PREVALENCE OF REFRACTIVE ERRORS AMONG BOY STUDENTS IN WESTERN IRAN; HIGH RATE OF ASTIGMATISM

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ABSTRACT

Purpose: to determine out how common refractive errors are among elementary school boys in Asadabad, Iran.

Methods: For this cross-sectional study, 1053 students were chosen using a multi-staged cluster sampling method. The examinations included UCVA, optimal VA, cycloplegic refraction, Cover test and ophthalmoscopy. Based on cycloplegic spherical equivalent refractive error hyperopia defined as +2.00 diopter or more, myopia as -0.50 diopter or worse and Astigmatism is defined as a cylinder that is equal to or worse than -0.50 diopter.

Results: of the 1053 participants, information was gathered of 1027 students. Participants were 9.52±1.63 years old on average. Uncorrected and optimum visual acuity of 20/40 or lower were found in 16.5 percent and 1.2 percent of the population, respectively. The prevalence of Hyperopia, Myopia and Astigmatism were 5.6%, 6.5% and 18.9% respectively.

Conclusion: This region had a high prevalence of refractive error, particularly astigmatism. Therefore, it is needed to attention paid to identifying and correcting these refractive errors by health system, especially for this age group.

Keywords: Prevalence, Hyperopia, Myopia, Astigmatism, Elementary School Children.

I. INTRODUCTION

Our visual system provides the majority of our information about the world around us. For this system to function properly, relevant elements in our field of vision must be imaged in focus on the retina. One of the most common “diseases” that can be treated is refractive errors (1). Refraction problems were the most common cause for visiting an ophthalmologist (21.1%), Glaucoma (19.3%), lens pathology/cataract (14.9%), and diseases affecting the posterior segment of the eye (14.9%) were the next most common (12.5 percent)(1).

If left untreated, refractive errors are the most common cause of visual issues in students, which can negatively impact their educational process as well as their physical and mental development. (2-8). Uncorrected refractive errors impact an estimated 108 million people around the world (9).

Uncorrected refractive error is the leading cause of visual impairment and the second most common cause of blindness in developing countries. Adults with uncorrected refractive error may experience visual impairment or blindness, which can have a significant influence their Well-being on both a financial and social level well-being, restricting their academic and job options (10).

Refractive errors are caused by an imbalance of the eye's axial length and optical power, that causes blurred retinal images by preventing light from focusing directly on the retina. (11). Hyperopia and myopia, often known as spherical errors, and astigmatism, which involves an optical asymmetry, are the three basic types of refractive errors. Astigmatism can be found
in both hyperopic and myopic eyes, despite being considered a separate category (12). Refractive errors Symptoms include blurry vision, headaches and asthenopia. (13, 14).

Uncorrected refractive errors can be corrected with an eye examination and prescription of some of the correction options available, such as suitable spectacles, contact lenses, or refractive surgery. (7, 10, 15, 16). Although refractive error is easily corrected, it is reported in some countries remains untreated for various reasons, including a limitation of high-quality refractive error services, social issues and economic problems, that it can cause more serious problems and even blindness (15, 17-22). Uncorrected refractive error has a significant and long-term impact, particularly in children, and it has become a frequent socioeconomic and public health issue. (15, 23). Also Amblyopia is a condition in which one or both eyes lose normal vision in the absence of any structural abnormalities or ocular disease, can develop if refractive error is not corrected early (15).

In recent decades, many studies have focused regarding the frequency of refractive error in the student population in the world and various percentages have been reported according to genetic and environmental conditions (20, 21, 24). According to recent studies, higher incidence and prevalence of hypermetropia have been reported in European and American societies and higher the occurrence and prevalence of myopia in East Asian societies, Japan, Taiwan, Hong Kong, Mainland China, Singapore and South Korea are particularly affected. (23, 25-29). Also by the end of the decade, Myopia is predicted to affect 2.5 billion individuals worldwide. (30). But in African and Middle Eastern societies, few studies have been reported.

Studies in different cities in Iran, including Aligudarz, Bojnoord, Dezful, Mashhad, Shahroud and Shiraz have reported the prevalence of myopia between 3.4 to 29.3%, the prevalence of hyperopia between 5.4 to 27.4%, and astigmatism between 9.8 and 20.7% (3, 13, 21, 31). But given the extensiveness and high population of Iran, as well as different levels of prevalence of refractive errors reported in different studies, further studies are required in this regard.

The present study has been designed, based on RESC protocol, to assess how refractive error among Asadabad city's male students prevails. (2). Asadabad city is located in Hamedan province in West Iran, with few extensive studies in this area. The findings of this study can add credible information to previous studies carried out in Iran and make a better understanding of refractive status in the West Iran.

**Subjects and Methods**

This research was done on a cross-sectional basis on male students in Hamadan Province, Asadabad city, aged 6-12 years. In this investigation, samples were chosen using a multi-stage cluster sampling method and 1053 students were determined to take part in the study.

**Inclusion and Exclusion Criteria**

Inclusion criteria contained age range of 6 to 12 years. All subjects must be elementary students and live in Asadabad region during the study.

