**Original Article:**

**Prevalence of Myopia Among Indian School Children in Kuala Lumpur**

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**Abstract:** BACKGROUND: Studies on the prevalence of refractive errors are scarce among Indian children population in Malaysia. Hence, this study aimed at determining the prevalence of refractive error among Indian schoolchildren in Kuala Lumpur. METHODS: A total of 1462 Indian schoolchildren 7–11 years of age participated in this study. The subjects consisted of 733 (50.1%) boys and 729 (49.9%) girls. Non-cycloplegic autorefraction was used to determine the refractive error. Myopia was defined as a SER of 1.00 dioptre (D) or worse, hyperopia as a SER of +0.50 D or more, and astigmatism as cylindrical power equal to or worse than 0.75 DC. RESULTS: The prevalence rates of myopia, hyperopia and astigmatism were 28.9%, 6.9% and 35.4% respectively. The prevalence of anisometropia was 7.7%. CONCLUSION: Myopia was the most common type of refractive error found in this population. Further investigation to identify the cause of myopia is needed in order to slow down the increase in severity of myopia among Indian schoolchildren.

**Key Words:** Prevalence rate, Refractive errors, Non-cycloplegic, Indian school children

**Introduction:**
Refractive error is one the universal causes of visual impairment among children that affect a large percentage of the population worldwide. (1) It is also known that uncorrected refractive error can lead to problem in learning to read which might eventually affect academic performance later in life. (2) Knowledge of the prevalence of refractive error is important for practitioners who care for children’s vision in anticipation of any possible academic problems associated with it. Since the launch of Global Initiative for the Elimination of Avoidable Blindness, (3) population-based studies on the prevalence of refractive error among children have been carried out comprehensively in all regions of the world. (1) In Europe the prevalence of myopia is comparatively lower compared to Asian population. (4) The prevalence are as the following: 3.4% in 10-15 year-old United Kingdom (UK) children, (5) 2.8% in 6-7 year-old in Northern Ireland, (6) 9.4% in 6-7 year-old children in England and 29.4% in 12-13 year-old children in England. (7) In other studies, the prevalence of myopia found to be 7.3% in 5-15 years old children living in La Florida, Chile while in USA, the figures were 2% (in 6 years-old) and 20% (12 years-old). (8-9) The prevalence among 5-13 years old children in South Africa was 4.0% whilst in Australia, 11.9% (10,11) The prevalence of myopia has also been reported comprehensively in Asian populations. As mentioned earlier, the prevalence of refractive error among Asian populations are found to be higher compared to the Western population. (1) The prevalence of myopia among Chinese children was about 21.6 % in 5-15 years old in Shanyi District, Beijing 38.1% in 5-15 years old in Guangzhou and 42.4% in 13-17 years old in Yangxi, Guangdong province. (12-14) In India, prevalence studies done at New Delhi and Andhra Pradesh revealed the following figures: 7.4% among 5-15 years old children in New Delhi and 4.1% among 7-15 years old children in Andhra Pradesh. (15-16) In Nepal, the prevalence were 1.2% among 5-15 years old in Mechi zone and 19.0% among 10-15 years old in Kathamandu. (17-18) On the other hand, the prevalence of myopia was recorded as 36.7% among 7-9 years old Singaporean children. (19) In Malaysia, studies on the prevalence of refractive errors are scarce although a couple of small studies have been done. In 1987, the prevalence of myopia in Malay school children of 7 to 8 years of age was reported as 4.3% by Garner and co-workers. (20) However, the prevalence of myopia has increased to 5.4% among Malay children in 21 years. (21) In 1990, a similar study conducted in Chinese school children found the prevalence of myopia to be 37% in those aged 6 to 8 years. (22) In 2014, a study by Mohidin and friends showed that the prevalence of myopia among Indian school children
was 16.9% among male and 16.4% among female. (23) In the same year, Goh and colleagues found the prevalence of myopia to be 15.5% among Indian school children in Gombak district. (24) Following that, another study in 2006 by Saw and friends found 12.5% among Indian school children. (25) It is apparent that the prevalence of myopia among Indian school children was found to be in a range of 12 to 17%. Moreover as it was done 15 years ago, it is rather outdated and it also does not truly represent the present population and the current trends in refractive error development. The studies conducted in Malaysia involves all ethnic is shown in Table 1.

