28	28

**Table 5.** Linear correlation of visual complaints with premature presbyopia

		Newspaper letters pile up	Hard to read food labels	Strains the eyes while reading	Head Away while reading	Desk calendar letters piled up	Stuffy eyes after reading	late focus	Need additional light when reading	Computer screen glare
Premature Presbyopia	Pearsons	0.301	0.314	0.273	0.145	0.275	0.260	0.230	0.343	0.206
	<i>p-values</i>	0.002	0.001	0.006	0.150	0.006	0.009	0.021	0.000	0.039

**Table 6.** Percentage of respondents wearing reading glasses

Characteristics		N	%
Wearing reading glasses after working in the present place	Not	78	78
	Yes	22	22
Total		100	100

Complaints of keeping the head away from the paper/writing while reading are considered insignificant because they have a *p-value* above 0.05, namely 0.15. These complaints from all respondents are also the smallest, namely 10%. Compared to other complaints.

Several respondents admitted to wearing reading glasses after work. However, after further verification some of them did not meet the criteria for these glasses. There were 22 respondents (22%) who fulfilled presbyopia after verification and measurement (table 6).

From the measurement results (table 7) it was found that one person was 29 years old, two people were 34 years old, one person was 35 years old, three people were 36 years old, six people were 37 years old, five people were 38 years old and four people were 39 years old. Of the 22 premature presbyopia, 20 were female (90.9%) and 2 were male (9.1%). Visual acuity measurements obtained normal vision in 4 people (18.18%), mild in 8 people (36.36%), moderate in 9 people (40.9%), severe in 1 person (4.5%). There was a decrease in the amplitude of accommodation  $\geq 2$  diopters in 17 people (77.3%) and the amplitude of accommodation decreased not significantly ( $< 2$  diopters) in 5 people (22.7%).

Bivariate analysis was carried out with the help of SPSS 26. This analysis was carried out to

determine the significance of the relationship between sociodemographic factors and work which is the independent variable on the incidence of the dependent variable (premature presbyopia) using *Chi-Square* in order to obtain the *Odds Ratio (OR)* which is the value of the tendency for the dependent variable to occur. with a degree of confidence of 95%. The relationship of the independent variables is considered significant to the dependent variable if the *p-value*  $< 0.05$  which can be concluded that the independent variables have a significant influence on the dependent variable. From table 8 it can be seen that *the p-value* of the independent variables age (p 0.014), type of VDT (p 0.49) and 1 hour non-stop VDT work (p 0.016) each has a *p-value*  $< 0.05$  so that these three variables are considered to have a significant relationship with the incidence of premature presbyopia.

By using binary logistic regression in the SPSS 26 application, multivariate analysis was carried out to see which independent variables had the most significant effect on the dependent variable and were the most dominant compared to other independent variables. From the results of the previous bivariate test, only independent variables with a *p-value*  $< 0.25$  were included in the multivariate test. Age, employee Working period, type of VDT, and 1 hour non-stop

