Prevalence, knowledge and factors associated with refractive errors in grade 9 students in selected schools in the Colombo district

Thariq T, et al

Faculty of Medicine, University of Colombo, Sri Lanka

Department of Community Medicine, Faculty of Medicine, University of Colombo, Sri Lanka

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Author responsible for correspondence:
Mohamed Thalal Thariq
Faculty of Medicine, University of Colombo, Sri Lanka
Email: medmbbs160974@stu.cmb.ac.lk

Abstract

Background
Refractive errors are preventable and is an easily treatable visual impairment that is especially common among children and adolescents and if uncorrected can lead to severe consequences. Our aim is to describe the prevalence and knowledge of refractive errors and determine the factors associated with refractive errors among grade 9 students in selected schools in Colombo district.

Methods
A cross sectional study was carried out among 120 grade 9 students sampled using a cluster sampling method from two selected schools in the Colombo district. Students completed a self-administered questionnaire. Visual acuity was measured using Snellen’s E chart at 6 meters. For those whose vision was less than or equal to 6/12, pinhole examination was performed to confirm refractive error as the cause for visual impairment. Students with spectacles were tested with and without spectacles. Data was analyzed using SPSS software.

Results
Out of the students, 53.3% were females with a median age of 13. The prevalence of refractive errors was 28.3% (CI at 95%; 20.5-37.2) while the prevalence of uncorrected refractive errors was 18.3% (CI at 95%; 11.9-26.4). Overall, 94.2% were found to have a poor knowledge regarding refractive errors. Having both parents and a sibling wearing spectacles, being a resident of Colombo district and sleeping for more than 6 hours a day were found to be significantly associated with the presence of a refractive error (p<0.05)

Conclusion
Prevalence of refractive errors in this study population was high. Factors associated with refractive errors could be utilized in planning preventive programme.
Background

Irrespective of age, refractive errors have taken their place as the commonest ocular problem among humans. It is considered a public health challenge. According to the World Health Organization (WHO), uncorrected refractive errors are the second common cause of blindness after cataract [1].

The Global burden of disease (GBD), Risk Factors and Injury Study in 2010 found that there were 6.8 million people (20.9%) were blind from uncorrected refractive errors and a further 101.2 million (52.9%) were visually impaired due to same reason [2].

A study conducted in Sri Lanka found that 67% of adults had refractive errors [1]. Lack of knowledge, stigma and erroneous beliefs towards refractive errors play a major role in the uptake of services provided for refractive errors in different continents [4]. Therefore, this study aimed at gaining more insight and assessing the gaps in the knowledge, regarding refractive errors in order to justify appropriate intervention programs.

School going children deserve more attention as it is at this age that a refractive error is most likely to develop. A study revealed that, 2% of children between 7 and 8 had myopia but this increased with age and reached 20% at 15 years [5]. Among the school-going children the prevalence of refractive errors is highest in the 14-to-16-year age group. Hence, screening students in this age group is more beneficial and a need [6]. Therefore, we selected grade nine students for our study who are in this age group.

Early correction of refractive errors results in a decrease in the number of school children with poor eyesight [7]. Visual problems due to myopia regularly show up during school going years [8]. Although there is a screening for refractive errors at different ages, the major shortcoming of the School Medical Inspection (SMI) is that only the screening is done. The follow up for refraction and prescription is limited. Nearly 3.7% of students dropped out from the visual screening during SMI [9]. This allows uncorrected refractive errors to rise. This could easily be prevented if the proper knowledge on refractive errors was present among children and parents. Another reason for our study.

There is limited data for factors affecting refractive errors and the exact aetiology of refractive errors is still not well known and therefore there’s a need for further evaluation [10]. There is scarcity of data for the age group 13 to 15 years. If school students have better screening and good guidance, they would be able to have a good eyesight and ability to perform better at their examinations and have a better life. Thus, identifying the factors associated with refractive errors in grade 9 students would have a big impact on their academic and social life. Therefore, we aimed to describe the prevalence and knowledge of refractive errors and to determine factors associated with refractive errors among grade nine students in selected schools in Colombo district.

Methods

This study was a descriptive cross-sectional study conducted in two selected schools in Colombo district including one boys’ school and one girls’ school. The schools were selected based on the feasibility and ability to collect the required sample (Approximately 175 students each, were available in grade nine of the selected schools). The study population included students of grade 9 in the selected schools.

