ARTICLE TYPE

The effect of external illumination on CSV-1000 contrast sensitivity measure among young adults

Azmir Ahmad[a,b]*, Norfaridah Abdul Aziz[a], Nor Hanani Ozali [a]

[a]Center for Optometry Studies, Faculty of Health Sciences, Universiti Teknologi MARA (UiTM), UiTM Kampus Puncak Alam, 42300 Bandar Puncak Alam, Selangor, Malaysia; [b]Optometry & Visual Sciences Research Centre (iROViS), Faculty of Health Sciences, Universiti Teknologi MARA (UiTM), UiTM Kampus Puncak Alam, 42300 Bandar Puncak Alam, Selangor, Malaysia.

Corresponding Author

Azmir Ahmad
azmir5807@uitm.edu.my

Abstract:

Contrast played a major role in determining object appearance in vast areas, from medical perspectives to daily living activities such as driving. There were various clinical tests to measure contrast sensitivity which was designed to be used either with internal illumination or under external illumination. This study was aimed to compare the contrast sensitivity measurement between external and internal illuminated CSV-1000 and external illuminated FACT among young adults. A total of 38 participants of 22.05-year-old (±1.958), with best-corrected visual acuity of 6/6 were included in this study. They had best-corrected visual acuity of 6/6 with no history of ocular disease and binocular problem. The contrast sensitivity of different spatial frequencies, namely 3 cycles per degree (cpd), 6 cpd, 12 cpd and 18 cpd were measured under normal illuminated clinical room based on three conditions; external illuminated FACT screen, external illuminated CSV-1000 and internal illuminated CSV-1000. The measurement of contrast sensitivity was taken 3 times to produce an average contrast sensitivity value. Based on the Kruskal-Wallis non-parametric test, there was a statistically significant difference in contrast sensitivity only for external illuminated CSV-1000 at 6 cpd ($p < 0.05$). However, for 3, 6 and 18 cpd, in addition to other testing conditions, there were no significant differences ($p > 0.05$). The external illumination on CSV-1000 might produce glare during the contrast sensitivity measurement. Thus, external illumination affected the discrimination of contrast at moderate level of spatial frequencies only for CSV-1000. The contrast sensitivity measurement for CSV-1000 was more accurate under its internal illumination.

Keywords: Contrast sensitivity; external illumination; internal illumination; spatial frequency

1. INTRODUCTION

In recent years, there was a rapid development in lighting sources which provides direct and indirect lighting. Inarguably, light affected various daily living activities especially visual-related tasks such as driving and reading. The effect was significant on different visual performance, namely visual acuity, colour perception, and even contrast sensitivity [1]. At high level of lighting illumination, in addition to improvement in visual acuity, the alertness level of the respondents was also increased. Thus, improper use of lighting could impair visual performance, including differentiating any object from the background.

The different appearance between object and background was due to the contrast. In the human vision system, contrast played a significant role in determining object appearance in vast areas, from medical perspectives to daily living activities. In medical aspect, any abnormalities in structural imagery could be appropriately identified with sufficient contrast such as abnormal optic disc in glaucoma assessment [2] or micro-aneurysms in diabetic retinopathy evaluation [3]. In mammography, improving contrast on the medical images increased early detection of medical problem [4]. On the other hand, low contrast condition could reduce the visibility level which then impaired daily activities including driving, especially in fog condition [5]. The low contrast condition could also happen in workplace environment especially under fumes exposure, which was hazardous to the workers, not just visually but also occupationally [6]. Therefore, the ability to discriminate object appearance from its background was important.

This visual discrimination ability could be measured using contrast sensitivity, which provided information on vision status in detail rather than cognitive status. As opposed to visual acuity which only measured vision discrimination ability towards high spatial frequencies target, contrast sensitivity could show the discrimination ability towards various spatial frequencies target including low frequency. Contrast sensitivity was widely tested in most clinical practice as it was useful in the evaluation and monitoring of eye diseases such as optic neuropathy [7].

The American Society of Cataract and Refractive Surgery revealed that about a third of 214 ophthalmologists who

participated in their study, measured contrast sensitivity as one of their routine assessment in monitoring visual function among cataract patients [8]. The clinical contrast sensitivity measure could explain symptoms of poor vision in patients with good visual acuity, and the test provided a comprehensive evaluation in patients with low vision, especially those with cataract and glaucoma. Furthermore, contrast sensitivity could be impaired even though the visual acuity was normal during clinical examination [9].

There was three main related clinical information that could be obtained through contrast sensitivity measure [10]. Firstly, it revealed the presence of visual dysfunction which was not discovered through other visual evaluations. Secondly, it provided a visual method to monitor the impact of treatment intervention. This intervention might be useful in improving contrast sensitivity only, but not in another visual performance aspect, such as visual acuity. Lastly, it gave information on visual disability and functional performance problems. As such, contrast sensitivity was measured for variety of reasons; as a general screening tool to detect under-diagnosed general disorders or as a follow-up tool for following an evolving disorder once it was diagnosed [7]. It was also used as predictive tool to identify task difficulties related to various daily living activities.

The measuring approach of a contrast sensitivity test could be classified into several categories; which among those was by using grating targets [11]. The grating targets could generate different level of spatial frequencies for contrast sensitivity measurement. This approach was generally applied in several commercially available clinical tests; in which it was developed based on the Functional Acuity Contrast Test (FACT) design of grating target type [12]. The FACT was more sensitive to the presence of early cataract patients [13]. Currently, the most popular commercial contrast sensitivity tests for measuring the contrast sensitivity were FACT and the Vector-Vision CSV-1000 test [14].

As lighting played a significant role in contrast sensitivity measurement, the testing apparatus was built using either internal or external illumination. The light source for internal illumination design was in the device itself, whereas for external illumination design, the lighting was from the testing area. As FACT and CSV-1000 test became widely used in the measurement of contrast sensitivity, the internal or external illumination on the testing apparatus might affect contrast sensitivity findings. A better understanding of the contrast sensitivity measurement allowed better diagnosis and management of eye disorders [15], [16]. Thus, this study was to compare the effect of external and internal illumination on contrast sensitivity measurement among normally sighted young adults. This was done by investigating contrast sensitivity measured from to external and internal illuminated CSV-1000, in addition to external illuminated FACT screen.

2. METHODOLOGY

Functional Acuity Contrast Test (FACT) and Vector-Vision CSV-1000 were used to measure the contrast sensitivity in this study. FACT screen consisted of sine-wave grating chart that tested five spatial frequencies which were 1.5, 3, 6, 12 and 18 cycles per degree (cpd). The FACT screen also comprised of five rows, namely A, B, C, D, and E, in which each row had nine varying levels of contrast. Participants had to determine the last gratings seen for each row and report the orientation of the grating; right, up or left. The test screen was designed to be externally illuminated. On the other hand, CSV-1000 consisted of four rows of sine-wave gratings. It measured four levels of spatial frequencies; 3, 6, 12 and 18 cpd. The contrast level differed in its logarithmic progression in each step, with 0.17 log unit step for contrast level 1 to 3 and 0.15 log unit step for contrast level 3 to 8. CSV-1000 was provided with internal illumination and operated using a remote controller. However, it could also be externally illuminated by switching off the internal illumination.

Participants were recruited in this study using convenient sampling based on 0.18 standard deviation from a previous study [17] with a precision value of 0.06. A total of 38 participants were involved in the study. The participants were university students aged between 18 to 25-year olds, with mean age (±SD) of 22.05 years (±1.96). All participants were emmetropes and low myopes with mean refractive error (±SD) of -0.74 D (±0.55). The inclusion criteria for the participants were best-corrected visual acuity of 6/6, with no history of ocular disease and binocular problem. Their contrast sensitivity was measured using external illuminated FACT screen, in addition to external and internal illuminated CSV-1000. The unit for spatial frequency of contrast sensitivity level was in cycle per degree (cpd). All measurement was done under normal illuminated clinical room with more than 400 lux of average room illumination. The ethical consideration had been approved by the Universiti Teknologi MARA (UiTM) and followed the tenet of the Helsinki Declaration.

For FACT, the test was performed at 1 meter under monocular right eye vision under external illumination. While occluding the left eye, the participant was asked to determine the last grating seen for each row of spatial frequencies and the position of the gratings. Then, the participants were tested with CSV-1000 at 2.5 meters from the chart. The contrast sensitivity was also measured under monocular right eye vision, however under both internal and external illuminations. Firstly, the participants were tested under the internal illumination of the chart. Participants reported the last seen gratings for each row, and it was measured for three times to obtain the mean. Afterwards, the test was repeated under external illumination only. All measurement of contrast sensitivity was taken three times to produce average contrast sensitivity value. The contrast sensitivity data were converted to log unit of contrast sensitivity to ensure that the contrast thresholds were uniformly increased, for the measurement to be analyzed statistically.

3. RESULT AND DISCUSSION

As CSV-1000 did not measure 1.5 cpd spatial frequency, contrast sensitivity for 1.5 cpd of the FACT was excluded. For three cpd spatial frequency, the range of mean for all three measurement conditions were between 0.90 to 0.94 log unit, while for 6 cpd spatial frequency, the range of mean was

between 0.88 to 0.94 log unit. For 12 cpd spatial frequency, the range of mean for all three measurement conditions were between 0.85 to 0.93 log unit, while for 18 cpd spatial frequency, the range of mean was between 0.79 to 0.93 log unit. The details of mean and standard deviation (SD) for external illuminated FACT, external and internal illuminated CSV-1000 were illustrated in Table 1.

Table 1: Mean (SD) contrast sensitivity (log units) for each spatial frequency for external illuminated FACT, external and internal illuminated CSV-1000

Spatial frequency (cpd)	External illuminated FACT (log unit) ± SD	External illuminated CSV-1000 (log unit) ± SD	Internal illuminated CSV-1000 (log unit) ± SD
3	0.94 (±0.06)	0.91 (±0.11)	0.90 (±0.09)
6	0.92 (±0.10)	0.88 (±0.16)	0.94 (±0.15)
12	0.87 (±0.15)	0.85 (±0.18)	0.93 (±0.19)
18	0.79 (±0.20)	0.85 (±0.17)	0.93 (±0.19)

Based on Shapiro-Wilk normality test, the data were not normally distributed ($p<0.05$). Therefore, the Kruskal-Wallis non-parametric test was used to compare the contrast sensitivity finding between the contrast sensitivity charts of different illumination conditions based on spatial frequencies. There was a significant difference in contrast sensitivity only for external illuminated CSV-1000 at 6 cpd ($p < 0.05$). However, for 3, 6 and 18 cpd spatial frequencies, there were no significant differences between all three measurement conditions ($p > 0.05$). The Kruskal-Wallis test findings for external illuminated FACT, external illuminated CSV-1000 and internal illuminated CSV-1000 were illustrated in Table 2, Table 3 and Table 4, respectively.

Table 2: Statistical analysis of the Kruskal-Wallis test for all measured spatial frequencies of external illuminated FACT

Spatial frequency (cpd)	3	6	12	18
Median (log unit)	0.90	0.90	0.90	0.75
Interquartile range (IQR)	0.04	0.15	0.04	0.15
Chi-square	4.977	4.350	3.739	3.840
p-value	0.419	0.500	0.588	0.573

This study showed that the contrast sensitivity differed significantly for external illuminated CSV-1000 at 6 cpd only. Though the median of contrast sensitivity for external illuminated CSV-1000 at all spatial frequencies was similar at 0.90 log unit only, the interquartile range at 6 cpd (0.30 log unit) was higher than other spatial frequencies (between 0.04 to 0.19). This indicated that the experimental room illumination on the contrast sensitivity testing chart could affect the measurement of contrast sensitivity at 6 cpd. This difference could be due to the higher sensitivity of young adult towards low to moderate spatial frequency [10], rather than high spatial frequency. At 6 cpd, the young adults could appreciate object discrimination from the background better.

Table 3: Statistical analysis of the Kruskal-Wallis test for all measured spatial frequencies of external illuminated CSV-1000

Spatial frequency (cpd)	3	6	12	18
Median (log unit)	0.90	0.90	0.90	0.90
Interquartile range (IQR)	0.04	0.30	0.19	0.15
Chi-square	4.904	11.037	3.552	2.399
p-value	0.428	*0.046	0.616	0.792

*Show significance difference.