**Table 7.** Measurement results

No	Usia	JK	VISUS (Snellen Chart) dan koreksi sampai 6/6	Kategori WHO (Normal,Ringan, Sedang,Berat)	Near Reading	NPA (RAF Ruler) Centimeter	AA Ukur (D)	AA usia menurut Hofstetter
1	29	P	6/30 s-1.25; 6/45 s-1.76	Moderate	25pt add+1	18/24	4.7D	9.8 D
2	34	P	6/9 - 6/6	Mild	25pt add+1	11/14	8D	8.3 D
3	34	L	6/20 s-1.5; 6/45 s-1.75	Moderate	25pt add+1	16/20	5.3D	8.3 D
4	35	L	6/6; 6/6	Normal	25pt add+1	14/19	6D	8 D
5	36	p	6/6; 6/9 s-0.5	Mild	25pt add +1	13/16	6.9D	7.7 D
6	36	p	6/30 s-2.7; 6/21 s-2	Moderate	25pt add+1	14/22	5.5D	7.7 D
7	36	p	6/60 s-3.25; 6/45 s-2.75	Severe	30pt add+1	12/16	7.1D	7.7 D
8	37	p	6/15 s-1.5; 6/12 s-1.25	Mild	25pt add+1	16/22	5.3D	7.4 D
9	37	P	6/30 s-1.25 A.0.5; 6/21	Moderate	25pt add+1	20/24	4.5D	7.4 D
10	37	P	6/9 s-0.5; 6/9 s-0.5	Mild	30pt add+ 1.25	18/28	4.3D	7.4 D
11	37	P	6/9 s-0.5; 6/9 s-0.5	Mild	25pt add+ 1	16/18	5.9D	7.4 D
12	37	P	6/21 s-1.25;- 6/21 s-1.25	Moderate	25pt add+ 1	18/20	5.3D	7.4 D
13	37	P	6/6; 6/6	Normal	20pt add+ 1.75	28/30	3.4D	7.4 D
14	38	P	6/45 s-0.5 A0.5; 6/45	Moderate	30pt add+ 1	18/22	5D	7.1 D
15	38	p	6/9 s-0.7; 6/9 s-0.7	Mild	30pt add+1	17/22	5.1D	7.1 D
16	38	p	6/15 s-1; 6/9 s-0.5	Mild	25pt add+1	14/20	5.8D	7.1 D
17	38	P	6/6; 6/6	Normal	30pt add+ 1.25	24/30	3.7D	7.1 D
18	38	P	6/6; 6/12 s-0.5 A0.5	Moderate	25pt add+1	18/22	5D	7.1 D
19	39	p	6/30 s-2.5; 6/21 s-2	Moderate	30pt add +1.25	18/25	4.7D	6.8 D
20	39	p	6/30 s-2; 6/30 s-2	Moderate	25pt add +1	19/24	4.7D	6.8 D
21	39	P	6/6; 6/6	Normal	25pt add+ 1	18/24	4.8D	6.8 D
22	39	P	6/9 s-0.75; 6/9 s-0.75	Mild	30pt add+1.25	22/25	4.2D	6.8 D

**Table 8.** Sosidemographic relationship with premature presbyopia

Variable		Premature Presbyopia				OR	CI 95%	p
		Yes		Not				
		n	%	n	%			
Age	≥35 years	18	30.5	41	69.5	4,061	1259-13098	0.014
	<35 years	4	9.8	37	90.2			
Gender	Woman	20	22.2	70	77.8	1.143	0.225-5.817	0.872
	Man	2	20	8	80			
Employee working period	≥4 years	20	24.7	61	75.3	2,787	0592-13127	0.180
	<4 years	2	10.5	17	89.5			
VDT type	Laptops/Notebooks	18	28.1	46	71.9	3.130	0968-10123	0.049
	Desk computer/ PC	4	11.1	32	88.9			
VDT Work Period	>4 years	15	23.1	50	76.9	1,200	0437-3293	0.723
	≤4 years	7	20	28	80			
VDT duration per day	>4 hours	19	23.8	61	76.3	1,765	0.466-6.680	0.398
	≤4 hours	3	15	17	85			
1 hour non-stop VDT	Yes	16	32	34	68	3,451	1220-9759	0.016
	Not	6	12	44	88			
Total screen time	>8 hours	17	22.1	60	77.9	1020	0.330-3.150	0.973
	≤8 hours	5	21.7	18	78.3			
Hypertension	Yes	0	0	8	100		0.679-0.853	1 *
	Not	22	23.9	70	76.1			
Diabetes mellitus	Yes	0	0	2	100		0.697-0.863	1 *
	Not	22	22.4	76	77.6			

\*fisher

**Table 9.** Multivariate analysis

Variable	Premature presbyopia		
	OR	CI 95%	p-value
Age	4010	0966-16638	0.056
Employee Working Period	1,450	0.226-9.289	0.695
VDT type	2,584	0.743-8.987	0.136
1 hour non-stop VDT work	3,789	1255-11445	0.018

VDT each have a p-value <0.25 so that only these four variables are included in the multivariate test. Based on the values listed in table The results of the multivariate test showed a p-value <0.05 only for the working variable 1 hour non-stop VDT with an odds ratio of 3.789.

## Discussion

Table 1 shows the sociodemographic description of the respondents. The number of research respondents who were dominated by female sex was 90 people or 90%. In accordance with the American Optometric Association

(AOA) which states that the onset of presbyopia is higher in women than men. Nirmalan's research (2006) also showed that the female gender was higher than that of the male (OR: 1.4, 95% CI: 1.1-1.8).<sup>10,11</sup> Even Priyambada (2019) reported that female sex dominated premature presbyopia with a percentage of 61.13%.

