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Original Research Article

A Study of Refractive Impacting Academic Performance and Associated Risk Factors Among School Children in Karimnagar

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Abstract:

Background: Numerous children experiencing poor vision due to refractive errors often go undiagnosed, leading to academic challenges. Refractive errors represent a preventable cause of visual impairment, and since children may not express concerns about their vision, early detection, and treatment are imperative to avert potential future blindness. The primary aim of this study was to determine the prevalence of refractive errors in school children and explore associated factors.

Methods: This cross-sectional study was a school-based study conducted by the Department of SPM, Prathima Institute of Medical Sciences, Naganoor, Karimnagar. School students from 6th to 9th standard in selected schools of Karimnagar District Visual acuity was assessed within the school premises, either under the shade of a tree or in well-lit classrooms, utilizing the Snellen E chart. Vision screening was done with the help of an experienced optometrist under the supervision of an investigator.

Results: A total of n=220 school children were examined. Within the cohort under study, 24.09% (N=53) of children were found to have refractive errors. In the present investigation, the prevalence of refractive error at the ages of 11, 12, 13, and 14 years was recorded as 15.09%, 18.87%, 28.30%, and 37.73%, respectively. (table 3). However, only 18.86% (N=10) of those identified with refractive errors had been previously diagnosed and were utilizing corrective spectacles, while the majority (81.13%) remained unaware of their vision issues. Additionally, it was observed that among those who were using corrective spectacles (N=10), a significant majority, constituting 80% (n=8), adhered to regular usage.

Conclusion: Numerous ocular diseases originate in childhood, and the resulting morbidity may go unnoticed, negatively impacting a child's academic performance and potentially leading to severe ocular disability later in life. This study emphasizes the elevated prevalence of undetected refractive errors in school children and underscores the significance of early detection and treatment through corrective spectacles to impede the further progression of refractive errors.

Keywords: Refractive Error, School Children, Myopia, Hyperopia, Spectacles.

Introduction

Vision is important for a child's learning and communication development. [1] The uncorrected refractive errors have emerged as a significant concern for healthcare policymakers. [2] Conducting effective vision screening in school children is crucial for the timely identification of correctable refractive errors and, addressing potential causes of diminished vision. Many ocular diseases originating in childhood can lead to unnoticed morbidity, negatively impacting a child's academic performance, and potentially resulting in severe visual impairments later in life. This proactive approach not only minimizes the risk of long-term visual disabilities but also ensures the overall well-being of the child. In developing countries, where 25% of the population comprises school-age children, the significance of vision screening is even more pronounced. According to 2012 statistics from the Ministry of Statistics and Programme Implementation, every sixth child globally resides in India. Refractive errors, arising when the optical system of the eye fails to adjust and bring parallel rays of light to focus on the fovea, pose a significant public health challenge among school children in India, leading to reduced vision. Cataracts rank as the leading cause of blindness in the country, closely followed by refractive errors. In the ophthalmology outpatient department, refractive errors emerge as the most common condition requiring attention. Poor vision not only hampers a child's performance

in school or at the workplace but also has lasting implications for their future. Globally, an estimated 123.7 million individuals suffer from moderate to severe distance vision impairment or blindness due to uncorrected refractive errors. [3] Refractive errors constitute 43% of global visual impairments, surpassing un-operated cataracts (33%) and glaucoma (2%) in prevalence. [4] The 'Vision 2020: the Right to Sight' program, initiated by the World Health Organization (WHO) in 1999, aimed to eliminate avoidable blindness worldwide by the year 2020. [5, 6] A key aspect of this initiative was prioritizing the prevention of blindness in children, particularly in developing countries, which account for three-fourths of the total 1.4 million blind children globally. [7] Global estimates indicate that 153 million individuals aged 5 years and above experience visual impairment primarily due to uncorrected refractive errors, with 8 million among them being blind. In the 5-15 age group, 12.8 million individuals face visual impairment from uncorrected or inadequately corrected refractive errors, representing a global prevalence of 0.96%. The prevalence of blindness in school children is estimated at 0.8 per 1000 children in the 0-15 age group. [8] Therefore, this current study was planned and conducted to determine the prevalence of refractive errors among school children in a chosen district in Karimnagar.