Exclusion criteria included lack of consent of parents, pathological problems such as glaucoma, retinal problems, opacity in the visual pathway, any history of ocular surgery, contraindication of use of cycloplegic drop and lack of cooperation in the student.

All participants were examined individually according to school year through optometry by one optometrist, including uncorrected visual acuity (UCVA), optimal visual acuity (BCVA), Cycloplegic spherical equivalent refractive error, cover test to detect deviations and ophthalmoscopy to examine the anterior segment, opacity of lens and retina.

First, direct ophthalmoscopy ruled out diseases in the posterior and anterior segments of the eye in students. In the absence of disease, the uncorrected visual acuity (UCVA) was measured by projector chart (Topcon Company) at a distance of four meters. Then, the refractive error was determined by auto refractometer (Topcon Company, model: 8900) and confirmed by Heine retinoscope. Then, the refractive error of the patient was corrected and optimal visual acuity was identified by projector chart (Topcon Company) at a distance of four meters. Possible deviation was examined by cover test. In the end, cycloplegic refraction was determined 40 minutes after three times administration of cyclopentolate 1% drops within 5 minutes by auto refractometer (Topcon company, Model: 8900) and Heine retinoscope. All data were recorded in a special form designed for this study by one person.

In this study, Refractive Error Study in Children (RESC) protocol explanation and values were applied. Cycloplegic refraction spherical equivalent less than or equal to -0.50 D was considered as myopia ≥ 2.00 diopters as hypermetropia and the cylinder ≥0.75 as astigmatism. The axis of astigmatism was determined according to with-the-rule (WTR) with axis 180 ± 30, against-the-rule (ATR) with axis 30 ± 90, and oblique with axes 30-60 and 120-150.
To analyze data, SPSS software Version 18 was used. The prevalence rates and 95 percent confidence intervals (CI) have been provided, adjusted for cluster sampling. Chi-Square analysis was used to examine the relationships between hyperopia, myopia and astigmatism and age. The level of significance was determined at 5%.

Ethical Issues

Written informed consent was gathered from the students and their parents for steps of the examinations. The Research and Ethics Committee of the Asad abad branch of ministry of education approved the protocol of the study and the study adhered to the Declaration of Helsinki.

II. RESULTS

Out of 1053 students, 1027 were examined and their data were recorded (response rate: 97.53%). Of those examined, two of them were diagnosed with anterior segment problems and three of them suffered from retinal and posterior segment disorders. Mean age of participants was 9.52 ± 1.63 years (range: 6-12 years). Uncorrected visual acuity was 20/20 in 83.5% of cases. 98.7% of those with full optical correction had a visual acuity of 20/20. Also, none of the participants have 20/200-20/40 optimal visual acuity. Information of Uncorrected visual acuity and optimal visual acuity is shown in the Table 1.

Table 1. Distribution of uncorrected and optimal visual acuity

<table>
<thead>
<tr>
<th>Visual acuity</th>
<th>UCVA (%)</th>
<th>Optimal VA (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20/20</td>
<td>83.5</td>
<td>98.7</td>
</tr>
<tr>
<td>≥20/40-20/20&gt;</td>
<td>14</td>
<td>1.2</td>
</tr>
<tr>
<td>20/200-20/40&gt;</td>
<td>2.5</td>
<td>0</td>
</tr>
</tbody>
</table>

The mean Cycloplegic spherical equivalent refractive error was 0.40 ± 0.89 diopters (range: -4.75-4.87 D). The mean cycloplegic spherical refractive error was 0.59 ± 0.85 diopters and mean of astigmatism refractive error was -0.38 ± 0.44 diopters. Our findings represent a reduction in hyperopia and increase myopia prevalence with age (Pearson Chi-Square= 508.284, df= 350, p= 0.00) (Figure 1). Myopia was found to be prevalent in 6.5 percent of people of all ages. (95%CI: 5.43-7.57) in this population and prevalence of hypermetropia was 5.6% (95%CI: 4.61-6.59). The relationship of hypermetropia and myopia by age is shown in Table 2. Hypermetropia dramatically decreased with increasing age, as Chi-square test showed statistically significant decrease (Pearson Chi-Square= 37.311, df= 10, p= 0.00).

Table 2. The relation of hyperopia and myopia by age

<table>
<thead>
<tr>
<th>Age</th>
<th>Myopia (%)</th>
<th>Hyperopia (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>4.2</td>
<td>10.9</td>
</tr>
<tr>
<td>8</td>
<td>6.4</td>
<td>7.8</td>
</tr>
<tr>
<td>9</td>
<td>7.5</td>
<td>5.5</td>
</tr>
<tr>
<td>10</td>
<td>4.6</td>
<td>3.6</td>
</tr>
<tr>
<td>11</td>
<td>7.0</td>
<td>3.2</td>
</tr>
<tr>
<td>12</td>
<td>9.8</td>
<td>3.8</td>
</tr>
<tr>
<td>Total</td>
<td>6.5</td>
<td>5.6</td>
</tr>
</tbody>
</table>

The prevalence of mild myopia was 96.9% and moderate myopia was 3.17%. Also 92.9% of participants had mild hypermetropia and 7.14% had moderate hypermetropia.