The age groups using the median because the results of the Kolmogorov-Smirnov and Shapiro-Wilk distribution tests obtained an abnormal distribution so the authors calculated the median and obtained the number 35. The Types of VDT devices are divided between laptops and desktop computers due to the difference in the dimensions of the smaller screens and the position of the keyboard that blends together, forcing laptop users to work more closely. Employee tenure shows how long (years) the subject has worked while VDT work period is how long the subject has worked using VDT, 4 years is the work period for one period of class of employee. VDT working time is the duration of time spent in a day working with VDT, 4 hours is VDT working time which generally causes initial complaints. VDT working period is the length of time working using VDT in years, because the data is not normally distributed, the authors use the median as the number 4 years. VDT work without interruption for 1 hour is the practice of working with VDT without interruption for 1 hour. Total screen time is the accumulated time spent using the VDT both for work and other activities and with other VDT devices, taken as a range of 8 hours because it is the total working hours in a day.

Measurements of visual acuity and amplitude of accommodation showed that 22 respondents (22%) had premature presbyopia from the results of measurements that supported this diagnosis. Table 7 shows the visual acuity values, far and near correction values, near point accommodation (NPA) and accommodation values obtained as well as the normal value of accommodation amplitude based on age (Diopters) from the Hofstetter formula. According to another study conducted by Fricke (2018), he reported that the global prevalence of presbyopia in 2015 was 25% (around 1.8 billion).<sup>12</sup>

Table 7 also shows that of the 22 people with premature presbyopia, there were 4 people under 35 years of age or 18.18% and 18 people aged 35 and over (81.82%). Bivariate analysis (table 8) of the age variable on premature presbyopia shows that there is a relationship between age and the incidence of premature presbyopia *p-value* 0.041 OR 4.061 CI 95% 1.259-

13.098. In this study, the most age who experienced premature presbyopia was 37 years old (22.3%). Similar to Nirmalan (2006) who reported the same results in India, in his study aged 30-39 years experienced presbyopia of 22.9%. Presbyopia tends to increase with age with an average age of 36.6.<sup>11</sup> This is almost similar to Anakjewu (2021) who stated that the age of onset for presbyopia is 38 years with a prevalence of 79.1% (95% CI = 74.7-83.5).<sup>13</sup>

There were 20 women who experienced premature prebiopia or 22.2% while there were fewer men, namely 20%. Despite similarities in gender comparison between this study and AOA, Nirmalan and Priyambada, the results of this study did not show a significant relationship between gender and the incidence of preterm presbyopia. The bivariate test (Table 8) shows that the gender variable has a *p-value* > 0.05, namely 0.872 with an OR of 1.143, 95% CI 0.225-5.817. With this *p-value*, gender is considered not to have association with the incidence of premature presbyopia.

Based on the working period of the employees in table 8, the results of premature presbyopia are more in the working period of employees over 4 years of 23.5% compared to the working period of 4 years and under which is only 15.8%. However, from the bivariate test (table 8), the employee's tenure variable has a *p-value* of 0.471 (> 0.05) so it is considered not to have a significant relationship with the incidence of premature presbyopia. According to the author, this can happen because the employee's tenure is not necessarily linear with the time duration and duration of VDT usage at work.

The total number of laptop-type VDT users is 64 people, almost double the table computer/PC users (36 people). Laptop users who experience premature presbyopia are 18 people or 28.1% of laptop users. This figure is higher than table computer/PC users who experience premature presbyopia of 4 people (11.1%) of all table computer/PC user respondents, namely 36 people or 18.18% of the number of premature presbyopia respondents who use desktop computers/PC. The number of laptop users according to the Central Bureau of Statistics is indeed more than desktop computers with a ratio of 1:7. Regarding the relationship between the type of VDT and the visual complaints of VDT users, it was reported by Anggrainy (2018). The study showed that the average complaint score for the laptop user group was 2.54 higher than the desktop-computer user group (*p*=0.001).<sup>14</sup>

With the bivariate test the VDT type variable showed a *p-value* of 0.049, OR 3.130 and 95% CI 0.968-10.123. This value explains that the variable type of VDT and the incidence of preterm presbyopia has a significant relationship. This is possible because the dimensions of the device are smaller so that the wearer feels more comfortable working if they are at a closer distance (near work). Nadhiva (2020) reported that 87.5% of subjects who worked VDT at optimal distances experienced complaints. In his report, he also mentioned that Darmaliputra and Dharmadi reported that 79.6% of computer users who work at a distance of less than 50 cm experience computer syndrome.<sup>2,14</sup> Priyambada (2019) also stated that the highest risk factor for premature presbyopia is close viewing of 30.5%.