Participants from the school were recruited based on a cluster sampling technique. Grade 9 consists of several classes. Our cluster size was determined based on the class with the least number of students (20) and the number of clusters required were 6 (120/20). Six clusters were randomly chosen from the grade 9 classes of both schools after listing all the classes of both schools in one list for the random selection.

Three study instruments were used
- Snellens “E” chart
- Pin hole occluder
- Self-administered structured questionnaire

The procedure was explained in detail to the students prior to the assessment. The selected students were given a self-administered questionnaire to determine their knowledge and factors associated with refractive errors. Thereafter visual acuity of the student was measured by the research team using the Snellen’s E chart.

Visual acuity was measured using the simplified Snellen’s “E” chart at 6 meters. A typical Snellen’s chart has 11 lines of large E, in a particular direction (Up, down, left, right). Visual acuity in a specific eye is the smallest row that can be read. “Ototypes” are the symbols on this chart and in this case it is the direction of the letter “E”.

Students covered one eye at a time with an optic occluder and were seated at a distance of 6 meters from the chart. The chair was positioned before the test in the right position that was measured at 6 meters using a measuring tape and we ensured that the position was correct for each student. Students were asked to wear spectacles if they were using it currently. Students were requested to start reading from the top of the chart to the bottom, until the point they couldn’t read no more. For those who wore spectacles, the vision was tested without the spectacles as well.
A refractive error as the cause of reduced vision was confirmed by using a pinhole occluder (an opaque disc with one or more small holes). This was carried out by requesting students to read down-words, the last best line they could read through the pinhole. An improved visual acuity when reading through the pinhole confirmed the presence of a refractive error in the child. If there was no improvement with pin hole, it was interpreted as reduced vision due to a reason other than a refractive error. Amblyopia was suspected if the person read the same amount of letters as before.

In the students’ visual acuity record, the VA (Visual Acuity) for each eye was recorded, stating whether it was with or without correction (spectacles). If the top letter could not be read at 1 meter (1/60), fingers were held up at varying distances of less than 1 meter and checked whether the student could count them. This was recorded as counting fingers (CF) and recorded as VA=CF. If the student could not count fingers a hand was waved and checked if he/she could see this. This was recorded as hand movements (HM) and recorded as: VA = HM.

The score was then categorized based on the World Health Organization classification of refractive errors as shown in Table 1.

The study was carried out during the COVID-19 pandemic with the necessary precautions taken and in accordance with the health and safety guidelines.

Statistical Package for the Social Science (SPSS) was used in data entry, processing and analysis. The knowledge-based questions in the questionnaire were divided as nice to know, good to know and need to know questions and were scored with one mark, two marks, and three marks respectively for every correct response and zero marks for incorrect responses. As the total score of the need-to-know questions amounted to 87/189 (46%) marks, this was taken as the cut off value to divide the study population as having “good” and “bad” knowledge. Chi-square test was used to assess the factors associated with refractive errors. The factors were cross-tabulated with students with and without refractive errors. A p value of 0.05 was used. Ethical clearance to carry out the study was obtained from the Faculty of Medicine, University of Colombo.

Results

Table 2 shows the frequency distribution of the study population by selected socio demographic characteristics.

In our study, 22.5% (CI at 95%; 15.3% - 30.0%) of the students were identified on the date of examination as having a mild (10.8%, CI at 95%; 5.9% - 13.8%) to severe (2.5%, CI at 95%; 0.5% - 7.1%) visual impairment. Majority of these students (96.3%) was found to have a visual impairment due to a refractive error. The prevalence of refractive error in both eyes was 17.5% (CI at 95%; 11.1% - 25.5%), followed by eye only 8.3% (CI at 95%; 4.0% - 14.8%) and left eye only 2.5% (CI at 95%; 0.5% - 7.0%), which make the total prevalence of refractive error as 28.3% (CI at 95%; 20.5-37.2) and uncorrected refractive errors amounting to 18.3% (CI at 95%; 11.9-26.4) of the study population. Refractive errors were more common in males (15% CI at 95%; 9.1% - 22.6%) than females (13% CI at 95%; 7.8% - 20.7%) in the study population. The prevalence of newly diagnosed refractive error was 17.5% (CI at 95% 11.1% - 21.5%) of the refractive errors were found prior to the examination.

