Visual Health and Its Relationship with Screen Time Among School Children

A Cross-Sectional Study in Sarawak, Malaysia

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Abstract—This study intended to determine visual health of the school children and investigate its relationship with screen time. This was a school-based cross-sectional study using multistage cluster sampling. A self-reported and interviewer-administered questionnaire were used to compile screen time information. Children presenting visual acuity was evaluated with Snellen chart and non-cycloplegic refraction was performed to those acuities worse than 6/12. Data analysis was performed using SPSS version 22. A p-value ≤0.05 with 95% CI was considered as statistically significant. About 87% children had normal or near normal visual acuity and 13% had visual impairment. The prevalence of refractive error was 22.8%. Astigmatism was the most prevailing type of refractive error, 10%. The children spent on average of 13.82 hours per week on screen time. Television is the most popular electronic devices. Boy spent more time on gaming consoles than girl. There was no statistically significant relationship between refractive error and screen time (p=0.581). The prevalence of refractive error among school children was 23%. The children spent nearly 14 hours per week on screen time. There was no statistically significant relationship between refractive error and screen time. Periodical children vision screening is paramount for early detection of vision impairment and provide possible intervention.

Keywords—screen time, refractive error, visual impairment

1 Introduction

The evolution of digital electronic devices had invaded into our daily life. Millions of children use screen-based devices on a daily basis for recreation and education purpose, either at home or school. Today's children growth is immersed in screen-based electronic devices due to the advancement of technology. Excessive use of electronic devices could hinder the children's eyes growth, bones development and interpersonal skills as well as leading to a sedentary lifestyle [1].

American Academy of Paediatrics guideline recommended that the total media time for children over the age of two to five was limited to an hour or less per day. Supervision and time limit should be set for children six years and older [2]. Malaysian children spent about 5 hours on electronic gadgets per day in the year 2018 [3]. Meanwhile, the young adult spent an average 4.69 hours per day on screen time on the year 2012 [4].

Parents and teachers should be aware of health problems arising from such a trend. Some parents might use such electronic gadget as an "*electronic pacifier*" to calm and entertain their kids. In this context, the objective of this study is to determine visual health of the school children and investigate its relationship with screen time.

2 Methods

2.1 Study Setting and Sampling

This is a school-based cross-sectional study at Bau (Sarawak) Malaysia. Bau District is under Kuching division of Sarawak. In year 2018, Bau has a total population of 60700 [5]. The district has multiethnicity population consists of 69% Bidayuh, 21% Malays, 3 % Iban and 7% others. She has 40 government-funded primary schools with approximate 5300 students. The study population was students of public school children aged between 7 to 15 years old. We recruited the children whom parents gave their written informed consent. Children with a particular need, born preterm and ocular comorbidity were excluded from the study. The study was conducted correspondingly with Helsinki's declaration.

For the determination of sample size, we used a single proportion with finite population correction and a 20% prevalence of refractive error [6, 7]. We used 0.05 as an acceptable margin of error and a standard normal variate of 1.96. So, the initial sample size was 388. As we followed multistage cluster sampling, the sample size was multiplied by the design effect of 2.0 and then inflated with 20% of the non-response rate. So, the final sample size was 930. We followed a multistage sampling technique to recruit the study participant. In the first stage, the number of public primary schools were selected randomly from Bau district under the Kuching division. The list of all primary schools was obtained from Bau district education office which served as a sampling frame. In the second stage, the desired number of classroom nested within the selected schools were selected randomly.

2.2 Measurements

Visual acuity. All the children underwent distance visual acuity (VA) check, using a lightbox Snellen chart. At a distance of six meter, the distance presenting visual acuity was measured monocular. If children whose unaided visual acuity was worse than 6/12, they were referred to an optometrist for non-cycloplegic refraction and spectacles prescription if indicated. Those children whom already wore spectacles, their spectacles lens power were measured with lensmeter (CCQ-400; Yeasn Corporation, Chongqing,

China). If this group of children aided vision were worse than 6/12, new subjective refraction will be done by optometrists.