The number of respondents with a VDT usage period of 4 years and under was 35 people (35%) and 7 people who experienced premature presbyopia (20%). Respondents with a VDT usage period of more than 4 years were 65 (65%) and 15 (23.1%) experienced premature presbyopia. The percentage of incidents based on years of service with VDT shows that those who have served longer VDT have a higher incidence rate than those who have served less VDT.

Computer syndrome has been reported to be associated with longer tenure. Nadhiva's research (2020) noted complaints of computer syndrome based on the length of work. 75% of the respondents who complained of computer syndrome came from the group with more than 10 years of service, while 25% came from less than 10 years of service (*p-value* 0.002).<sup>2</sup> However, Table 8 shows the percentage of bivariate test results on the VDT service period variable with a *p-value* of 0.723 with OR of 1.200 and 95% CI 0.437-3.293. The *p-value* > 0.05 in this study indicates that VDT working age is not significantly related to the occurrence of premature presbyopia.

The length of work with VDT per day shows that people who work with VDT up to 4 hours per day experience premature presbyopia in 3 people (15%). Whereas those who worked VDT for more than 4 hours a day experienced a greater number of presbyopia, namely 19 people (23.8%) of the total respondents who worked VDT for more than 4 hours or 19% of the total respondents. The number of hours worked is directly proportional to the number of incidents.

However, from the bivariate test on this variable (Table 8) *p-value* 0.398, OR 1.765 and 95% CI 0.466-6.680 shows that the variable length of work using VDT

per day is not significant with the incidence of premature presbyopia. Although in Xiao Cheng's research (2019) it was reported that 81.5% of VDT workers worked between 6-11 hours every day. He said that the duration of work with VDT in a day was directly proportional to the emergence of various physical complaints including visual deterioration, in his research Cheng reported that a *p-value* of 0.015 in ocular disorders appeared with extensive work using VDT.<sup>15</sup>

In table 8 the variable habit of working 1 hour without a break was recorded as many as 50 people (50%) and those who experienced premature presbyopia as many as 16 people (32%) were much higher than the group that did not work nonstop who experienced premature presbyopia of 6 people or 12% of the group totals. Bivariate test for this variable (Table 8) shows that the habit of working with VDT without a break for 1 hour has a significant relationship with the incidence of premature presbyopia (*p-value* = 0.016) with OR 3.451 CI 95% 1.220-9.759.

An investigation of the duration of work without rest conducted by Mellner and Moberg (1983), showed a strong correlation between the duration of work without rest and the frequency of symptoms. Working without a break for 30 minutes shows 47% of complaints of visual fatigue, while more than 30 minutes shows complaints of 66%.<sup>1</sup> Jatinder Bali (2014) suggests regular pauses for VDT users as this shows increased comfort and relaxation in the accommodation system. Regular breaks of 5-10 minutes are better than long breaks after working 2-3 hours.<sup>4</sup> This can be explained because the two components involved in presbyopia are lens sclerosis and ciliary system weakness. In premature presbyopia, lens sclerosis is unknown. Meanwhile, ciliary weakness can occur, one of which is due to *eye strain* or *eye strain* (Duane).<sup>9</sup>

A popular suggestion for relaxation is eye relaxation as suggested by Mahar Safdar to apply the 20-20-20 exercise as an effort to reduce eye fatigue that arises when working on a computer, namely after every 20 minutes working close, look away for 20 seconds to relieve eye strain. and see objects 20 feet away. Unimanon in his study also suggests taking a 10-minute break from near work after every two hours of work.<sup>16</sup>

Total screen time is a combination of the total time spent using VDT and other gadgets such as cellphones, tablets and other e-readers. Table 8 shows that of the 23 people with a total screen time of up to 8 hours, 5 people (21.7%) had premature presbyopia and of the

77 people with a total screen time of more than 8 hours, 17 people (22.1%) had premature presbyopia.