Table 4: Statistical analysis of the Kruskal-Wallis test for all measured spatial frequencies of internal illuminated CSV-1000

Spatial frequency (cpd)	3	6	12	18
Median (log unit)	0.90	0.90	0.90	0.90
Interquartile range (IQR)	0.00	0.15	0.15	0.19
Chi-square	3.773	8.06	4.751	4.733
p-value	0.583	0.153	0.447	0.449

Karas and McKendrick revealed that young adults were not affected by the surround modulation of contrast due to neurophysiological reason [18]. They differed from elderly adults' group as the elderly had decreased perceptual brightness induction. The brightness induction relied on neural synchronisation which was disrupted by the aging process. The abnormality among older individuals was less likely to be detected as there was greater variability in response of normal participants [19]. As the participants in the current study were young adults, their contrast sensitivity findings were more reliable.

Thus, instead of internal illumination, the external illumination influenced the sensitivity at a lower frequency. The external illumination on CSV-1000 might produce glare during the contrast sensitivity measurement which was among the factors that affecting contrast sensitivity [20], in addition to ocular hypertension and dry eye [21], [22]. As all participants were not having any history of the ocular problem, there were no ocular factors that would affect the contrast sensitivity in the current study. Nevertheless, the similar level of median of contrast sensitivity at all spatial frequencies (0.90 log unit) especially at the lower to moderate frequencies of 3 and 6 cpd was in agreement to the study done by Owsley and colleagues in which the contrast sensitivity for those spatial frequencies remained the same throughout adulthood [10].

In this study, FACT screen was used as control measurement as it showed slightly better retest agreement rather than

Vistech chart (VCTS 6500) as FACT had smaller step units of 0.15 log unit for the subsequent spatial frequency size [13]. It was also one of the reliable tests for measuring contrast sensitivity even; thus it was used as guidelines in designing new applications for contrast sensitivity measurement [14]. This visual discrimination ability was vital in the vision system, including the analysis of object or image especially with regards to medical conditions [2], [3]. Thus, each related person should have good contrast sensitivity which needed to be properly measured. As the current findings showed that no significant difference for all spatial frequencies even though the FACT screen was externally illuminated, the absence of internal illumination in FACT screen test did not affect the measurement of contrast sensitivity.

4 CONCLUSIONS

It could be concluded that the external illumination affected the discrimination of contrast at moderate spatial frequencies only for CSV-1000. This implied that the contrast sensitivity measurement for CSV-1000 was more accurate under its internal illumination. Thus in the future, contrast sensitivity measurement can be taken interchangeably between the standard external illuminated FACT and the internal illuminated CSV-1000 as there was no statistical difference between these two conditions. This proper measurement could contribute to assessing vision status and the quality of daily activities including driving and working, thoroughly [4], [5].

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ARTICLE TYPE

Computer vision syndrome and ergonomic practices among university office workers

Elly Liyana Zainodin[a]*, Nor Aziyati Abu Bakar[a]

[a]*Center for Optometry Studies, Faculty of Health Sciences, Universiti Teknologi MARA (UiTM), UiTM Kampus Puncak Alam, 42300 Bandar Puncak Alam, Selangor, Malaysia*

Corresponding Author

Elly Liyana Zainodin
ellyli0936@uitm.edu.my

Abstract:

Introduction: Computer vision syndrome is prevalent among computer users, particularly office workers. Proper workstation design and good posture are essential preventive measures of computer vision syndrome among office workers to increase their work productivity and quality of life. A cross-sectional study was done to determine the symptoms of computer vision syndrome experienced by office workers in UiTM Selangor Puncak Alam Campus and their ergonomic practices and posture. Material and Methods: A self-administered questionnaire was distributed to 140 administrative staffs from 8 faculties. Results: The most common symptoms experienced by the office workers were shoulder pain (90%), followed by neck pain (88.6%), and headache (82.9%). Neck pain (p=0.004) and shoulder pain (p=0.027) was significantly related to using a laptop on the thigh. Headache was significantly associated with viewing computer screen at a distance lesser than 30 inches (p=0.038). Conclusion: High prevalence of CVS among the office workers is preventable by implementing strategies focusing on awareness of the visual ergonomics and adjustment to the workstation.

Keywords: computer vision syndrome, ergonomic practice, workplace, office workers

1. INTRODUCTION

Prolong use of the computer has been found to cause Computer Vision Syndrome (CVS), a condition describes a group of eye and vision-related problems [1]. Ocular symptoms that characterise the CVS include eyestrain, irritation, burning sensation, redness, blurred vision, and double vision. Symptoms such as shoulders pain, neck, or back pain are non-ocular symptoms known to be associated with CVS [2]. People who spend more than 4 hours a day on the computer have been found to have more visual problems than those who do not [3]. Besides than duration of exposure, improper workstation design, and poor posture are additional risk factors known to have caused CVS [4]. Computer users who maintain a prolong uncomfortable position, and static body movements acquire musculoskeletal disorders, eye fatigue, and headaches [5]. One study in Malaysia recorded 33% prevalence of upper limb musculoskeletal disorder among clerical office workers [6].

One method for reducing the prevalence of musculoskeletal and visual symptoms is to provide specialised ergonomics training and workstation changes [7]. Appropriate height of the seat and armrest, backrest, straight alignment of the wrist and the elbow, and correct positioning of the keyboard are among the proper strategies for an ergonomic workstation [4]. An ergonomically designed workplace will not only reduce the risk of CVS but consequently improve the productivity of work [8].

Failure to implement the ergonomic principles at the workplaces could lead to physical exhaustion, impaired productivity, and declines products quality [9]. Avid computer users like office workers are prone to have a loss of work productivity and compromised quality of life due to prolong and persistent CVS. The knowledge and attitude of ergonomics are essential in preventing the onset and progress of musculoskeletal and ocular injuries [10]. In one of the public universities in Malaysia, administrative staffs reportedly had a high prevalence of CVS (63%) despite that the majority has good knowledge of visual ergonomic [11]. Although the majority have good knowledge, half of them had poor attitudes on visual ergonomics. Khan et al. similarly reported that even for those who knew were not able to carefully and entirely apply the ergonomic practices for prevention from health hazards [4]. In light of those findings, investigation on the practice of ergonomics among office workers to identify the factors that could have caused or increased the risk of CVS is necessary before the planning of the preventive strategies. Thus, this study aims to determine the prevalence of CVS symptoms among office workers in UiTM Selangor Puncak Alam Campus and additionally assess the ergonomic practices among the office workers.

2. METHODOLOGY

The CVS symptoms and ergonomic practices among office workers of eight faculties in UiTM Selangor Puncak

Alam Campus were evaluated using a questionnaire in cross-sectional study design. The questionnaire was adapted from the previous study by Mowatt et al. surveyed the prevalence of computer vision syndrome (CVS) and ergonomic practices among university students in Jamaica [12]. The original set of questionnaires was in English. The questions were translated into the Malay language to suit the targeted participants. The draft version of the survey was pretested on five individuals to ensure ease of understanding and clarity, and then accordingly revised. All questions were closed-ended. The final questionnaire has 6 sections; (A) general demographic, (B) method of use of computer, (C) symptoms while working on the computer, (D) ergonomic principles while looking at the computer screen, (E) body posture and placement of the computer and (F) awareness of CVS and ergonomic principle.

The bilingual pretested, self-administered questionnaire were distributed to administrative staffs of eight faculties (Faculty of Architecture, Planning, and Surveying, Faculty of Art and Design, Faculty of Business and Management, Faculty of Health Science, Faculty of Hotel and Tourism Management, Faculty of Pharmacy, Faculty of Accountancy and Faculty of Education) in UiTM Puncak Alam, a public university located in Selangor. The questionnaires were collected within a week of distribution date. Ethics approval was obtained from the UiTM Research Ethics Committee. Completion of the survey indicates voluntary participation.

The data obtained were presented in descriptive analysis. Statistical analysis with Chi-square tests was done at the 0.05 significance level to assess the significance of associations between CVS symptoms and ergonomic practices using SPSS version 21.0.

3. RESULT AND DISCUSSION

One hundred forty office workers took the survey. Of the 140 office workers, 44 were males, and 96 were females with a mean age of 36.73 years. Majority of the office workers have myopia (46.4%) and wear glasses (67.1%) Table 1 summarised the sample demographic data.

Table 1: Demographic characteristics

Characteristic	Frequency, n (%)
Gender	
Male	44 (31.4)
Female	96 (68.6)
Age (years)	
Mean (SD)	36.73 ±7.762
Wear Glasses	
Yes	94 (67.1)
No	46 (32.9)
Type of refractive error	
Myopia	65 (46.4)
Hyperopia	16 (11.4)
Presbyopia	11 (7.9)
Don't know	2 (1.4)

Information on the subjects' daily computer usage is summarized in Table 2. Most of the office workers wear glasses when using a computer (50.7%). Regarding the duration of usage, most of the subjects use the computer for more than 6 hours (45%), followed by 4 to 6 hours (38.6%) and 2 to 4 hours (16.4%). The main reason for using the computer was for word processing (59.3%) followed by data entry (33.6%). Checking emails (3.6%) and social media (3.6%) are the least frequent activity done using the computer. Majority of the office workers reported they use desktop (76.4%) and position their device on the desk (83.6%). A majority of the office workers use a computer at a distance of more than 20 inches (70.7%) at their eye level (84.3%).

Table 2: Information on computer usage

Characteristic	Frequency, n (%)
Visual aid wear for computer use	
Glasses/Contact lens	82 (58.5)
None	58 (41.5)
Duration of computer use/day	
2 to < 4 hours	23 (16.4)
4 to < 6 hours	54 (38.6)
>6 hours	63 (45.0)
Main reason for using computer	
Checking emails	5 (3.6)
Social media	5 (3.6)
Data entry	47 (33.6)
Word processing	83 (59.3)
Most frequent device	
Smartphone/Tablet	20 (14.3)
Laptop	13 (9.3)
Desktop	107 (76.4)
Position of device	
Handheld	22 (15.7)
On lap	1 (0.7)
On desk	117 (83.6)
Distance from the computer screen (inches)	
<30	91 (65)
>30	49 (35)
Level of viewing (eye level)	
Same level	118 (84.3)
Looking Upwards	3 (2.1)
Looking Downwards	19 (13.6)

3.1. Distribution of CVS symptoms

Figure 1 showed the most reported symptoms by the office workers according to severity while working on a computer. The most common symptoms experienced by the office workers were shoulder pain (90%), followed by neck pain (88.6%), and headache (82.9%). Taking into account the severity of symptoms, blurred vision (7.1%), neck pain (5.7%),

and shoulder pain (5.7%) were the most commonly reported severe symptoms. In this study, blurred vision, neck pain, and shoulder pain were the most severe symptoms widely reported.

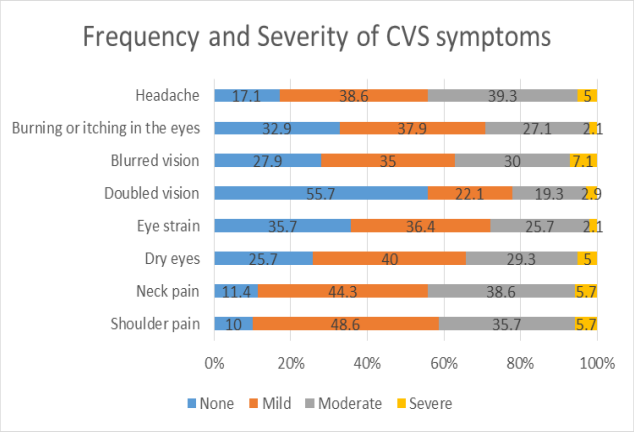

Figure 1: Distribution of CVS symptoms according to the severity

3.2. Awareness of CVS and ergonomic principles

In response to a question about awareness of CVS and ergonomic principle, more than half (55%) of those surveyed indicated that they are aware of CVS, but less than half (40%) aware of the ergonomic principles when using a computer. Half of the office workers (50.7%) reported that they are not aware of the 20-20-20 rule, which indicates a computer user to take a break every 20 minutes by looking about 20 feet away from the computer for 20 seconds.

3.3. The pattern of computer usage and ergonomic practice

The ergonomic practices of the office workers were self-reported (Table 3). The majority of office workers were found to have never used anti-glare screen (55.7%) or document holder (45.7%) when using the computer. Adjustable chairs were always used (37.9%) but most did not use an adjustable keyboard (29.3%). Most of the office workers took a break every hour (29.3%) for about 10 to 20 minutes (48.6%). When the office workers were asked about their usual posture while working on the computer, only a few practices good postures placing their feet on the floor or footrest (18.6%), arms and forearms at a right angle (12.9%), and lower legs kept vertically (9.3%). More than half of them (59.3%) have never rested their laptop over the thigh or use a computer on the bed (53.6%).