The maximum score that could be obtained was 189 while the minimum score that could be obtained was zero. In the study sample, the minimum mark scored by a study unit was zero while the maximum mark scored by a study unit was 100. The mean score of the marks scored by the study units was 50.22 (CI= 46.1 - 54.3, SD=+22.99) while the median mark was 50. The mode of the distribution was 63.

The significant findings of our study are shown in Table 3.
Table 2. Frequency distribution of the study population by selected socio-demographic characteristics

<table>
<thead>
<tr>
<th>Selected socio demographic characteristics</th>
<th>Number(^{a}) ((n=120))</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (in completed years)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>18</td>
<td>15.0</td>
</tr>
<tr>
<td>14</td>
<td>101</td>
<td>84.2</td>
</tr>
<tr>
<td>15</td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>56</td>
<td>46.7</td>
</tr>
<tr>
<td>Female</td>
<td>64</td>
<td>53.3</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sinhalese</td>
<td>119</td>
<td>99.2</td>
</tr>
<tr>
<td>Muslim</td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td>Religion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buddhist</td>
<td>119</td>
<td>99.2</td>
</tr>
<tr>
<td>Islam</td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td>Amalgamated place of residence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colombo District</td>
<td>73</td>
<td>60.8</td>
</tr>
<tr>
<td>Non-Colombo District</td>
<td>47</td>
<td>39.2</td>
</tr>
</tbody>
</table>

Table 3. Factors associated with refractive errors in the sample

<table>
<thead>
<tr>
<th>Factors associated with refractive errors</th>
<th>Refractive error present</th>
<th>Refractive error absent</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td></td>
<td>(n=34)</td>
<td>(n=86)</td>
<td></td>
</tr>
<tr>
<td>Both parents and a sibling wearing spectacles</td>
<td>(\chi^2=5.145)</td>
<td>(df=1)</td>
<td>(p=0.023)</td>
</tr>
<tr>
<td>Yes</td>
<td>2</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>No</td>
<td>32</td>
<td>27.1</td>
<td>86</td>
</tr>
<tr>
<td>Amalgamated sleeping hours</td>
<td>(\chi^2=7.962)</td>
<td>(df=1)</td>
<td>(p=0.005)</td>
</tr>
<tr>
<td>Less than 6 hours</td>
<td>12</td>
<td>52.2</td>
<td>11</td>
</tr>
<tr>
<td>More than 6 hours</td>
<td>22</td>
<td>22.7</td>
<td>75</td>
</tr>
<tr>
<td>Place of residence</td>
<td>(\chi^2=2.013)</td>
<td>(df=1)</td>
<td>(p=0.156)</td>
</tr>
<tr>
<td>Colombo district</td>
<td>27</td>
<td>37</td>
<td>46</td>
</tr>
<tr>
<td>Non Colombo district</td>
<td>7</td>
<td>14.9</td>
<td>40</td>
</tr>
</tbody>
</table>
Discussion

Our study aimed to assess the prevalence of refractive errors among grade 9 students in selected schools in Colombo along with the factors associated with refractive errors and the knowledge of the students regarding refractive errors. The visual acuity was measured using a Snellen E chart at 6 meters followed by pinhole examination. A Snellen's chart although less sensitive than the logMAR chart, was used as it took less time to examine the visual acuity for each study subject, while remaining almost just as specific as the logMAR chart. The pinhole was used as it is a simple yet, effective method in confirming visual impairments due to refractive errors. We found that, 22.5% of the student’s had a visual impairment with 10.8% being mild visual impairment and 2.5% having severe visual impairment. The proportion of students with visual impairment in our study was higher than in the global study carried out from 1990 to 2015 among 1 billion people from 98 different countries where 18% were found to have visual impairment.

Majority of these students (96.3%) were found to have a visual impairment due to a refractive error. The prevalence of refractive error in both eyes was 17.5%, in our study while a study carried out in Galle in 2015 [11] found this to be 3.9%. The findings in our study for the prevalence of refractive error in the right eye only 8.3 % and left eye only 2.5%, were much higher than the proportion found in the study in Galle which was 0.7% and 1.6% respectively. The difference in location and time between the two studies and the fact that the latter study utilized auto refraction to diagnose refractive error could be cited as the reason for the differences of results between the two studies. The fact that the prevalence of uncorrected refractive errors was 18.3% and only 61.8% of the population had a refractive error detected prior to our study signals out that refractive errors need more attention in the Sri Lankan context.