### Table 1: Prevalence of Myopia in Malaysia

<table>
<thead>
<tr>
<th>Study</th>
<th>Ethnicity</th>
<th>Prevalence of myopia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Garner et al (1987)</td>
<td>Malay</td>
<td>7-8 years old (4.3%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15-16 years old (25.6%)</td>
</tr>
<tr>
<td>Chung et al (1996)</td>
<td>Chinese</td>
<td>6-12 years old (37%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13-18 years old (50%)</td>
</tr>
<tr>
<td>Mohidin et al (2005)</td>
<td>Indian</td>
<td>7-18 years old</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Male (16.9%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Female (15.1%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RE: Male (16.4%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Female (18.8%)</td>
</tr>
<tr>
<td>Goh et al (2005)</td>
<td>Malay, Chinese, Indian</td>
<td>7-15 years old Malay (R: 13.9%, A: 15.4%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chinese (R: 45.3%, A: 46.4%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Indian (R: 15.5%, A: 16.2%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Others (R: 16.8%, A: 18.2%)</td>
</tr>
<tr>
<td>Saw et al (2006)</td>
<td>Malay, Chinese, Indian</td>
<td>7-15 years old Malay (9.2%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chinese (30.9%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Indian (R: 12.5%)</td>
</tr>
<tr>
<td>Choong et al (2006)</td>
<td>Malay, Chinese, Indian</td>
<td>7-12 years Monocular Subjective refraction (29.9%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Binocular Subjective refraction (25.6%)</td>
</tr>
<tr>
<td>Hashim et al (2008)</td>
<td>Malay</td>
<td>6-12 years old</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.4%</td>
</tr>
</tbody>
</table>

It is apparent that there is a lack of data on the type, severity and prevalence of refractive errors among Malaysian Indian primary school children. A study on prevalence of refractive error among Malaysian Indian school children is necessary to get a clear picture of the refractive error. Hence the present study was carried out to fill this void. Current study was also in line with the World Health Organisation’s Vision 2020 campaign for countries to provide current data on the topic in question. (3)

### Methodology:

**Sample selection:** The present study, named as the Refractive Error Study in Kuala Lumpur Indian Schoolchildren (REKLIS) is a population-based study of refractive error in school children aged between 7 to 11 years old. Subjects were recruited from National Indian primary schools in Kuala Lumpur. Approval for the study was obtained from the Ministry of Education and Federal Territory of Education Department before the schools were approached. In total, out of 15 schools approached, 12 schools agreed to participate. All children aged 7 to 11 years old were recruited to participate in the study through letter invitations, followed by the issuance of consent letters to the parents/guardians. In total, out of the 2275 children who were invited to participate, 1462 (64.3%) participated. The study was carried out from January to October 2015. Human subject research approval was obtained from the Research and Innovation Management Centre (RIMC) at SEGi University, and the study was conducted according to the tenets of the Declaration of Helsinki.

### Field Operations:

Fieldwork was performed between January 2015 and July 2015, taking place from one school to another. Work within a particular school was generally completed within 2 to 3 days, before moving on to the next one. Prior to going to the school the headperson of the school was contacted to explain the purpose of the study and seek for his or her support. The purpose of the study was explained to the parents/guardians through the informed consent form. The name, age and gender were collected for each child between 7 and 11 years old of age. To maximise response rates, those who refused to participate in the study were contacted with the help of the school teachers before they were deemed to be non-participants.

### Eye Examination:

The eye examinations conducted included habitual visual acuity assessment, autorefraction and best corrected visual acuity. Clinical examination were conducted in temporary stations in school classrooms during school hours. Distance habitual visual acuity (VA) measurements were obtained monocularly and binocularly using EDTRS chart, recorded as the smallest line read by the child with current spectacles (if worn) or without (if none was worn). The right eye was tested first and then the left eye, followed by binocular visual acuity measurement. The children then underwent autorefraction (Accuref-R9001; Shin Nippon, Japan) without cycloplegia. Three reliable readings were obtained in each eye, and the average of these values was used for analysis. Best corrected visual acuity was recorded for each child. The autorefractor was calibrated daily before testing, and the same autorefractor was used for all subjects throughout the study.

### Data Management and Analysis:

Clinical data were recorded in specially designed data form. A computer was used to check for data that were missing, inaccurate, or consistent at the completion of data entry for each school. As within-subject mean spherical equivalent refraction (SER) of the eyes correlated highly (Spearman correlation coefficient = 0.16, p < 0.05), only right eye data are presented other than anisometropia. SER was defined as the sphere plus half-negative cylinder. Myopia was defined as a SER of at least -1.00 D and hyperopia as +0.50 D or more. Astigmatism was defined as a cylindrical measurement of at least 0.75 D of the RE and was grouped into three categories: with-the-rule astigmatism (cylindrical axes between 1° and 30° or 150° and 180°), against-the-rule-astigmatism (cylindrical axes between 60° and 120°), and oblique astigmatism (cylindrical axes between 31° and 59° or 121° and 149°). Anisometropia was defined as those who are having unequal refractive error (≥2.00D) (Tong et al 2004) of myopia, hyperopia and combination. The combination or also known as antimetropia were those myopic in one eye and hyperopic in the other eye.

### Quality Assurance:

All investigators involved in this research participated were trained well. During eye examination, the tested subject went through separate stations: VA and autorefract. A leading investigator was assigned for the quality control of each of the stations to minimise possible systematic biases.