3.4. Factors related to CVS symptoms

The association of visual and musculoskeletal problems with the ergonomic condition of the worker's working environment was evaluated (Table 4). Neck pain (p=0.044) was found to be significantly related to laptop usage, while shoulder pain was found to be significantly associated with both laptop (p=0.027) and desktop usage (p=0.022). There was a significant association between the symptom of headache and viewing distance of lesser than 30 inches (p=0.038) but no association between the viewing angle with any of the CVS symptoms ($p > 0.05$). Those who used a laptop on thighs were likely to get symptoms of burning or itching in the eyes (p=0.036) and doubled vision (p=0.002). The symptoms of headache (p=0.049) and eye strain (p=0.013) were significantly related to the increasing curvature of the back while working on a computer. Other ocular symptoms such as blurred vision, double vision, and dry eyes were not significantly related to the ergonomic practices during computer use. The present study was conducted among university administrative staffs whose majority used desktop mainly for data entry and word processing following the current nature of office works that are mostly computer dependence. Our finding revealed that the non-ocular symptoms of shoulder pain (90%), and neck pain (88.6%) were most commonly experienced, followed by ocular symptoms of headache (82.9%). Talwar et al. similarly found neck pain as the most disturbing non-ocular symptom among professional computer users in Delhi while Akinbinu and Mashalla also found headache as most disturbing ocular complaint among office workers in Nigeria [13], [14].

Table 3: Ergonomic practices during computer use

	Frequency, n (%)			
	Never	**Occasionally**	**Frequently**	**Always**
Computer practices				
Anti-glare screen	78 (55.7)	24 (17.1)	22 (15.7)	16 (11.4)
Adjustable chair	14 (10.0)	34 (24.3)	39 (27.9)	53 (37.9)
Document holder	64 (45.7)	41 (29.3)	24 (17.1)	11 (7.9)
Adjustable keyboard	41 (29.3)	36 (25.7)	37 (26.4)	26 (18.6)
Regular breaks	3 (2.1)	65 (46.4)	48 (34.3)	24 (17.1)
Breaks				
Frequency of breaks	Every ½ hour	Every hour	Every 2 hours	Every 3 hours
	39 (27.9)	41 (29.3)	37 (26.4)	20 (14.3)
Length of breaks	<5 mins	10-20 mins	>20-30 mins	>30 mins
Posture				
Wrist support	28 (20.0)	67 (47.9)	33 (23.6)	12 (8.6)
Arm at right angle	8 (5.7)	69 (49.3)	45 (32.1)	18 (12.9)
Thigh horizontal	29 (20.7)	66 (47.1)	37 (26.4)	8 (5.7)
Leg kept vertically	11 (7.9)	64 (45.7)	52 (37.1)	13 (9.3)
Feet on floor	14 (10.0)	49 (35.0)	51 (36.4)	26 (18.6)
Hunch shoulder	27 (19.3)	77 (55.0)	31 (22.1)	5 (3.6)
Increase curvature of back	36 (25.7)	71 (50.7)	29 (20.7)	4 (2.9)
Laptop on thigh	83 (59.3)	53 (37.9)	2 (1.4)	2 (1.4)

Computer-related problems, especially musculoskeletal, can be prevented by proper workstation strategies such as seating posture, appropriate viewing distances, and viewing angle, and computer screen. A study by Moffet et al. investigates the

impact of two work situations using laptop and desktop on muscle activity and neck postures [15]. They found that people bend their head forward, had more back trunk inclination and wrist extension resulting in more symptoms in the back, wrist, and neck when using the laptop. In the present study, the office workers adopted correct positions of the arm and leg, with wrist support. However, some workers have been found to place their laptop on the thigh (59.3%). Those who placed their laptop on the thigh was found to suffer from both shoulder pain (p=0.027) and neck pain (p=0.004). The improper posture of sitting in front of the laptop for an extended period among the office workers in this study may have lead to neck pain and shoulder pain among the workers. High frequency of hunch shoulder (80.7%) and increased curvature of the back (74.3%) when using the computer was also observed in this study as a majority tend to view the computer screen at a distance less than 30 inches (65%).

Table 4: Association of CVS symptoms and computer use

Computer use		**CVS Symptoms n (%)**		**p-value**
Laptop		Neck pain		0.004
		Present	Absent	
	Yes	9 (6.4)	4 (2.9)	
	No	115 (82.1)	12 (8.6)	
		Shoulder pain		0.027
		Present	Absent	
	Yes	9 (6.4)	4 (2.9)	
	No	117 (83.6)	10 (7.1)	
Distance from computer screen less than 30 inches		Headache		0.038
		Present	Absent	
	Yes	37 (26.4)	13(9.3)	
	No	79 (56.4)	11 (7.9)	
Increasing curvature of the back		Headache		0.049
		Present	Absent	
	Yes	90 (64.3)	14 (10.0)	
	No	26 (18.6)	10 (7.1)	
		Eyestrain		0.013
		Present	Absent	
	Yes	73 (52.1)	31 (22.1)	
	No	17 (12.1)	19 (13.6)	
Usage of laptop on the thigh		Burning or itching in the eyes		0.036
		Present	Absent	
	Yes	44 (31.4)	13 (9.3)	
	No	50 (35.7)	33 (23.6)	
		Doubled vision		0.002
		Present	Absent	
	Yes	34 (24.3)	23 (16.4)	
	No	28 (20.0)	55 (39.3)	

Additionally, the ocular symptom of headache was also reported by those who viewed the computer at a distance of lesser than 30 inches (p=0.038). Keeping a proper viewing distance about 35 to 40 inches from the screen and screen position at an angle of 10-20 degrees below eye level are recommended to allow the eyes to relax and reduce eyestrain [16]. Lower frequency of CVS symptoms was reportedly observed among students who viewed the computer screen below eye level than those who viewed the screen at eye level or above the eye level [17]. The present study found no significant association between the viewing angle and any of the symptoms even though a majority of the office workers in this study viewed the computer screen at eye level rather than in downwards position.

Although half of the workers (50.7%) were not aware of the 20-20-20 rule, most of them practice ergonomic principles, which include taking regular breaks for a duration of at least 20 to 30 minutes (48.6%). Among other practice adopted were using document holder, adjustable chair, and the adjustable keyboard was also observed among the office workers. Talwar et al. and Venkatesh et al. reported that the use of the anti-glare screen on a computer protects against visual problems [13], [18]. However, a significant association between visual symptoms and the use of the anti-glare screen was not evident among those who did not use the anti-glare screen (55.7%) in the present study. Limitation of this study was that the exclusion of subjects with musculoskeletal disorders was self-reported. Therefore, symptoms of CVS may not be an accurate representation of that arise from the incorrect practice of ergonomic.

4. CONCLUSIONS

The most common symptoms experienced by the administrative staffs were shoulder pain, neck pain, and headache. Preventive strategies emphasising on awareness of the ergonomic principles when using a computer and the correct posture at a workstation should be implemented in the future to reduce the prevalence of CVS among the staffs.

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ARTICLE TYPE

The pattern of contact lens usage among university community: A cross-sectional study in UiTM Puncak Alam

Nadia Emylia Zairolanuar [a], Fatin Nur Najwa Norazman [a]*

[a]*Center for Optometry Studies, Faculty of Health Sciences, Universiti Teknologi MARA (UiTM), UiTM Kampus Puncak Alam, 42300 Bandar Puncak Alam, Selangor, Malaysia*

Corresponding Author

Fatin Nur Najwa Norazman
fatin161@uitm.edu.my

Abstract:

The cross-sectional study was conducted to find a pattern of contact lens usage among university community and problems related to its use. Two hundred and fifty-two participants among the university community in UiTM Puncak Alam that fulfil inclusion criteria were given a set of questionnaire consists of 22 items to be answered. Results showed that 81.3% of respondents are current contact lens users, with females (81%) outnumbered males in lens wear. Most preferred contact lens type was soft-disposable (73.8%), while most quoted reasons for usage were convenience (61.5%) and comfort (17.9%). Symptoms like dry eyes, red eyes, and watery eyes were the most reported problems faced by the wearers. There was no association between pattern of contact lens usage with contact lens complications. Even though majority of wearers do not have issues with contact lens, problems associated with its wear continue to persist in this study as 33.4% of them experienced problems related to its wear. Even though most participants did not have issues associated with CL use, awareness of lens care and hygiene needed to be increased to avoid any eye complications in the future.

Keywords: contact lens, complication, a modality of lens wear

1. INTRODUCTION

Contact lens is a thin lens that placed directly on the surface of the eye. It is considered as a medical device and can be worn to correct vision, for cosmetic or therapeutic purpose. The usage of the contact lens is increasing, and the estimated increase is about 6% per year [1]. The estimated size of the contact lens population in both the United States and worldwide vary substantially with worldwide estimated ranging from 125 million in 2004 to 140 million in 2010 [2]. In Malaysia, it is estimated that 6-7% of the population wear contact lenses and the majority of them are in the 20-30 years age group [3].

There are various types of contact lenses in the market, such as soft contact lenses, rigid gas permeable lenses, daily disposable contact lenses (daily, biweekly and monthly) and extended wear contact lenses. Sixty-eight percent of the contact lens users used 1 to 3 months of disposable contact lenses, making it the most commonly used type of contact lenses [4].

Wearing contact lens in daily life needs not only awareness and knowledge but also a high level of compliance [5]. The improper use of contact lens may cause complications to the eyelids, conjunctiva or structure of the cornea. The prevalence of contact lens complications has been reported to be two-third to half of the patients attending the contact lens clinic [2]. The aetiology of the complications with contact lens use is multifactorial, which includes the type and material of contact lens, wearing schedule, contact lens solutions, cases and the compliance of the patients towards care regimen.

The awareness about these complications lacked in the younger generation, and 87% of these users preferred contact lens use in spite of the ocular problems due to cosmetic reasons. The ocular health education especially knowledge in the correct and careful practice regarding contact lens wear can prevent complications resulting from the wearer's inappropriate behaviour [6]. A recent study by [7] showed that students who use contact lenses for a prolonged time had faced problems such as general discomfort (43.10%) and redness (20.68%). They found that 47.7% experienced ocular discomfort, followed by dry eyes (38%) and redness of eyes comprises (19.4%).

To our knowledge, reports on the pattern of contact lens usage and association with lens complications among Malaysian is scanty. It is, therefore, the aim of this study is to find the pattern of contact lens use including the type of lens wear, wearing schedule, the solution used, lens cleaning and how it affects the wearers' eyes particularly among contact lens users in Universiti Teknologi Mara (UiTM) Puncak Alam Campus in Selangor. By knowing the pattern of contact lens usage, contact lens practitioners may have to play a more significant role to enhance knowledge and correct practice of contact lens patients concerning contact lens care to prevent possible complications.

2. METHODOLOGY

Purposive sampling was used in this cross-sectional study. The subjects were candidates who are current and past contact lens users. Staff and students from the Optometry department were excluded from the study since they were probably exposed to eye health issues related to contact lens wear and care. By using a calculation based on the prevalence of contact lens complication on the previous study, the sample size obtained is 251. The sample size then is rounded up to 252 subjects since it was distributed equally to non-health sciences and health sciences community, including students and staff. This research was approved by UiTM Research Ethics Committee (REC/46/16) and each participant signed a consent form before data collection.

Data was collected using a questionnaire adapted from Unnikrishnan and Hussain [8]. The close-ended questionnaire consists of 22 questions. It comprises of demographic data, the pattern of contact lens usage including the type of CL wear, wearing schedule, the solution used, lens cleaning schedule and problems related to its usage. The questionnaire was self-administered to contact lens users around UiTM Puncak Alam Campus. However, the researcher was present to answer any questions that were not clear to the respondents. If subjects are not familiar with the terms, they can straight away ask and answer the survey properly hence it will decrease the irrelevant answer. The researcher collected it upon completion.

All data collected were analysed using Statistical Package for Social Sciences (SPSS) Software 21.0 in a descriptive statistical test. Chi-Square for the association between the pattern of CL usage and problems related to its use was used and $P<0.05$ was considered as statistically significant. Only completed questionnaires were included in the data analysis.

3. RESULT AND DISCUSSION

Out of the total 252 university community of UiTM Puncak Alam that have answered the survey, 81% were females, and 81.3% were found to be current users of contact lenses. Forty-seven out of 252 does not currently wear CL but wore them in the past. The reason they stopped wearing contact lens were uncomfortable (6.3%), poor compliance to lens care (4.0%) and infection to the eyes (1.2%). The age of the community surveyed ranged between 19 to 42 years old with a mean age of 22.63. Half of the respondents were from health sciences community and other 50% from non-health sciences students and staff.