The level of knowledge of the students was determined by a scoring system mentioned previously. Despite having a high mean score for overall knowledge (50.22, CI=46.1-54.3, SD=+22.99), majority of the students (94.2%) were found to have a poor knowledge regarding refractive errors. A higher proportion of students in our study (72.5%) were found to have poor knowledge regarding refractive errors due to ineffective or non-existent methods of correction whereas in some studies this proportion was as low as 14% [13]. Among the study participants who had heard about refractive errors, 65.5% said that refractive errors is ‘not being able to see properly’, followed by, ‘not being able to see near by’ 44.2%, ‘not being able to see far’ by 46% and is ‘a problem in the curvature of the eyeball’ by 46%. This proportion was higher than the international study where 30.9% students knew ‘short-sightedness’, 12.9% knew ‘long-sightedness’ 7.9% knew ‘astigmatism’ and 18.4% didn’t know what it is [12].

We felt that our study participants had poor knowledge regarding risk factors for refractive errors. Only 23% knew that family history was an important risk factor while only half the study population (52.2%) were aware that increased screen time posed a significant risk of developing refractive errors. The proportion of students who acknowledged were much higher in a study carried out in Nairobi [13] where they were aware of these risk factors. A majority of children in our study (63.7%) knew where to seek help for refractive errors and this proportion was similar to the study carried out in Nairobi (63%) [13].

Regarding factors associated with refractive errors, we found a significant association between, the students who had both parents plus a sibling wearing spectacles and having a refractive error (p=0.023; df=1, p<0.05). Family history of refractive error was found to be significantly associated with refractive error in many studies where having a parent with myopia had a higher odds ratio of the child having to wear glasses (Odds ratio of 3.3) [12].

We also found a significant association between being a resident of Colombo district and refractive error (p=0.009; df=1, p<0.05). Although the school was situated in Colombo, there were students who traveled from Kalutara, Gampaha and other districts. So data was amalgamated to Colombo and non-Colombo district residents.

We also found a significant association between the number of hours spent on sleeping and refractive errors (p=0.005). However, other studies show that sleeping for lesser durations increase the risk of refractive error. A study carried out by Jee D et al in Korea [15] in 2016 found a significant association that myopia was decreased in those with more than nine hours of sleep (p=0.006) while a study carried out in Japan by Ayaki M, et al in 2016 [16] showed the shortest duration of sleep which was less than 6 hours, was significantly associated (p<0.01) with a myopic error. We could not find a significant association between the following factors and refractive errors: gender, time spent outdoors, time spent engaged in near work activities and knowledge on refractive errors.

Our study had many strengths. The questionnaire was pre tested and changed accordingly to suit the time taken to fill out the questionnaire and was available in all three national languages of the country to improve comprehensibility. Our self-administered questionnaire was issued before the clinical examination and therefore the
bias was reduced in answering the questions. The questionnaire had open spaces to allow additional answers to be given if the study subject didn’t find any of the given answers as satisfactory. Measurement of the refractive error was carried out according to a predetermined protocol with one examiner only involving himself with one particular task. This helped in reducing interviewer bias. Further, our study is among the limited studies that was carried out in the Colombo district among this age group of school going children. Compared to other studies, our study had a 100% response rate, with 100% participation in the examination.

However, the sample size was a major limiting factor in finding out significant association of factors with refractive errors. The present study was carried out in government school. Therefore, the findings cannot be generalized to the private sector schools and Pirivena schools in that area. Further, the findings of this study cannot be generalized to the whole country. Confounding cannot be excluded from the study findings related to factors associated with knowledge, as a multivariate analysis was not attempted in this study. Only the content validity of the questionnaire was assessed. Reliability of the questionnaire was not assessed and ideally, the scores for knowledge should be validated.

Conclusion
The prevalence of refractive errors was high among the study population. Therefore, measures should be taken to introduce preventive programmes in order to reduce the prevalence of refractive errors among our study population. The knowledge of refractive error was inadequate among the study population. In future, measures should be taken to improve the knowledge regarding refractive errors among our study population. Factors such as being a Colombo district resident, having both parents and a sibling with a refractive errors and sleeping more than six hours were significantly associated with having a refractive error. Therefore, these factors should be taken into consideration when planning programs to reduce the prevalence of refractive errors among our study population.

Author declaration
Competing interests
No competing interests. None of the authors have competing interests.

Ethical approval and consent
Ethical clearance for the study was obtained from the Ethics Review Committee of the Faculty of Medicine, Colombo. Consent was obtained from the parents and assent was obtained from the students.

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