### Results:

Out of 15 schools, 12 schools participated in the study. A total of 2275 schoolchildren were enumerated for the study out of which 1462 children were examined. The non-responders include children who were absent on the day of examination and those who declined to participate. The subjects consists of 733 (50.1%) boys and 729 (49.9%) girls. The children were aged 7 to 11 years (µ=9.1±1.4 years). There was no significant difference in mean ages between boys (9.05±1.4 years) and girls (9.08±1.4 years); p > 0.05. The distribution of habitual VA for each eye is presented in Table 2. Habitual VA better than 0.3 logMAR was found in 1029 (88.6%) children in the right eye while 1049 (71.8%) in the left eye.
Using this definition, the prevalence of hyperopia (5.9%). On the other hand, prevalence of anisometropia is 7.7% with 93.8% of them are anisometropic.

These data provide the first population-based comparison of refractive error among Indian school children in 7 to 11 years. Data from Mohdini and friends provided association between myopia and gender in Indian schoolchildren in Kuala Lumpur. In this study, myopia was defined as having SER of -0.50D or greater based on measuring refractive error using retinoscopy without cycloplegia. Using this definition, the prevalence of myopia in the Akhir et al was 54.5% among Malay schoolchildren 7 to 10 years of age. (27) However, Akhir et al showed that optimal myopia definition was <-1.00D without cycloplegia, as it has good combinations of sensitivity (83.9%) and specificity (95.7%). Therefore, myopia definition for this study was set to <-1.00D. (27) Myopia was found to be higher among the Indian school children in this study. The prevalence of myopia (28.9%) was higher compared to all the previous study on Indian school children. (24) This could be due to the study gap. The latest study before REKLIS was dated in 2006 which is 11 years ago. (25) The technology development and the environmental change could be the attributing factor for the hike in prevalence of myopia among the Indian school children. However, the prevalence is substantially lower compared to Singapore (36.7%) and Hong Kong. (28) The difference in the prevalence could be due to the population studied and also the methodology. Older subjects aged 9-11 years old was found to be significantly more myopic than the 7 and 8 years old subjects. This result is similar to a study in Singapore eye where the prevalence of myopia increased from 29% at age 7 years, to 35% by age 8 years, and to 43% by age 9 years. (29) The prevalence of myopia (6.9%) was between the 3.5% and 16.3% reported in China and Chile, respectively. (8, 12) It is, however, at variance with the findings in other studies in Malaysia. (21, 30) The prevalence found to be 0.9% in Petaling Jaya and 1.0% in Kota Bharu. (21-30) The differences could be attributed by the differences in the methods, definitions, populations and demographics in both the studies. For instance, in this study, non-cycloplegic auto-refractor was used to determine refractive error; hyperopia was defined as powers of +0.50D or greater; and subjects were Indian primary schoolchildren compared to other studies which used cycloplegic auto-refraction results. On the other hand, the prevalence of hyperopia in the Western countries are much higher among the children. (31) Multi-ethnic Paediatric Eye Disease Study (MEPEDS) reported a prevalence of greater than 20%. However, the Baltimore Paediatric Eye Disease Study (BPEDS) found a lower prevalence of 8.9% of the white children and 4.4% of the African-American children. (32-33) This prevalence is considered higher than the REKLIS study as the hyperopia was defined as at least of 3.0D
compared to 0.50D in the REKLIS study. Thus, it is evident that Kuala Lumpur Indian children have a substantially lower prevalence of hyperopia than the Western children, which could reflect trends for earlier development of myopia in Kuala Lumpur Indian children.

The prevalence of astigmatism (= -0.75DC) in our study was 35.4% which is higher compared to previous studies. (34-35) For example, the prevalence of astigmatism (= 1.00D) was reported to be 19.2% in Singaporean children aged 7 to 9 years old (36) and 4.8% in Australian children aged 6 years. (37) This variation could be due to the nutrients intake and genetics. Other than that, it was also found that near visual task causes eyelid pressure on cornea. This causes a change in astigmatic changes. (38)

These gives a strong suggestion that the prevalence of myopia is substantially higher in Malaysian Indian populations than in Western populations. (39) These differences could be due to environmental differences, nutrients intake, excessive amounts of near work, educational level, socioeconomic status, and outdoor activity. Most Kuala Lumpur children attend 4 years of kindergarten and actively attends extra tuition as early as 7 years old which increases the amount of near work load among the children. (40) As they are exposed to visual display units (VDUs), the amount of time spent for outdoor activity also decreases. At the same time, increasing the amount of near work. This could be the reason for the increase in myopia among Malaysian Indian children in 10 years.

Conclusions

Myopia was the most common type of refractive error found in this population. It is evident that Kuala Lumpur Indian schoolchildren have a substantially lower prevalence of hyperopia than Western children, which could reflect trends for earlier development of myopia in them.

Conflict of Interests

The authors declare no conflict of interest.

Acknowledgement

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