3.1 Pattern of contact lens wear

In this present study, the majority of respondents used soft-disposable contact lens (73.8%) followed by extended wear CL and a minority of them used RGP lenses (2.8%). This finding was consistent with the result of a similar study done in Kartanaka, where 96.8% of respondents preferred soft-disposable [8]. However, target population is not the same where this study involving university community comprised of 14 staff and 238 students but study in Kartanaka included college students only.

Table 1: Information of wearing schedule of contact lenses

Wearing Schedule		Frequency (n=205)	Percentage (%)
Hours	Less than 8 hours	57	22.6
	8-10 hours	121	48.0
	More than 10 hours	27	10.7
Days	Less than 5 days	66	26.2
	5 days	122	48.4
	More than 5 days	17	6.7
Sleep with the lens on	Yes	22	8.7
	No	183	72.6

The information regarding wearing schedule of contact lenses by respondents is given in Table 1. This study found that most contact lens wearers used contact lens for 8-10 hours daily (48%) and only 10.7% of them use their lenses for more than 10 hours in a day which is quite similar with a study done in Chengdu [9] but with various universities involved, unlike this study. This is presumed due to the university community working and going to class from 8 a.m. until 5 p.m., which accounted for 9 hours, and they took it off right after the office hours are finished. Wearing contact lens more than 10 hours is not suitable for the eyes as it can induce hypercapnia and hypoxia of corneal epithelium [10]. As for days wearing contact lens, five days is the most reported by wearers in this study (48.4%), similar with a study done by Wu et al. [11], in which 61% of the respondents wore contact lens for more than three days in a week. Nearly 8.7% of respondents admitted to not removing their lenses before going to bed. Because of the lack of sufficient oxygen for a long time, while sleeping with contact lenses, these people may be more prone to suffer from corneal damage.

There are various types of solution used by contact lens wearers and was divided into two categories which are a multipurpose solution (MPS) and saline. In this study majority of respondents use MPS as a solution to clean and store their lenses (94.6%) and only 5.4% of them use saline as lens care and regimen. This is due to most respondents are aware and has knowledge of appropriate lens care and hygiene [12]. This finding is similar with a study done by Wu et al. in 2010 [11] as she reported MPS as the most solution used by participants (76%) and the minority of participants used saline. Fortunately, there was no respondent using tap water to clean or store their lenses like the study done in SEGi University, Damansara where 5.6% of participants used tap water for their lens care [4]. Awareness on infection to eyes by cleaning contact lens using tap water like microbial keratitis is low among the participants there. The wearers do not widely know anti-protein for lens wear; hence, there is a few of respondents (1.6%) used it in their lens care. This finding is in agreement with study done by Tajunisah et al., in 2008 [13] as she

reported that high number of medical students admitted not practising the use of enzyme tablet to clean the lenses.

3.2 Problem related to lens wear

Among infections or problems associated to contact lens wear, it was found out that 14.7% of respondents quoted dry eyes, followed by red eyes (10.3%), watery eyes (4.4%), discomfort (2.8%) and crusting on eyelids (1.2%) as the problems faced due to lens use. Any of the respondents did not report other problems such as poor near and distant vision, short wearing time, allergies to the solution and frequent contact lens deposits. However, around 66.6% of respondents did not have problems associated with the use of contact lens. Figure 1 shows a bar chart for the percentage of problems faced due to contact lens wear.

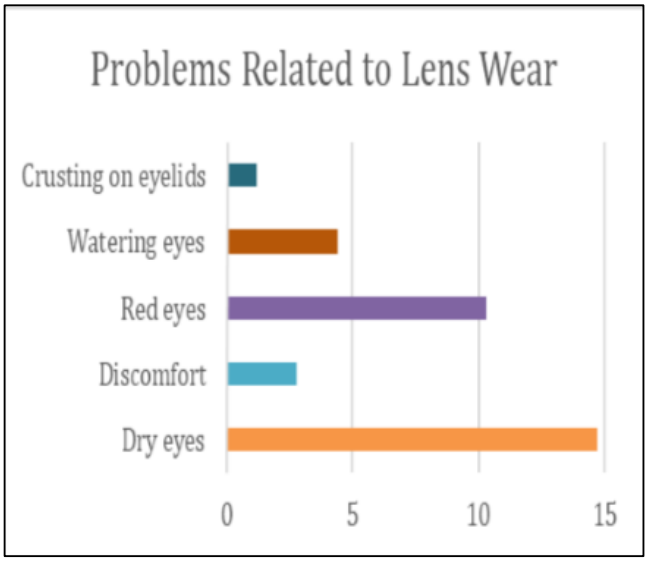

Figure 1. Percentage of problems related to lens wear

3.3 Association between the pattern of contact lens wear and problems related to its use

The association between the pattern of contact lens wear and problems of eyes due to its use was found to be not statistically significant.

It is known that extended contact lens wears prone to get complication than disposable and RGP lenses since it can induce hypoxia and leads to corneal ulcer [14]. Hence longer hours of daily use will exhibit more symptoms because it alters corneal physiology [8]. However, the type of lenses and daily hours of lens wear was not associated with problems related to its use in this study. This might be due to most materials used to manufacture contact lenses nowadays is suitable to be worn for about 8-10 hours daily.

Most of the respondents used multipurpose solution to clean and store their lenses. Therefore, there was no association found between type of solution used and contact lens problem. The finding was not in agreement with findings reported by Joslin and colleagues [15]. This difference might due to proper way of cleaning lenses and frequent case changing to avoid development of bacteria on the lenses. Cleaning schedule of lens also has no association with problems related to CL wear. It can be assumed that as long as contact lenses were cleaned and appropriately rinsed before reinserting into the eyes, number of pathogen or bacteria growth could be reduced hence, no infection happens. If the respondents knew well about complication of contact lens no matter what type of lens they used, an infection might be reduced. As awareness increasing over time, contact lens complication is decreasing as well.

4. CONCLUSIONS

In conclusion, the study showed most lens type preference by UiTM Puncak Alam community was soft disposable lenses with a various modality such as monthly, biweekly and daily disposable. Majority of respondents used their lenses for 8-10 hours daily and five days in a week. Only some respondents did not remove their lenses before sleep which is worrisome. Solution preferred by contact lens wearers was MPS instead of saline.

On the other hand, there was no association between patterns of contact lens usage with problems related to its use in this study. Even though most participants did not have problems related to contact lens use, awareness of lens care and hygiene needed to be increased to avoid any eye complications in the future. Further study needed to investigate more association between the pattern of CL usage, awareness of lens care and problems related to contact lens use.

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ARTICLE TYPE

A report of visual impairment among children with disability

Noor Halilah Buari [a]*, Noor Shuhada Aziz[a]

[a]*Center for Optometry Studies, Faculty of Health Sciences, Universiti Teknologi MARA (UiTM), UiTM Kampus Puncak Alam, 42300 Bandar Puncak Alam, Selangor, Malaysia*

Corresponding Author

Noor Halilah Buari
noorhalilah.buari@gmail.com

Abstract:

The visual impairment among children could interfere with visual development and affect the quality of life. Therefore, the status of visual impairment and its correlation with demographic, visual acuity and refractive error among disability children was investigated. A retrospective study was conducted to review the clinical records of children with disability (birth to 18 years old) from the Low Vision and Rehabilitation Clinic of UiTM Visioncare. The age, gender, types of disability and ocular parameters such as visual acuity and refractive errors were extracted and analysed. A total of 27 clinical records were reviewed. A total of 25.9% of children with a disability had a visual impairment. It was higher among boys (17.8%) than girls (7.41%). A strong positive linear correlation was exhibited between visual acuity and visual impairment (r=0.80, p=0.01). Meanwhile, the visual impairment was poorly correlated with gender, types of disabilities and refractive error. Thus, children with disability prone to have vision impairment. Visual acuity provides information on visual impairment status can be detected and measured in clinical setting. This report could help the clinician to be better prepared when dealing with children with any types of disabilities for early detection of visual disorder and better intervention prognosis.

Keywords: visual impairment, visual acuity, refractive errors, disability children

1. INTRODUCTION

Early childhood is a crucial phase of growth and development because experiences during early childhood can influence outcomes across the entire course of an individual's life [1]. This provides an opportunity to prepare them for life-long learning and participation, thus, preventing potential delays in development and disabilities. The world report on disability in 2011 stated that approximately one billion people worldwide are living on disability, with at least 1 in 10 children. In Malaysia, there were 445 006 persons with disabilities registered in Malaysia, represented 15% of the population [2]. Out of it was 29 289 children with several types of disabilities accounted for 6.6%. The highest disability among children was learning disability, followed by physical disability, hearing disability, multiple disabilities, visual disability, speech disability and mental disability [2].

Given opportunity is a key for the children with disabilities able to lead fulfilling lives and contribute meaningfully to the community. Society's misperception is the greatest challenge that people with disabilities had to deal with. The report showed that less than 10% of children with disability of school-going age attended school; and those who attend school, do so in segregated settings [3]. With best-corrected vision, those children can be outshined in their education. Therefore, vision screening and eye examination are crucial for this group of children to ensure there is no interruption in their learning.

However, the vision problem was reported to be synonym among those with disabilities. The average visual acuity of Down's Syndrome children was at 6/12 (Snellen fraction) which was reduced than normal vision status [4]. Malaysian children with Down's syndrome had vision impairment ranging from 30% to 45% [4], [5]. A similar pattern was found among adults with intellectual disabilities which 39.7% had a vision impairment or blindness [6]. In other studies, it was also reported that adults with intellectual disabilities had severe low vision in (13.8% to 1.2%), blindness (5.0% to 3.8%) and also reduced near vision (19%) [7], [8]. Previously, much higher undiagnosed vision impairment and blindness was noted which up to 40% [8]. Children with cerebral palsy also showed significant vision reduction (less than 6/9) for best-corrected visual acuity (15.5%) and near visual acuity (8.4%) [9].

Vision impairment happened among children with disabilities could be caused by a various ocular disorder such as uncorrected/untreated refractive errors [4], [7], [9], or ocular pathologies included congenital cataract, glaucoma, retinoblastoma, retinal detachment and others [5], [10]. Even without visual anomalies, they still experience sensory impairment which cannot be treated with optical correction [11]. Also, disabilities itself disturbed to function in daily activities, and visual impairment diminishes the daily functioning even more. It is because additional emotional and behavioural problems will impact the children with disabilities and also visual impairment than other groups of

children with normal vision or even with single disabilities [12]. Therefore, this study intended to investigate the visual impairment status and its correlation with demographic, visual acuity and refractive error among children with disability.

2. METHODOLOGY

A retrospective study was opted by reviewed the clinical records of eye examination in Low Vision and Rehabilitation Clinic of UiTM Visioncare from the year 2012 to 2015. Children with a disability aged between birth to 18 years old were selected. Single or multiple disabilities such as learning disability, intellectual disability, physical disability, hearing disability and mental disability was included and must register with the Welfare Department. However, children that registered as vision disability was excluded.

The data were extracted from clinical records comprised of patient's demographics such as age, type of disability and gender. Then the visual parameters such as best-corrected distance visual acuity for the right eye, left eye and refractive error status were recorded. From the visual acuity, vision impairment was determined. The definition of visual impairment classification was based on the World Health Organization (WHO) [13]. Visual impairment is a presenting visual acuity of less than 6/18 in the better eye using available means of optical correction (with spectacle when available). Blindness was defined as presenting visual acuity of less than 3/60 up to no light perception in the better eye.

Descriptive analysis was done for demographic data including frequency, percentage, mean and standard deviation. The status of visual impairment among children with a disability was determined in percentage. Using Statistical Package for Social Sciences (SPSS) software Version 21.0, Pearson correlation test was chosen to investigate the correlation of vision impairment status with demographics, visual acuity and refractive error.

3. RESULT AND DISCUSSION

A total of 27 clinical records among children with a disability were examined. Four types of disability among children were noted included physical disability, learning disability, hearing disability and multiple disabilities. Learning disability included Downs' syndrome, autism, Attention Deficit Hyperactive Disease (ADHD) and global developmental delay. The multiple disabilities were defined as those who had more than one significant disabilities. Table 1 describes the demographic characteristics including the age, gender, types of disabilities, visual acuity and refractive error status.