Material and Methods

This cross-sectional study was a school-based study conducted by the Department of SPM, Prathima Institute of Medical Sciences, Naganoor, Karimnagar. Institutional Ethical approval was obtained for the study after following the due protocol for ethical approval for human research. Permission was obtained from the principals of the respective schools for the conduct of the study.

Inclusion criteria

1. School students from 6th to 9th standard in selected schools of Karimnagar District.
2. Males and females
3. Schools who permitted the conduction of the survey.
4. Consent obtained by the school from the parents of the pupil.

Exclusion criteria

1. Absentees on the day of collection of data
2. Not willing to examination
3. Not as per the inclusion criteria

Sample size calculation: The sample size is calculated based on an estimated mean prevalence of 10%. Considering a confidence interval of 95%, absolute precision of 4%. $N = Z1\text{-}\alpha^2pq/d^2$ Where, Z1-α= standard normal deviant at 95% confidence level i.e. 1.96, p= prevalence= 10%, q=100-p=90%, d= margin of error of 4% (16) =216 we included 220 subjects in the study.

The first stage was a simple random sampling method followed by a stratified sampling selection of schools and all the students from sixth to ninth standard in the selected schools were included in the study. A Pretested semistructured questionnaire was developed and validated. It consists of socio-demographic details of the individual and the family, history related to refractive error, parental and sibling history of refractive error, and time spent near work and outdoor activities. Visual acuity was assessed within the school premises, either under the shade of a tree or in well-lit classrooms, utilizing the Snellen E chart. Vision screening was done with the help of an experienced optometrist under the supervision of an investigator.

Subnormal vision was defined as uncorrected visual acuity below 6/9 in the worst eye. Refractive error was identified in the following scenarios: a) when subnormal vision was present with a non-plano power on retinoscopy, without anterior or posterior segment abnormalities; b) if visual acuity improved with pinhole testing; and c) in subjects exhibiting latent hyperopia, indicated by visual acuity of 6/6 with a +1.75 D lens. Only children with visual acuity less than 6/6 in at least one eye underwent assessment through retinoscopy. An optometrist conducted objective refraction with retinoscopy, performed half an hour after applying 1% cyclopentolate eye drops. Myopia was defined as a refractive error of ≤-0.5 D, hyperopia as a refractive error of ≥+1.5 D, and astigmatism as a refractive error exceeding 0.5 D. Data collection was carried out by skilled optometrists and ophthalmologists familiar with the study measurements and interview techniques. To ensure data quality, collectors underwent training, and 5% of the students were subjected to supervision and cross-checking by an ophthalmologist.

Statistical analysis: All the available data was refined and entered in an MS Excel spreadsheet and the gathered data were entered into a computerized database using SPSS version 21.0 (IBM Corp., Armonk, NY, USA). The continuous variables were represented as mean, standard deviation, and percentages, and categorical variables were represented as p values, and values of (<0.05) were considered significant.

Results

A total of 220 students were examined during the duration of the study. Out these 124(56.36%) were male students and 96(43.63%) were females students. The most frequent age group is 12 years old, with 32.72% of participants. The least frequent age group is 14 years old, with 10.90% of participants. Overall, the participants are evenly distributed across the age groups, with no significant

differences (Table 1). The majority of participants were Hindus n=194(88.18%) followed by Muslims n=18(8.18%) and Christian n=8(3.36%) depicted in figure 1.