The prevalence of astigmatism in this study was 18.9% (95%CI: 17.21-20.59). As figure 2 shows, the prevalence of astigmatism increased with age (Pearson Chi-Square= 20.57, df= 5, p= 0.001).
Of the students with astigmatism 53.6% had with the rule, 29.9% Against the rule and 16.4% oblique astigmatism (Table 3). There was no noticeable age difference in the types of astigmatism. (Pearson Chi-Square= 15.69, df= 10, p= 0.109).

Table 3. The relation of different types of Astigmatism

<table>
<thead>
<tr>
<th>Age</th>
<th>Astigmatism group (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WTR</td>
</tr>
<tr>
<td>7</td>
<td>60.5</td>
</tr>
<tr>
<td>8</td>
<td>57.3</td>
</tr>
<tr>
<td>9</td>
<td>51.6</td>
</tr>
<tr>
<td>10</td>
<td>50.0</td>
</tr>
<tr>
<td>11</td>
<td>52.4</td>
</tr>
<tr>
<td>12</td>
<td>52.4</td>
</tr>
<tr>
<td>Total</td>
<td>53.6</td>
</tr>
</tbody>
</table>

III. DISCUSSION

In this investigation, we assessed the prevalence of refractive error in boy students in Asad Abad. This has been done for the first time in this region. The contributions rate in this study was noticeable (97.5%), which is a strength of our study. The prevalence of uncorrected visual acuity below 20/40 optical was 16.5%, which is close to Denmark Studies, Oman and Egypt, but is much higher compared to studies in Iranian cities Dezful, Shiraz and Bojnoord and other studies like England.
The prevalence of hypermetropia in this study was 5.6%. The results of this study is close to various studies conducted in Germany, Pakistan, Denmark, Shiraz and Bojnoord, but was less compared to studies in Dezful and Oman; unlike most studies in Iran, hypermetropia rate was less than myopia that can be the result of frequent use of electronic devices (3, 35, 36). Like other studies, hypermetropia also decreased with increasing age (3, 31, 32). Because hyperopia has been found to be one of the most important risk factors for amblyopia, this form of refractive error and its correction require special attention (37-39).

Myopia is becoming more prevalent over the world, and in some areas, it has become an epidemic (40). The prevalence of myopia in this study was 6.5%, which is near to majority studies in the world and Iran. Myopia is on the rise throughout Asia, regardless of the fact that its prevalence differs between country. (23). Studies in South East Asia, such as Hong Kong, Japan and China, reported higher levels of myopia (40-42). The prevalence of myopia increased from 4.2% at 7 years to 9.8% at 12 years in this study; several studies have also observed such increase (29, 43). For example, in the study in Bojnoord, myopia raised from 0% at 7 years of age to 9.8% at age 15 years old (3). The increased prevalence of myopia with age may be due to enlargement the axial length of the eye and increased near work by eye (40).

The prevalence of astigmatism had different values in different studies but in most studies it is less than 25% in this group age (13). Different measurement procedures and study populations could be to blame for these differences. The prevalence of astigmatism in this study was 18.9%, which is close to the studies in Dezful, but higher than other Iranian studies such as Shiraz, and Bojnoord (3, 31). The prevalence of astigmatism in Southeast Asian population is higher than other studies in East Asia (42). In some studies, it has been reported that astigmatism rate increases with age (3). Also in some study astigmatism has decreased by age increasing (44). But in this study, we did not observe such a relationship and there was no relationship between age and astigmatism. Most prevalent types of astigmatism in this study was with-the-rule astigmatism with a prevalence of 53.6%, which is like many other studies (3, 31). In this study WTR astigmatism decrease from 60.5% to 52.4% and ATR astigmatism increase from 21.6% to 34.9% in 5 years. According to a review of the literature, there is a strong correlation between age and refractive astigmatism orientation, suggesting that as people get older, the astigmatism shifts from WTR to ATR. (44, 45). Unlike some other studies, we observed no relationship between age and type of astigmatism in this study.

Impaired visual acuity in the current study was more than other studies conducted in Iran, which needs more attention to be paid to screening programs in Asadabad city to be treated at the proper time. The prevalence of myopia in Asadabad was a bit more than other Iranian cities like Dezful, Shiraz. Bojnoord and prevalence of hypermetropia was less than other Iranian cities that can be due to genetic issues and due to change in the visual activities of children and their frequent use of electronic devices. The rate of astigmatism in this study was more than most studies, but close to a study conducted in Dezful, Iran, which requires more attention to be paid to this type of refractive errors. In this region, specific population screening plans should be implemented, as well as training services for ophthalmologists and optometrists. Future research could indicate if the variation in refractive error frequency is attributable to selection characteristic, genetic causes, or environmental variables.

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Conflicts of Interest

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