3.1. Vision impairment among children with disability

Referring to figure 1, the visual acuity was divided into four categories which normal vision (6/6 to 6/7.5), moderate vision (6/9 to 6/18), mild vision impaired (6/24 to 6/48) and moderate vision impaired (6/60 to 6/120). Vision impairment accounted for 25.93%. The report was observed to be higher in male (17.81%) as compared with the female (7.41%). Among all

Table 1: Demographic characteristics

Parameters	
Age (years)	9.85 ± 4.55 years
Gender (%)	
Boys	44.4%
Girls	55.6%
Types of disabilities (n, %)	
Learning disability	20 (80%)
Physical disability	1 (4%)
Hearing disability	1 (4%)
Multiple disabilities	2 (12%)
Visual acuity (LogMAR)	
Right eye	0.42±0.33 LogMAR
Left eye	0.34±0.33 LogMAR
Refractive error (Diopter)	
spherical equivalent RE	0.22±2.13 D
spherical equivalent LE	0.04±2.03 D

types of disabilities, learning disability was the highest percentage had visual impairment where 5 children (18.52%) had best-corrected visual acuity less than 6/18.

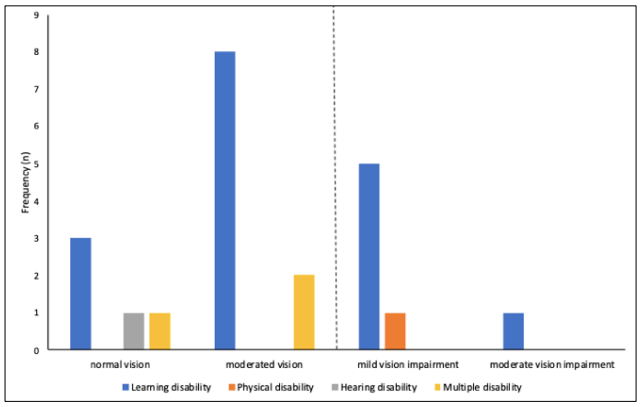

Figure 1: Distribution vision impairment according to visual acuity and types of disabilities

The finding was comparable with other studies as children with disability showed a quite high prevalence of vision impairment. As learning disability which included Down's syndrome, autism, Attention Deficit Hyperactive Disease (ADHD) and global developmental delay were the most, who had vision impairment. A similar pattern was showed previously as the vision impairment happened among children with Down's syndrome was ranging from 30% to 45% [4], [5]. While children with intellectual disabilities also showed some degree of vision impairment and blindness [6]–[8]. Even though vision impairment was defined as visual acuity of less than 6/18, but, referring to figure 1, those with moderate vision (6/9 to 6/18) was also high contributed 37%. The result was higher than the previous study, where those with visual acuity less than 6/9 was accounted for 15.5% among children with cerebral palsy [9]. None of the data reported blindness in our findings that could be due to a limited number of reviewed clinical data. However, blindness was quite common among those with disabilities which accounted for 3.8% to 5% of the population [7], [8].

Vision impairment among children with a disability could be due to ocular disorders that happened during visual growth and development. Usually, children with a disability had significant refractive errors. Down's syndrome and cerebral palsy children commonly to have hyperopia [4], [7], [9] and also astigmatism [5]. The vision impairment could also be due to uncorrected or untreated refractive error since childhood [8] or strabismus, which lead to being amblyopia. Ocular pathologies were also reported among them such as congenital cataract, glaucoma, retinoblastoma, retinal detachment and others [5], [10] that also could be contributed to the vision impairment.

3.2. Correlation of vision impairment with demographics, visual acuity and refractive error

The correlation of vision impairment among children with disabilities was investigated towards demographic data, visual acuity and refractive errors using Pearson correlation test. The demographic characteristics were the age, gender and types of disability. Then the correlation was tested between vision impairment status with visual acuity and refractive errors.

It was found that visual impairment had a weak correlation with age ($r = -0.22$, $p = 0.36$), gender ($r = -0.32$, $p = 0.10$) and types of disability ($r = -0.37$, $p = 0.07$), respectively. Visual acuity was exhibited to be strongly correlated with the vision impairment status. The result showed $r = 0.80$, $p = 0.01$. There was a weak correlation between refractive error and the visual impairment $r = -0.05$, $p = 0.80$. This means that visual acuity measurement could indicate the vision impairment among children with disability.

This study found a weak association of visual impairment status between demographic variables such as age, gender and types of disability. Some of the previous studies on the state of vision impairment were found to be not correlated and correlated with age. In Beranang population study, age factor was not associated with impaired visual acuity [14]. Meanwhile, there was a linear relationship of reduction in visual acuity and increasing of children age in Gombak study [15]. However, both studies were done among a healthy population which not those with disability. This contradictory finding might be due to limited number of reviewed clinical records in this study, which only 27 clinical record whereby, those studies comprised of large number of samples.

Hardly any published journal in open literature had worked on the association of demographic characteristics, visual acuity and refractive error among children with disability. Thus, the findings were unable to be strongly supported by extensive evidence. On the other hand, a strong positive linear relationship was revealed between visual impairment status and visual acuity. It was undoubtedly true because visual acuity determines the severity of visual impairment. Adults with visual acuity of 6/18 or worse had a significant effect on the quality of life [16].

Furthermore, visual acuity of 6/60 or worst diminished the quality of life. Both levels of visual acuity were fallen under the visual impairment category. Reduction in visual acuity was a significant risk factor for self-reported disability in adults [17]. It was because difficulty in performing a task that required excellent resolution and changes in light adaptation was associated with visual acuity. The difficulty increased as the vision impairment worsen. However, these two previous studies were done on adults without any disability.

In term of refractive error and vision impairment, several studies found that refractive error was common among children or adults with disabilities [4], [5], [7], [8], [10]. The common type of refractive errors was hyperopia and astigmatism. The refractive error was also the leading cause of visual impairment. However, vision impairment caused by uncorrected refractive error could be treated or avoidable.

4. CONCLUSIONS

The prevalence of visual impairment accounted for 25.9% was quite a significant burden to children with disability. Having a single disability will carry a few loads in performing daily activities smoothly, additional vision disability will diminish the daily functioning. Visual acuity that provides information on the visual impairment status can be detected and measured in a clinical setting. Furthermore, some of the causes of vision impairment could be treated and avoidable. The children with disability should have routine eye examination for early detection of a visual disorder and better intervention prognosis.

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ARTICLE TYPE

Influence of visual display near task (VDNT) on the blink rates (BR) and dry eye symptoms among soft contact lens wearer

Aresya Najmee[a*], Nurul Inarah Mohamad Zambri[a]

[a]*Centre of Optometry, Faculty of Health Sciences, Universiti Teknologi MARA (UiTM), UiTM Kampus Puncak Alam, 42300 Bandar Puncak Alam, Selangor, Malaysia*

Corresponding Author

Aresya Najmee
aresyanajmee@uitm.edu.my

Abstract:

This article studies the effect of the visual display near task (VDNT) on blink rate (BR) among soft contact lens wearer and the association between blink rates with the symptoms of dry eye in habitual contact lens wearer. Eighteen participants (mean age: 22.1±1.6 years) were recruited in this study. All participants were adapted soft contact lens wearer with low to moderate power (0.00D to ≤ -6.00D). Dry eye symptom questionnaire (CLDEQ-8) was given to each participant and asked to answer prior to the study. Blinking were then captured for 23 minutes which comprised of 3 minutes before VDNT with a 3-meter target (as baseline measurement) and another 20 minutes during VDNT at 40 centimetres. Blinking was counted by stopwatch when the ocular surface area fully covered by the upper eyelid. The Blink Rates for 1 minute was calculated from the average. The total point of CLDEQ-8 were correlated with the blink rates in both conditions. The mean of the blink rates before VDNT 23.5 blink/min (SD± 9.09 blink/min) higher than the mean of the blink rates during VDNT 11.4 blink/min (SD ± 5.03 blink/min). The mean difference of both conditions was statistically significant $p < 0.05$ and the 95% confidence interval (CI) was 12.15 (8.767-15.539). The weak positive correlation of dry eye symptoms and the blink rates before VDNT, r=0.104 (p=0.682) and during VDNT, r= 0.142 (p=0.573). There was no significant of dry eye symptoms and both blink rates, respectively. The blink rate/min was affected during visual display near task among soft contact lens wearer. The blink rate reduced significantly during VDNT. A good selection of subjects can influence the correlation between dry eye symptoms and blink rates. However, this study agreed that both contact lens and VDNT could be the factors that contribute to the tear film instability due to less endogenous blinking occurred when more attention required by the task.

Keywords: blink rates, contact lens wearer, visual display near task, dryness

1. INTRODUCTION

A smooth ocular surface, tear film, lacrimal gland and the eyelid maintains a good quality of refractive error. Aqueous humour is a component in the eye that nourishes the anterior cornea and produce biochemical metabolites [1]. Tear film and its production is a functional unit structure that responsible for maintaining the health of ocular surface from dehydration. It also functions as the first line of defence in resisting injury and protects the eye against body changes and surrounding condition. Generally, tears component is divided into three layers which are mucin, aqueous and lipid. The lipid layer is the outermost of tears film secreted by the meibomian gland that holds back the excessive of tears evaporation [2]. These tears film also called pre-corneal tear film (PTF). Dry eye and complaints of eye symptoms always associated with PTF instability. The symptoms arise when any of the tears film layer being disturbed. Obstruction of meibomian gland distribution accompanied with decreased tears secretion from lacrimal gland cause increased evaporation of tears from the ocular surface. This contributes to the inadequate moisture of PTF; therefore, dry eye symptoms may experience [3]. It is reported that the lipid layer qualitatively manifest when it cannot hold the tears from break-up [2].

Dry eye symptoms can be symptomatic and asymptomatic. Hence, the complaints can be due to several factors such as thermal factor, task demand and the individual eye condition. Thermal factors arise from low humidity and high temperature. High demand on the near task such as playing video games may cause a reduction in blink rate due to the wide exposure of ocular surface. The blink rate of dry eyes patient also declines with the alteration of the tear film, gland dysfunction, blinking anomalies and especially for the contact lens wearer [4].

The contact lens has become a successful treatment due to its function as optical correction and cosmetic reason [5]. It is now becoming more popular in younger population especially among college, university students and young adults. The contact lens has proved to provide convenience, increase availability, affordability with increase of the quality of life (QoL) [6]. The contact lens has given benefit in providing a wider visual field and improves aesthetic of a person compared to glasses [5]. However, dry eye is the main eye

symptoms reported among contact lens wear. When contact lens is inserted on the ocular surface, tear film become altered, and contact lens divided tear film into pre-lens tear film (PLTF) and post-lens tear film (PoLTF). Pre-lens is defined as the distance of air surface from contact lens surface while post-lens tear film is the distance of lens back surface to the cornea. The mechanism of dry eye due to contact lens can be direct and indirect. Direct mechanism stimulation altered meibomian gland; thus, PoLTF becomes thin as the friction between the back contact lens and cornea/conjunctiva increase. Hence, cause dryness, foreign body and discomfort sensations. Indirect mechanism caused alteration of the aqueous layer in PLTF and reduced its volume thus become unstable and easily breakable within a short period of blinking. This correlates when contact lens wettability is not enough to cover the corneal surface as lacking in hydrophilic mucin layer [7-8].

PLTF has reduced tear volume, reduced lipid layer thickness, and increase evaporation rate compared to the normal tear film [9]. Regarding the tear film alteration, contact lens has highly associated with contact lens discomfort (CLD). It is a common symptom of ocular discomfort which presented among contact lens wearers such as fatigue, irritation dryness, excessive tearing and red-eye. This symptom becomes more severe as the wearing increase over the day [9]. It also becomes more evident as the lens ageing in monthly or conventional disposable contact lens, particularly lenses with ionic polymers. Consequently, lens dehydrated quickly on ocular surface cause blurriness and unstable vision due to the accumulation of protein deposits [10]. Hence, Contact Lens Dry Eye Questionnaires (CLDEQ-8) was developed to describe symptoms among contact lens wearer. It is a global opinion with 8 questions that evaluate dryness, discomfort, blur of vision and desire to remove contact lens [11]

Eighty-four percent of the world population had use visual display unit by the end of 2018 in their daily life [12]. Viewing electronic display has become a significant part of daily living at home, work and during leisure time [13]. The visual display unit can be in many forms such as tablet, desktop, computer, and smartphone. By giving full attention for prolong time on VDNT such as playing video game induce high cognitive demand that causes in deterioration of the ocular surface tear film [14]. Besides, action type of video games with 3D complex settings, feature quickly moving targets that pop in and out of view, necessitate substantial visual processing of the periphery, and include large amount of clutter and irrelevant task objects. This game requires the player to consistently switch between highly focused and highly distributed attention, to make a rapid and accurate decision. Hence, a high level of a cognitive task being introduced [15]

Blinking rate is defined as blink per minute. Blinking is an important mechanism in tears distribution and drainage. It also helps to keep maintaining equilibrium of the tear volume on ocular surface and in conjunctival sac [16]. There are three types of blinking which are reflex blinks, voluntary blinks and endogenous blinks [17]. In measurement of blink rate, it includes complete and incomplete blinks. Complete blink defined by a downward movement of upper eyelid covering more than 75% of the cornea while minor twitches of upper eyelid covering less than 30% hence incomplete blinks was counted as upper eyelid covering cornea between 30% to 70% [18]. The regular blinking pattern in rest position can be altered by activity and eye gaze which affect the function of the tear [19]. Viewing task in downward gaze such as smartphone cause reduction in blinking [20]. VDNT can also be categorized in low and high cognitive demand. The study showed there is significant low blink rate with high visual demand [14]. The mean blinking rate in a relax position was 22 blinks/min, and then it reduces to 10 blink/min with viewing book and 7/min with viewing screen [13]. Hence, while viewing screen, the internal controls have been introduced over blinking to minimise task from being interrupted by the upper eyelid [21].