Refractive error. Using Snellen chart at 6 meter, World Health Organization (WHO) defined normal or near-normal visual acuity as presenting acuity ≤6/12, distance visual impairment was presenting visual acuity equal to 6/18 or worse, and blindness as worse than 3/60 [8]. Refractive error happens when the eye losses the focusing power and result in blurred vision. Myopia, hyperopia and astigmatism are commonly seen among school children.

Screen time. Amount of time or activity done in front of screen-based electronic devices. The electronic devices were television, computer/laptop, tablet/iPad, smartphones, and handheld video game consoles. The choice of electronic devices among student was recorded.

2.3 Data collection and ethical issues

A Malay language version of the self-developed questionnaire was used for data collection. The questionnaire was pre-tested before the final study. A self-reported answer to the questionnaires method was employed for older children. The interviewer-administered questionnaire was used for younger age children. After completion of socio-demographic and information related to electronic devices, the student were examined for visual acuity.

2.4 Data analysis

Before data entry into the computer, it was checked for any inconsistency and completeness. Firstly, a descriptive analysis with simple frequency, mean and standard deviation was calculated. To determine the relationship between visual health and screen time, non-parametric Mann-whiteny U test for dichotomous and Kruskal-Wallis test for polytomous independent variables. Data analysis was performed using IBM SPSS version 22.0. A p-value of ≤0.05 considered as statistically significant.

3 Results

A total of 569 primary students participated in this survey. The mean age of the students was 10.89 ±1.48 SD years with a minimum age seven and maximum age 15 years. More than half (55.7%) were female and rest were male students (44.3%). Majority of the students were Bidayuh (78.2%), and the rest were Chinese (8.1%) and Malays (6.7%), Iban and other ethnic groups.

3.1 Visual Health

From the study, the normal or near-normal vision with presenting distance visual acuity of 6/12 or better was about 87%. Visual impairment with presenting distance

visual acuity of 6/18 or worse (either eye) was 13.4% of the right eye and 11.7% of the left eye (Table 1).

Table 1. Distribution of both eye presenting visual acuity

Visual acuity	Right eye		Left eye	
	n	***%***	***n***	***%***
6/6	371	65.2	377	66.3
6/9	94	16.5	97	17.1
6/12	28	4.9	28	4.9
6/18	32	5.6	22	3.7
6/24	16	2.8	20	3.5
6/36	24	4.2	17	3.0
6/60	2	0.4	6	1.1
>6/60	2	0.4	2	0.4
total	569	100.0	569	100.0

The prevalence of refractive error was 22.8%. The highest percentage of refractive error was myopia astigmatism (7.7%), followed by myopia (6.9%). However, 6.0% had mixed refractive error between two eyes (Table 2).

Table 2. Distribution of refractive error

Refractive error	n	%
Normal	439	77.1
Myopia	39	6.9
Myopia astigmatism	44	7.7
Astigmatism	13	2.3
Mixed	34	6.0

3.2 Screen time

The children spent an average of 13.82 hours per week on screen time. Boys spent more hours on electronic devices 14.66 hours per week, meanwhile girls spent 13.18 hours per week. The children's screen time on a weekday was 5.45 hours per day as compared to 8.37 hours on the weekend. Television is the most popular among students. On average per a week, they spent 6.00 hours on watching television, 4.03 hours on the smartphone, 1.48 hours on laptop/ computer, 1.17 hour on the tablet, 1.14 hour on playing consoles game (Table 3).

Table 3. Type and duration of the electronic device used per week

Device used	Mean (hours)	Device used	Mean (hours)
Televion	6.00	Smartphone	4.03
Personal computer/laptop	1.48	Consoles	1.14
Tablet	1.17	Total	13.82

From our analysis, boys spent more time in gaming consoles (p=0.001) than girls. However, the mean screen time were not significantly different between the gender for other electronic devices (Table 4). Duration of screen time also not significantly different among the five ethnic groups (Table 5). Overall, there was no statistically significant relationship between refractive error and screen time (p=0.581) (Table 6).