Table 8 displays the results of the bivariate test for the total screen time variable, the result is a *p-value* of 0.973 with an OR of 1.020 and a CI of 95% 0.330-3.150. With a *p-value* greater than 0.05, this shows an insignificant relationship between the total screen time variable and the incidence of premature presbyopia in this study. In Pakistan, Doggar (2021) reported that around 35% of the participants in his study had presbyopia. More than 182 people generally have been wearing glasses for 1-3 years. Nearly 95% of the total participants used mobile phones for more than 3 years and generally used this for more than 5 hours per day.<sup>6</sup>

From the overall relationship between the independent variables and the incidence of the dependent variable (premature presbyopia) in table 8, it can be concluded that the variables are age (*p-value* 0.014), type of VDT (*p-value* 0.049), and VDT work 1 hour non-stop (*p-value* 0.016) is an independent variable that has a significant relationship with the dependent variable (premature presbyopia) although the odds ratio for each is different. But to determine which variable is the most significant and most dominant among other variables, a multivariate test is performed. In this test the variables included were the variables resulting from the bivariate test with a *p-value* <0.25 so that in addition to the three variables above, the employee's tenure variable was also included in the multivariate test because it has a *p-value* of 0.180.

Multivariate test using binary logistic regression. And from the results of the multivariate test (Table 9) it was found that working with VDT non-stop for 1 hour was the variable that had the most significant relationship to premature presbyopia with a *p-value* of 0.018 OD 3.789 CI 95% 1.255-11.445. While the other 3 variables do not show significance because they have a *p-value* > 0.05.

### Excess research

VDT is a media that has become a part of life for all ages and occupational groups. Research on the relationship between VDT and premature presbyopia is research that is rarely done, especially in Indonesia. It is hoped that this research can be a stimulus to conduct research on the same topic but with better preparation and more comprehensive implementation. This research uses primary data, namely answers from interviews and

direct measurement results to respondents so that the data obtained is actual data.

### Research limitations

Respondents in this study did not have a health database, especially eye health. Presbyopia assessment tools are minimal and none have been validated. The diagnosis of presbyopia is still subjective and this study still relies on conventional measurements. The research population is still limited. The number of respondents has not represented each variable proportionally. The literature on presbyopia is numerous but for premature presbyopia it is very limited.

### Conclusion

There is a relationship between the use of the Visual Display Terminal (VDT) and the incidence of premature presbyopia in office workers with a prevalence of 22%. The non-visual complaint that was significantly related was hyperlacrimation (*p-value* 0.032), while the most significant visual complaint was the complaint of the need for additional light when reading small print (*p-value* 0.00).

Factors that have a significant relationship with the incidence of premature presbyopia are increase in age (*p-value* 0.014, OD 4.061 CI 95% 1.259-13.098), VDT type (*p-value* 0.049 OD 3.130 CI 95% 0.968-10.123), the habit of working with VDT non-stop without a break in 1 hour (*p-value* 0.016 OD 3.451 CI 95% 1.220-9.759).

The habit of working with VDT non-stop without a break of 1 hour is the most significant factor in the incidence of premature presbyopia and is the most dominant compared to other variables. Multivariate test results showed a *p-value* of 0.018, OD 3.789 and 95% CI 1.255-11.445.

### Suggestion

Puskesmas management must make and implement occupational health and safety policies in general and eye health specifically for employees who work using VDT every day, especially in terms of VDT duration and workload. Procurement of devices and use of VDT in the workplace needs to pay attention to ergonomic

aspects. The use of protective equipment can be applied such as screen protectors or protective glasses.

VDT workers must cultivate themselves to work ergonomically. Starting from the working position, the type and size of the equipment used, the length of work in days and the limitation on the duration of intensive work.

Relaxation at work must be implemented because it does not only concern eye health but the overall health of workers.

Subsequent research can be carried out with a wider population, more varied work backgrounds, more comprehensive size parameters and with a more proportional comparison.

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## Conflict of Interest

None

## Author Contributions

All the authors helped with revising and improving the manuscript. All authors read and approved the final manuscript.

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