VDNT and contact lens has proved to influenced tear film instability [7-8]. The average of the spontaneous blinking rate can be altered with different level of VDNT, emotional states and mental activity however with contact lens, and it helps to maintain the normal tear film, optical quality and hydration through the interchange of tears between contact lens and cornea [22]. Meanwhile, while playing video game, tears film instability will increase, and cause blinking rate to be increased frequency with fully adapted soft contact lens due to the adequate extrinsic ocular surface stimulation which overrides the internal controls and the blinking parameters [23]. Nevertheless, the blinking amplitude has decreased significantly with contact lens while playing video games with correlation of dry eye severity [24]. However, it reaches agreement when adapted contact lens provides sufficient ocular surface or lid stimulation to increase blinking rate. Incomplete blinking can influence inefficient blinking with contact lens wear which leads to ocular surface staining and dry eye symptoms as tears are not distributed normally and inferior cornea being exposed [23]. Therefore, the aims of this study to evaluate the blinking rate among soft contact lens wearer during VDNT (playing video games) and to evaluate the correlation between blink rate before and during VDNT with the dry eye symptoms (CLDEQ-8).

2. METHODOLOGY

Eighteen subjects (mean age: 22.1±1.6 years) participated in this study. Ethical approval was obtained from UiTM Research Ethics Committee. All subjects were given informed consent and have passed screening test, adapted with soft contact lens low to moderate power (0.00 to ≤-6.00D) whether daily disposable contact lens or monthly contact lens and best-corrected visual acuity with contact lens was ≤6/9. No subject had any history of ocular disease, eye infection and contact lens complication before. Before the experiment (~10 minutes), all subjects inserted their habitual contact lens. During this adaptation period, the purpose and the flow of the experiments were explained while the participants signed the consent form, fill in the demographic data, and answered CLDEQ-8 questionnaires. (Contact Lens Dry Eye Questionnaires). CLDEQ-8 is a simple questionnaire with scoring system to measure dryness symptoms among contact lens wearer, consist of 5 sections of 8 questions which are related to discomfort, dryness, blurred vision, and desire of removing contact lens which gives a total score of 37 points.

Refer to the previous study, and contact lens wearer were classified as symptomatic dry eye if the total score was ≥ 12 points [25].

Adaptation period was provided to ensure comfortability and to obviate reflex tearing that contributes to excessive rate of blinks [26]. Subjects were required to play a video game as visual display near task (VDNT) while blink rates being recorded. A pilot study has been done with repeated measurements of blink rates before VDNT with 2 minutes, 3 minutes and during VDNT with 10 minutes, 15 minutes and 20 minutes. The blink rates were significant with 3 minutes VDNT and 20 minutes during VDNT. Two conditions were required: one to evaluate blink rates in a relaxed position for 3 minutes as a baseline and the other to evaluate blink rates while playing a video game (iZUmas Oya Faction Version 4.2) from an IPAD for 20 minutes. Both tasks were performed under the same ambient lighting (1145 lux) and environmental condition (22-27ºC) and at the same playing distance (40cm). The IPAD had a screen size of 7.9 inches and a resolution of 2048 x 1536 pixels. To avoid internal control in natural blinking pattern and forced blinking, subjects were not told to that blinking were analysed. Subjects' blink rates were recorded for 3 minutes before VDNT and were asked to relax and direct their gaze toward distance target (3m) as for the baseline measurement. Subjects were then asked to play a video game (during VDNT) for about 20 minutes with the blink rates been recorded. Video of the blinking was recorded using a digital camera, Nikon DSLR 45.7 Megapixels. Blinks were counted by stopwatch when the ocular surface area fully covered by the upper eyelid. The Blink Rates for 1 minute was calculated from the average.

Statistical analysis was conducted using the Statistical Package for the Social Science (SPSS) software for Windows version 21.0. Normality test was done using the Kolmogorov-Smirnov test. For parametric data, data was analysed using Paired sample t-test to compare the difference of the blink rate (per/min) before VDNT and during VDNT. A p-value of less than 0.05 denoted as statistically significant. The correlation between dry eye symptoms and before VDNT and after VDNT were derived using Pearson's correlation test for data with normal distributions.

3. RESULT AND DISCUSSION

3.1. Blink Rate

The mean difference of the blink rates before and during visual display near task (VDNT) was statistically significant $p<0.05$. The mean of the blink rates before was 23.5 blink/min (SD±9.09 blink/min) while the mean of the blink rates VDNT was 11.4 blink/min (SD±5.03 blink/min [Table 1] The mean for the blink rate during was lower than before VDNT.

The mean difference for both conditions was statistically significant, $p< 0.05$, with a 95% confidence interval (CI), 12.15 (8.767-15.539).

Table 1: Change of the blink rate/min with DVNT

	Blink rates/min before and during VDNT mean (SD)			
	Before	During	Mean Difference	t-stat (df), p value
Blink Rates (blink/min)	23.5 (9.09)	11.4 (5.03)	12.15 (8.76-15.54)	7.57 (17), <0.05

The blink rates were reduced significantly while playing video games among soft contact lens wearers in which video game has to induce high attention demand that causes reduction in blinking due to information processing as well as to minimise the eyelid distraction in prolonged attention period [27-28]. Besides, internal control like cornea sensitivity and visual disturbance is believed to slow down the blinking to enhance attention [28]. This is because playing video games required quick to respond to the important stimuli as the game's features could be confusing from the backgrounds such as contrast, visual acuity and crowding effect [17]. Downward gaze position with visual display near task also influence blink rates to decrease due to less tear evaporation with the decrease in the exposed ocular surface area [20] However, the blink rates has proved to significant increase in fully adapted soft contact lens because enough support by extrinsic ocular surface and lid stimulation to revoke internal controls and also maintain relative rate of blinking [23]. Besides affecting the blink rates, both VDNT and contact lens insertion has contributed to the poor tear stability [7]. This may due to the alteration in tear film with meibomian gland dystrophy, which degraded the lipids that lower the mole percentage of wax esters in the tear film. Therefore, contact lens wearer is significantly associated with dry eye syndrome [12].

3.2. Correlation Dry Eye Symptoms and Blink Rate

A positive poor correlation of dry eye symptoms and the blink rates before VDNT, $r=0.104$ ($p=0.682$) and during VDNT $r=0.142$ ($p=0.573$) [Figure 1]. There was no significant correlation of dry eye symptoms and the blink rates before and during VDNT. The high and low score of dry eye symptoms had no significant correlation with the blink rates.

Besides affecting the blink rates, both VDNT and contact lens insertion has contributed to the poor tear stability [7]. This may due to the alteration in tear film with meibomian gland dystrophy, which degraded the lipids that lower the mole percentage of wax esters in the tear film. Therefore, contact lens wearer is significantly associated with dry eye syndrome [12]. Prolonged use of a soft contact lens caused hypoxia as it induced lens sensitivity [9]. The blink rates increase with contact lens due to ocular surface irritation that caused cluster in the blinking pattern and unstable tears especially to those who are new to contact lens [29]. When combining with VDNT, other signs and symptoms arise such as visual discomfort, asthenopia, reduce visual acuity with poor visual contrast [12]. There is also a correlation in an incomplete blink with the blink interval as it results in excessive tears evaporation with VDNT that also induce eyestrain [30].

Eyestrain symptoms do not improve with frequent blinking but improve with adequate ocular moisture. In prolong time of eyestrain, it eventually induces dry eye [31]

Contact Lens Dry Eye Questionnaires (CLDEQ-8) was used similar to the previous study done by Jansen et al (2010) which purposely to grade the severity of dryness symptoms among contact lens wearer. It is because contact lens wearer commonly reported dry eye symptoms and it is a subcategory of dry eye. Thus, CLDEQ-8 is one of the tools to provide wearer's worldwide opinion, review improvement and worsening of the overall opinion on their contact lens [25]. This study found that half of the subjects scored more than 12 points that classified as symptomatic dry eye. However, there was positive poor correlation of dry eye symptoms and the blink rates before (r=0.104) and during VDNT (r= 0.142) with p = 0.682, p= 0.573. Due to the good selection of subjects, CLDEQ-8 was not a good tool in this study as dry eye subjects were excluded. Besides that, this questionnaire is a combination with clinical signs such as corneal staining, low TBUT and poor Schirmer test, which increase sensitivity and specificity of diagnosis of dry eye [25].

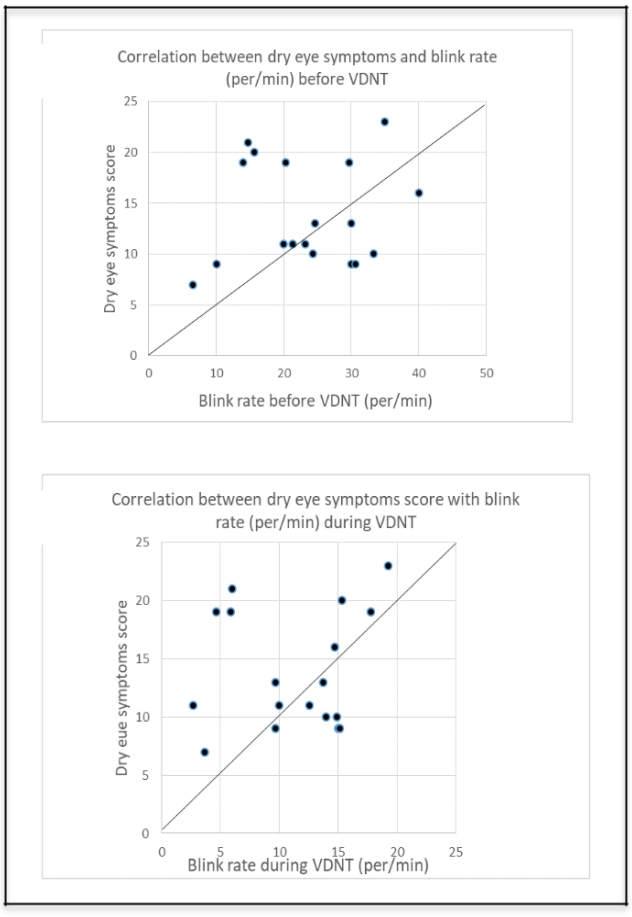

Figure 1: Correlation of dry eye symptoms and blink rates before and after VDNT

Nevertheless, this study had a limitation due to small population size. Further study was suggested with a more significant number of subjects that incorporate many different types of people, various contact lens power and materials, thus giving more reliable results. Besides, other questionnaires can be used such as Ocular Surface Disease Index (OSDI) which include the impact of dry eye symptoms on vision-related functioning in daily life [32].

4. CONCLUSIONS

The blink rate/min was affected during visual display near task among soft contact lens wearer. High cognitive demand task with increase concentration has introduced to the intrinsic control of upper lid distraction due to visual information processing. Good selection of subjects can influence the correlation between dry eye symptoms and blink rates. However, both contact lens and VDNT could be the factors that contribute to the tear film instability due to less endogenous blinking occur as more attention required by the task.