Table 4. Duration of screen time in hours by gender

Device	Gender	Mean	IQ1	Median	IQ3	p-value
Television	Male	5.83	3.00	5.00	7.00	0.115
	Female	6.14	4.00	5.00	7.00	
Computer	Male	0.71	0.00	0.00	1.00	0.758
	Female	0.63	0.00	0.00	1.00	
Laptop	Male	0.83	0.00	0.00	1.00	0.806
	Female	0.82	0.00	0.00	1.00	
Tablet	Male	1.30	0.00	0.00	1.00	0.738
	Female	1.07	0.00	0.00	1.00	
Smartphone	Male	4.28	1.00	3.00	5.50	0.629
	Female	3.85	1.00	3.00	5.00	
Gaming console	Male	1.73	0.00	0.00	3.00	**0.001***
	Female	0.67	0.00	0.00	0.00	
Screen time	Male	14.66	7.00	12.15	19.50	0.229
	Female	13.18	8.00	12.00	17.00	

p-value *reached from Mann-Whitney U-test, *p<0.05*

Table 5. Duration of screen time in hours per week by ethnicity

Device used	Ethnicity	N	Mean	IQ1	Median	IQ2	p-value
Screen time	Bidayuh	445	13.57	7.00	12.00	18.00	0.147
	Iban	28	16.14	9.50	16.00	22.00	
	Malay	38	12.87	6.00	12.00	15.00	
	Chinese	46	15.74	9.00	14.50	21.00	
	Others	12	14.00	7.50	12.50	18.00	

p-value reached *from Kruskal-Wallis test*

Table 6. Duration of screen time in hours by refractive error

Device used	Refractive error	N	Mean	IQ1	Median	IQ3	p-value
Screen time	Normal	439	13.71	9.50	14.00	17.50	0.581
	Myopia	39	13.98	8.50	14.00	17.00	
	Myopiastigmatism	44	14.23	7.00	11.00	18.00	
	Astigmatism	13	16.00	9.00	13.00	19.00	
	Mixed	34	13.97	3.15	5.00	7.00	

p-value *reached from Kruskal-Wallis test*

4 Discussion

The visual system of children is immature until the age of 8 to 9 years. Sub-optimal vision among children can hinder their school performance and lead to behavioral problem. Ministry of Health Singapore conduct vision screening for primary one student age 7 and every year thereafter [9]. Meanwhile, Malaysia nationwide eye screening covered primary 1 (7 years), primary 6 (12 years) & form 3 (15 years) by School Health Team, under Family Health Development Section (Bahagian Pembangunan Kesihatan Keluarga), Ministry of Health Malaysia [10].

The refractive error problem varies according to geographic regions ethnicity. Over the past two decades, refractive error prevalence is increasing trend. In Malaysia, refractive error prevalence among school children was ranged in between 7% to 47.7% [11-13]. The prevalence of visual impairment in our study is 23%. The commonest refractive error among Bau district school children was astigmatism with 10.0%. A meta-analysis reported that estimated pool prevalence of astigmatism was 14.9% and was the commomest refractive errors in children [14]. In Malaysia, Chew et al found that the astigmatism represented 84% of refractive error among kindergartens children at district Segamat (Johor) [6], Meanwhile with-the-rule astigmatism was the commonest type of refractive error in Kuching study population [15].

In year 2014, Malaysia rural boys spent mean 3.4 hours per day and girl spent 2.8 hours per day on screen time [16]. The mean values were significantly different between the sexes [3,17]. Four years later, our study showed rural area children spent on average of 13.82 hours per week on screen tome. Boys spent more time in gaming consoles that girls.

Excessive screen time causes health issues to children and young people. There was strong evidence association between screen time and obesity, mental health problem and unhealthy meal intake [18]. Small amount of daily screen time is benefit especially educational screen time help to improve academic learning process [19].

This was a cross sectional study which has its own inherent weakness. Comprehensive eye examination, stereopsis and colour vision test were not offered to students. The study was conducted in a rural population. Generalization of the results to the urban school students should be interpreted carefully. Urban students are more accessible to electronic gadgets and eye screening.

5 Conclusion

The prevalence of refractive error among school children was 23%. School children spent nearly 14 hours per week on screen time. There was no statistically significant relationship between refractive error and screen time. Periodical children vision screening is paramount for early detection of vision impairment and provide possible intervention.

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7 Ethics approval

The Medical Ethics Committee, Faculty of Medicine and Health Sciences, Universiti Malaysia Sarawak (02/2018) and the Ministry of Education Malaysia KPM.600-3/2/3-eras (1022) approved the study.

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