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ARTICLE TYPE

Full- Field Electroretinogram (ffERG) on Color Vision Deficiency

Saiful Azlan Rosli *[a,b], Hamizah Ismail[a]

[a]Centre for Optometry studies, Faculty of Health Sciences, Universiti Teknologi MARA (UiTM), UiTM Kampus Puncak Alam, 42300 Bandar Puncak Alam, Selangor, Malaysia; [b]Optometry & Visual Sciences Research Centre (iROViS), Faculty of Health Sciences, Universiti Teknologi MARA (UiTM), UiTM Kampus Puncak Alam, 42300 Bandar Puncak Alam, Selangor, Malaysia

Corresponding Author

Saiful Azlan Rosli
saiful2797@uitm.edu.my

Abstract:

This study aimed to describe the electrophysiological respond of amplitude and latency time using full-field ERG (FfERG) among colour vision deficiency. Twelve eyes of colour vision deficiency subject were recruited in this study which the mean age of the subjects was 22.0 ± 1.41 years. Psychophysics colour vision test was done by using Nagel Anomaloscope. Room illumination was photopic adapted for 10 minutes, then single flashes of 3 cd.s.m^{-2} presented until four similar artefacts-free ERG waveforms, which based on ISCEV 2015 protocol. All the data were analysed using a one-sample t-test, which was compared to the normative test value. Cone a-wave amplitude (μV) was statistically significant higher by 31.65, 95% CI [21.74, 41.55], p=0.00 than a normal cone a-wave amplitude of -30.73 μV. Meanwhile, cone a-wave latency time (ms) shows statistically significant higher by 0.92, 95% CI [0.05, 1.79], p=0.04 than a normal cone a wave latency time of 14.30 ms. Also, cone b-wave amplitude (μV) shows a significant lower by -107. 95% CI [-136.94, -77.63], p=0.00 than a normal cone b-wave amplitude of 119.26 μV. FfERG techniques ability to detect any abnormality that occurred in the retina and visual pathway related to vision.

Keywords: amplitude and latency time, colour vision deficiency, electrophysiology, ffERG, ISCEV.

1. INTRODUCTION

Normal colour vision used all three types of light cones accurately known as trichromacy. Human retina consisted of two types of photoreceptor, which were rod and cone. Rod photoreceptors were playing a role in the vision for dim light whereas cone photoreceptor responsible in bright light. People with normal colour vision have three types of cone photoreceptors, which consisted of short sensitivity or blue, middle sensitivity or green and long sensitivity or red cones[1]. Each of cones has different spectral sensitivity, which was the foundations of normal trichromatic colour vision [2]. Pigments inside the cone can differ colours and send output through the optic nerve to the brain based on light wavelength [3]. However, if cones lack one or more light-sensitive pigments, disturbance of three primary colours occurred, knowns as colour vision deficiency[4].

Visual electrophysiological testing could provide information in a variety of cases and used in the acceptance of diagnosis for patient's symptom. It also aids in pediatric clinician assessment for a young child with apparent poor vision and the ophthalmologist dealing with unexplained visual loss in children and adults [5]. In addition, it possible to identify the lesion occurs in the globe, optic chiasm, and optic nerve, that identified rod and cone involvement [6]. For example in retinitis pigmentosa, which was heterogeneous disease that has been associated with a mutation in different genes and related with progressive retinal degeneration [7].

Using the full-field Electroretinogram (ffERG), it is an important clinical tool for diagnosing and observing retinal disease likes retinitis pigmentosa (RP) which was related with photoreceptor dysfunction and retinal pigment epithelium that causes inherited progressive retinal conditions [6]. So, ffERG would be suitable to aid in differentiating between rod-cone and cone-rod degenerations.

Most of the colour vision test battery use photopic conditions as the test lighting environment. Using the ffERG, the electrophysiology responds of a respective cone in amplitude and implicit time could be described and compared to normal colour vision.

2. METHODOLOGY

This study was conducted at the Advanced Electrophysiology Eye Center (AEeC), Center of Excellence for Research in Optometry & Vision Science (iROViS), Universiti Teknologi MARA (UiTM), Malaysia. Six of Malay colour vision deficiency subjects from aged 21 to 23 years old, who were 4 males and 2 females. All the subjects selected via simple convenience sampling, which was through the

previous colour vision clinic record from the UiTM Optometry Clinic. All the subjects had diagnosed as colour vision deficiency and confirmed again by colour matching test Nagel Anomaloscope. The ethical consideration had been approved by the Universiti Teknologi MARA (UiTM) and followed the tenet of the Helsinki Declaration.

All the subjects have a minimum visual acuity of 6/6 for distance and N6 for near with habitual vision. Besides that, subjects were free from eye-related disease likes diabetes, macular degeneration, Glaucoma, Retinitis Pigmentosa, and systemic diseases that might jeopardise the retinal integrity and photoreceptor response.

The ffERG investigation started with the dilation of both pupils of the subjects using 2 drops of 1.0% Tropicamide (Mydriacyl; Alcon Laboratories, USA) instilled in 5 minutes gap between each drop. Before each of the ffERG examinations took place, the machine had been set to calibrate automatically. Full-field ERG was analysed on the computerised Opto-electronic Stimulator Vision Monitor Mon-Pack One Metrovision (Pérenchies, France) and the ffERG subject preparation and protocols for photopic stimulation followed the ISCEV Standard 2015 set by the International Society for Clinical Electrophysiology of Vision (ISCEV) [8]. After full dilation, the subject was on light adaptation in room illumination for 10 minutes. After light adaptation, the pupil size of the subjects was measured with conventional pupillary size ruler, before performing photopic ffERG. Photopic ffERG protocols included single flashes of 3 cd.s.m^{-2} that were presented until 4 similar artefact-free ERG waveforms were obtained and averaged (the Cone ERG). Also, later on, 30 Hz flickers ERG was averaged based on 15 sweeps of 250 milliseconds duration (the 30 Hz Flicker ERG).

The outcome of ffERG on cone a-wave amplitude, latency time, cone b-wave amplitude and latency time of colour vision deficiency was compared using a one-sample t-test, by the normal colour vision from previous study [9].

3. RESULT AND DISCUSSION

The mean age of the subjects was 22.0 ± 1.414 years. From the colour-matching test by the Nagel Anomaloscope, found that the majority of the subject's colour vision deficiency was anomalous trichromacy, which was protanomaly and deuteranomaly. The others were classified as deuteranope. Table 1 showed the classification of colour vision deficiency using the Nagel Anomaloscope.

The summary of the mean, standard deviation and median for cone a-wave amplitude, cone a-wave latency time, cone b-wave amplitude and cone b-wave latency time for photopic of the 12 eyes ffERG were presented in Figure 1. Table 2 showed the significant difference between the ffERG on colour vision deficiency towards the normative test value done by a previous study [9]. No significant difference was reported for cone b-wave latency time.

Table 1: Classification of the types of colour vision deficiency and severity among the subject from the Nagel Anomaloscope grouping.

Types of colour vision deficiency	Severity	Subjects
Deuteranope	Severe	1
Protanomaly	Mild	2
	Severe	1
Deuteranomaly	Mild	1
	Severe	1

Table 2: Summary of the significant value of colour vision defect photopic adapted ffERG

	Cone a-wave amplitude (μV)	Cone a-wave latency time (ms)	Cone b-wave amplitude (μV)	Cone b-wave latency time (ms)
Mean	0.92	15.22	11.98	28.54
SD	15.59	1.37	46.67	5.01
Normative Test value [9]	-30.73	14.30	119.26	30.02
Mean diff.	31.65	0.92	-107.29	-1.48
tc	7.03	2.32	-7.96	-1.02
sig. (2-tailed)	*0.00	*0.04	*0.000	0.33
Lower 95% CI	21.74	0.05	-136.94	-4.66
Upper	41.55	1.79	-77.63	1.71

Std. Error: standard error, tc: standardised difference, sig. (2-tailed): two-tailed p-value of the test, CI: confidence interval of difference. *Show significance difference.

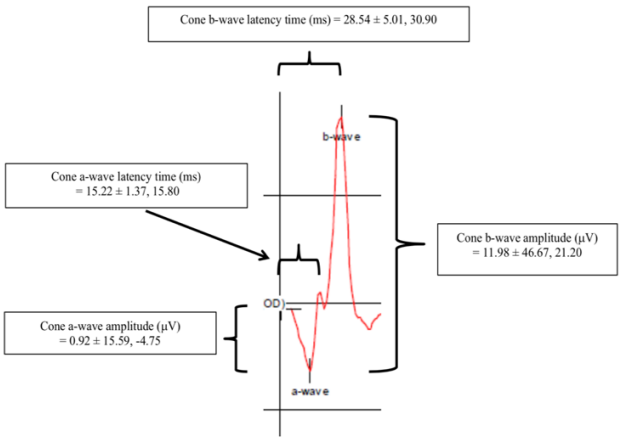

Figure 1: The mean, standard deviation (SD) and median for photopic adapted cone responses (indication: mean ± SD, median) of the cone a-wave amplitude (μV), cone a-latency time (ms), cone b-amplitude (μV) and cone b-latency time (ms) for color vision deficiency. The illustration in figure did not represent the real qualification of ffERG reading

This study found the mean value of colour vision deficiency was lower than normal value in cone a-wave amplitude, cone a-wave latency time, and cone b-wave amplitude. The same condition resulted for those people who had retinitis pigmentosa, which was the amplitude presumably was reflected mainly the total number of functional photoreceptors and the amplitude of the ERG

decreases as the number of photoreceptors in the retina decrease in retinitis pigmentosa progresses, that related with retina disease [10].

Currently, the diagnosis in patients for colour vision deficiency was subjectively measured based on psychophysics method from the patient. Studies had shown that there was a lot of colour vision test in specific illumination. However, the electrophysiology respond of specific cone function functions was relatively unknown. In recent years, non-invasive objective diagnostic tools for the quantitative assessment of the macula have been developed and introduced into clinical ophthalmology. Full-field Electroretinogram (ffERG) could provide objective quantification of electro retinal function from within the macular region. FfERG was an objective, non-invasive technique that has proven utility in assessing macular function in age-related macular degeneration, in patients with vitreomacular traction, macular holes, epiretinal membranes, and in patients with diabetic macular oedema.

4. CONCLUSIONS

Colour perception perceive from the central vision, which stimulated by the three types of cone. The anatomical and physiological process on how each cone stimulates the signal could be gathered from the ffERG technique. The future study can be done on how to standardise objectively and subjectively especially in the critical colour vision needs, such as in transportation, signal light perception, engineering and hence find the solution on how to enhance colour vision performance.

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ARTICLE TYPE

Awareness of pediatric eye examination among parents in Selangor

Wan Elhami Wan Omar[a]* & Nurul Afida Abdul Razak[a]

[a]*Centre of Optometry, Faculty of Health Sciences, Universiti Teknologi MARA UiTM, UiTM Kampus Selangor, 42300 Bandar Puncak Alam, Selangor, Malaysia*

Corresponding Author

Wan Elhami Wan Omar
elhami@uitm.edu.my

Abstract:

The objective of this study was to determine the awareness level of pediatric eye examination among parents in Selangor. The study also aimed to determine the association of parents' educational and socio-economic background towards the awareness of pediatric eye examination. The study was a cross-sectional descriptive study. The survey was conducted using a collective administration questionnaire. Questionnaires were distributed to the parents with children of the age of 2 to 12 years old. The questionnaire consisted of information on demographics (gender, age) and parents' educational and socio-economic background. Out of 192 total number of respondents, 123 (64.15%) respondents were aware of the importance of pediatric eye examination while the other 69 (35.9%) respondents were not aware of it. Despite the high level of awareness towards pediatric eye examination among the respondents, there were 39 (20.3%) of them did not know that routine eye examination is necessary for their children's eye health and another 6 (3.1%) were not sure about it. There was no significant association between education level (r=0.199, p=0.06) and socio-economic background (r=0.01, p=0.99) and awareness level of pediatric eye examination among parents. There was still lack of practice regarding parents seeking good eye care health for their children. Therefore, health care practitioners, especially optometrist, need to increase pediatric eye health education through many sources. This will reinforce good pediatric eye care practice and allow the planning of preventive measure and early intervention that can help in avoiding visual disability and blindness in children.

Keywords: pediatric eye examination awareness, eye examination in pediatric

1. INTRODUCTION

Vision is one of the important senses that a child needs for learning. 80% of learning is visual, which means if a child is having difficulty seeing clearly, his/her learning can be affected as well. To ensure the children are having a good vision, their eyes need to be checked at a certain age of their development. According to the American Optometric Association (AOA), children should have their eyes checked at the age of 6 months, three years, before starting their first grade in school, and then at least every two years following.

According to the National Coalition for Vision Health 2010, six out of ten children experiencing reading difficulties have uncorrected or undetected vision problems, and almost 25% of school-age children have vision problems. If left undiagnosed, vision problems will negatively impact learning and literacy, as well as self-esteem and overall quality of life [1]. The relationship between vision difficulties and school or learning problems has been well documented. At least 20–25% of all children have vision problems [7]. A study of vision problems in school-age children in Kentucky found that up to 80% of children with reading disabilities have visual deficits [8]. Bessler and Birnbaum (2004) reported that children who have difficulty seeing would act out or misbehave because they cannot focus on academic tasks [9]. Zaba (2001) found that 74% of adolescents had failed at least one vision test [7].

Refractive errors, amblyopia and strabismus are the common eye problems that can occur in children of preschool and early school age. Early detection provides the best opportunity for effective treatment [4]. The American Academy of Pediatrics recommends early vision screening at three years of age.

The problem with children's vision is that sometimes they are unaware and cannot tell their parents that they are having a vision problem. Most of the time parents or caretakers noticed changes in their children behaviour relating to vision such as squinting their eyes, tilting their head or the children themselves report that they cannot see, then only eye and vision examination will be done. There are also many common focusing, alignment disorders and eye diseases that can affect children's vision. These eye condition can be treated early or prevented if parents are aware of the signs of vision problem and take quick action to bring their children for an eye examination. Thus, this study was done to determine the knowledge and awareness level of parents in Selangor related to the pediatric eye examination. The study was also to determine whether there is any association of awareness level with the parents' educational and socio-economic background.

2. METHODOLOGY

The study was a cross-sectional study where it had been conducted from March to April 2017. A total of 192 parents

who have children aged between 2 to 12 years old were selected using convenient random sampling. Parents who or had experienced working in eye health care were excluded from the study.

The study was conducted via a survey. The questionnaire used was based on the theoretical framework as reported by Senthilkumar et al [2]. Consent forms, information sheets and questionnaires were distributed to the parents with children aged between 2 to 12 years old. The consent form, information sheets and questionnaires were written in both English and Malay languages.

The first part of the questionnaire consisted of information on demographics (name, gender and age) and parents' educational and socio-economic background (occupation, income, number of children and their age).

The second part of the questionnaire consisted of questions regarding the knowledge, awareness, attitude and practices of parents regarding pediatric eye examination. Answer choices were listed, and participants were asked to tick the answer boxes for each question in the form.

A mini-pilot study was done among 10 subjects to assess the reliability of the questionnaire. The data was inserted into SPSS, and the reliability test was done by using Cronbach's Alpha. The Cronbach's Alpha value of 0.839 was confirmed as reliable for this study, and the data collection was proceeded by distributing the questionnaire to parents.

Institutional approval to conduct the study was obtained from the Research Ethics Committee of Faculty of Health Sciences and UiTM. All participants involved were voluntarily, and written consent was obtained from each participant before their participation in the study.

The data was analysed using the Statistical Package for Social Sciences (SPSS) software Version 21.0. For investigation on the level of awareness of paediatric eye examination among parents, the data was converted into percentage. In order to determine the association of parents' educational and socioeconomic background towards the awareness of paediatric eye examination, statistical analysis of Pearson's chi-square was used to analyse the data.

3. RESULT AND DISCUSSION

3.1. Demographic data

A total of 192 participants responded to this study. The age range of the respondents was between 20 years old and 70 years old, with a mean of 42.22 ± 2.53. Figure 1 showed 15 (7.8%) respondents were between the age of 20 to 30 years old, 81 (42.2%) respondents between the age of 31 to 40 years old, 81 (42.2%) respondents between the age of 41 to 50 years old, 9 (4.7%) respondents between the age of 51 to 60 years old and 6 (3.1%) respondents between the age of 61 to 70 years old.

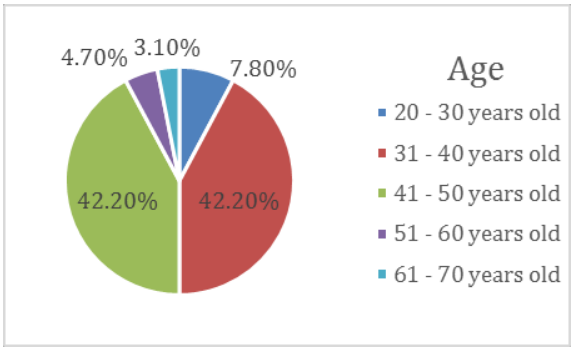

Figure 1: Age distribution of the respondents

The education level was divided into five groups which were a primary school, secondary school, Diploma, Degree and Master/PhD level as shown in Table 1. Meanwhile for the socio-economic level was determined by the respondents' level of income as shown in Table 1 which had been divided into a low, moderate- and high-income level based on the Malaysian Department of Statistic. Low income is categorised as people with income less than RM 2999. Moderate was ranged between RM 3000 to RM 7999 while high income was people with income of more than RM 8000.

Table 1: Educational background and income level of the respondents

		Frequency	Percentage
Education level	Primary school	0	0%
	Secondary School	57	29.7%
	Diploma	54	28.1%
	Degree	54	28.1%
	Master / PhD	27	14.1%
	TOTAL	**192**	**100%**
Income level	Low (<RM2999)	81	42.2%
	Moderate (RM3000-RM7000)	93	48.4%
	High (>RM8000)	18	9.4%
	TOTAL	**192**	**100%**

3.2. Knowledge and awareness level on paediatric eye examination

Out of 192 respondents, 123 (64%) of the respondents were aware of the importance of pediatric eye examination while 69 (36%) of them were not aware.

Despite a high level of awareness, 39 (20.3%) of them did not know, and 6 (3.1%) of them were not sure that routine eye examination is necessary for their children's eye health. Majority of the respondents 147 (76.6%) know that eye examination is necessary for their children, Figure 2.

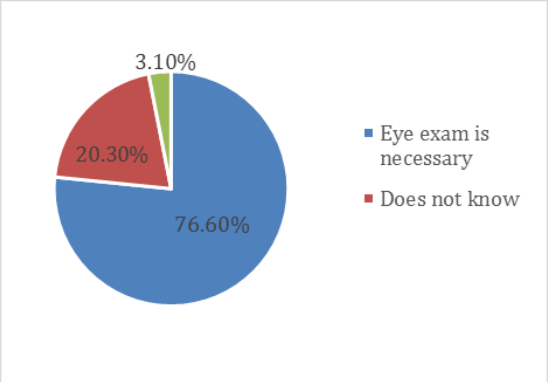

Figure 2: Awareness of parents on the necessity of doing routine eye examination on their children

The vast majority of the respondents, 81 (42.2%) believe that comprehensive eye examination should be done every year. Majority of the respondents, 54 (28.1%) thought that they have to bring their children for comprehensive eye examination only when their children report visual problems. While other 30 (15.6%) and 3 (1.6%) respondents thought that the appropriate schedule to bring their children for a comprehensive eye examination is on every two years and every five years respectively. The remaining 24 (12.5%) respondents were not sure the appropriate schedule to bring their children for a comprehensive eye examination, Figure 3.

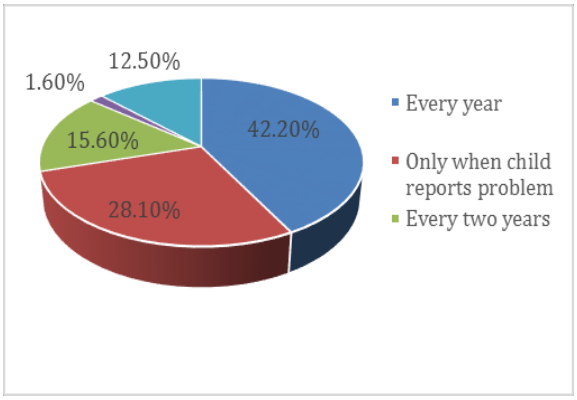

Figure 3: Awareness of the comprehensive pediatric eye examination frequency

The vast majority of the respondents, 189 (98.4%) aware that they should seek help from Optometrist or Eye Care Practitioner whenever their children have eye symptoms and problems. The rest, 3 (1.6%) of them thought that it was not vital to seek professional care whenever their children have eye symptoms, and problems Figure 4.

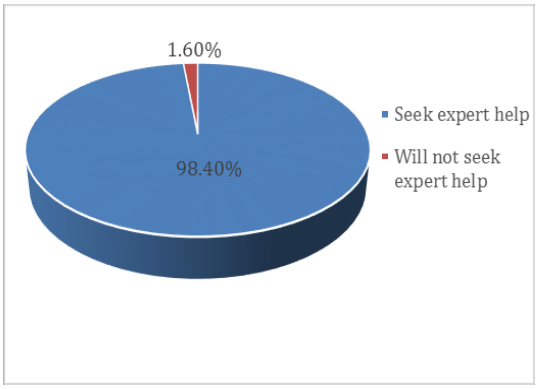

Figure 4: Awareness of parents to bring their children to see Optometrist or Eye Care Practitioner for an eye examination if their children have eye problems

3.3. Association of parents' educational and socio-economic background towards the awareness of pediatric eye examination

In Table 2, the value of r = 0.199, indicating that there is a moderate positive relationship between education level and the awareness of pediatric eye examination among parents. Pearson chi-square test was performed, and the p-value is p=0.06, which indicates there is no statistically significant linear association between education level and awareness level of pediatric eye examination among parents, Table 2.

In Table 2, the value of r = 0.01, indicating a low positive relationship between income level and awareness level of the pediatric eye examination. From Pearson chi-square test, p=0.99. Therefore, there is no statistically significant linear association between income level and awareness level of paediatric eye examination among parents Table 2. Income level of parents does not influence the awareness of paediatric eye examination. The higher the socio-economic status of the parents does not indicate the high level of awareness on paediatric eye examination.

Table 2: Correlation and association between education level and income level with the awareness level of pediatric eye examination among parents

	r	*p-value*	*df*
Education level	0.199	0.06	1
Income level	0.01	0.99	1

Based on the results, more than half of the overall respondents were aware of the importance of pediatric eye examination. This is consistent with the previous study that was done in Nigeria, which showed 71.4% of parents were well aware of the importance of eye health of their children [3]. This may be due to the common public knowledge on the importance of

vision in children's development.

It was found out in this study that parents were aware of their children's condition if they are having signs of vision problems. This is because the child will have obvious signs such as rubbing their eyes constantly, sitting very close to the television or holding the book too near to their face when reading. The result was the same with a previous study that reported 59% of parents seek eye care professionals' help when they noticed their children are having symptoms of refractive error [3]. In another study by Senthilkumar et al., reported that parents were aware of common eye problems [2]. Parents were usually aware of common conditions like refractive errors because the child cannot hide the signs. The parents in the previous study were also aware of conditions that required the use of glasses which if left untreated, it could lead to poor performance in school as the child would not be able to see well or copy correctly from the blackboard[1].

Despite the high level of awareness towards paediatric eye examination among the respondent, there were 39 (20.3%) of them did not know that routine eye examination is necessary for their children eye health and another 6 (3.1%) were not sure that routine eye examination is necessary for their children eye health. Eye exams for children are extremely important because the previous study showed that the prevalence of visual impairment among preschool children in an urban population in Malaysia was 5% [4]. The visual impairment was mostly due to refractive errors, which was preventable if the problem was identified at an early stage. This record shows that it is vital for the parents to have good knowledge and eye health-seeking behaviour to make sure their children's vision develop at normal sate. This will also help to rule out any eye health and vision problem in the early stage for proper visual development because children often are more responsive to treatment when problems are diagnosed early.

From the results, it showed that there was no association between education level and level of awareness for pediatric eye examination among parents in Selangor. This result differs from a study done by Kimel, in which it had shown that children who received eye examinations had parents with at least a diploma educational background [5].

The result of this study might be biased due to the uneven distribution of respondents and educational level. Majority of the respondents were from secondary school 57 (29.7%), diploma 54 (28.1%) and degree 54 (28.1%) education background while only 27 (14.1%) respondents were from Master/PhD educational background. The area of this study conducted was in the sub-urban and urban area which the population there had high public awareness and knowledge about health care and eye care.

The result from this study also showed that there was no association between socioeconomic background and awareness level of paediatric eye examination among parents in Selangor. This result differs from the previous study by Dandona et al., whereby subjects of upper socioeconomic status were significantly more aware of eye diseases as compared to those who have lower socioeconomic status [6]. The result of this study might be biased due to uneven distribution of respondents and level of income. Majority of the respondents were of low (42.2%) and moderate (48.4%) socio-economic status while only 18 (9.4%) respondents were from the higher socioeconomic background. Parents living in Selangor area have easy access to the eye care premises which generally would make them more aware of eye health of their children. Besides, the population in this study was within urban and sub-urban area only. This area gets the most priority for public health education program if compared to other places.

4. CONCLUSION

This study concludes that although there is a high percentage of awareness in paediatric eye examination among parents, they tend to have less knowledge and wrong perception of seeking appropriate eye care for their children. Public enlightenment and health education programs can be one of the strategies to spread more awareness to the parents about the implications of these conditions, their causes and the effects they might have if their children eyes and vision left untreated.

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