Table 1: Age-wise distribution of the school participants checked for refractive errors

Age in years	Frequency	Percentage
11	64	29.09
12	70	32.72
13	62	28.18
14	24	10.90
Total	220	100.0

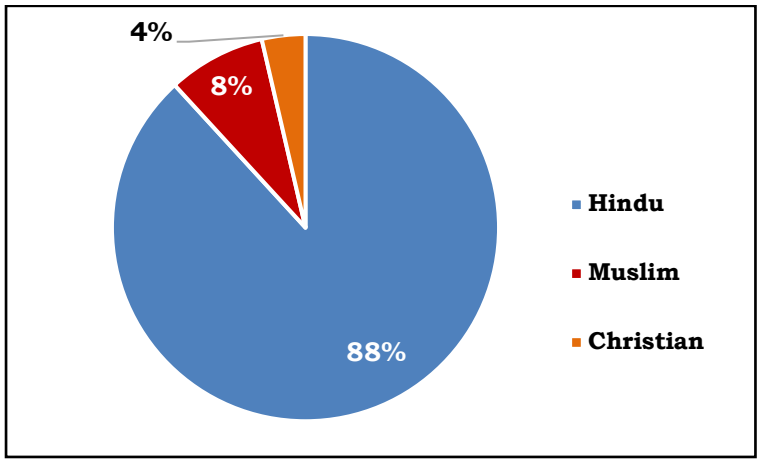

Figure 1: Religion distribution of participants included in the study

Table 2 provides insights into two key aspects of the participants: their family type and socioeconomic status (SES). Family Type: Nuclear Family: Dominant at 70%, indicating most participants come from traditional family structures with two parents and children. Joint Family: Represents 25%, showing a significant portion live with extended family members like grandparents or aunts/uncles. Three Generation: This category is much smaller at 5%, suggesting multigenerational households are less common within the sample. Family structure might be relevant to understanding potential risk factors for refractive errors. For example, studies suggest living in a crowded environment (common in large joint families) could influence near-sightedness development.

Table 2: distribution of the school participants checked for refractive errors

Variable	Frequency	Percentage
Type of family		
Nuclear	154	70.00
Joint Family	55	25.00
Three generation	11	05.00
Total	220	100.0
Socioeconomic status		
Class I	15	6.81
Class II	40	18.18
Class III	55	25.0
Class IV	79	35.9
Class V	31	14.09
Total	220	100.0

Socioeconomic Status (SES):

Class V: The lowest social class has the smallest share at 14.09%. Class IV: Represents the largest group at 35.9%, indicating most participants belong to the middle class. Class III & II: Combined, these mid-range classes comprise 43.18% of the sample. Class I: The highest social class has the smallest representation at 6.81%. SES can be linked to access to healthcare, nutrition, and educational opportunities, which might influence vision health. Higher SES groups might have better access to preventive eye care and healthier living conditions, potentially impacting the prevalence of refractive errors.

Table 3: Incidence of refractive errors found in the cohort

Age Group	Frequency	Percentage
11 years	8	15.09
12 years	10	18.87
13 years	15	28.3
14 years	20	37.73
Total	53	100.0

Within the cohort under study, 24.09% (N=53) of children were found to have refractive errors. In the present investigation, the prevalence of refractive error at the ages of 11, 12, 13, and 14 years was recorded as 15.09%, 18.87%, 28.30%, and 37.73%, respectively. (table 3). However, only 18.86% (N=10) of those identified with refractive errors had been previously diagnosed and were utilizing corrective spectacles, while the majority (81.13%) remained unaware of their vision issues. Additionally, it was observed that among those who were using corrective spectacles (N=10), a significant majority, constituting 80% (n=8), adhered to regular usage. The primary reasons for irregular spectacle usage, as noted among participants, were issues related to cleanliness. Furthermore, within the participant pool, 15% (N=33) had a parental history of refractive errors. This history was distributed among fathers (8.6%), mothers (4.09%), and both parents (2.27%).

Table 4: Most commonly reported symptoms of children with refractive errors

Symptoms of RE	Frequency (53)	Percentage
Double vision	9	16.98
Blurred vision	17	32.07
pain	6	11.32
Irritation	4	7.55
Redness	3	5.66
Watery eyes	6	11.32
Headache	8	15.09
Total	53	100

Table 4 shows the most common symptoms reported by children with refractive errors (RE). Blurred vision is the most frequent symptom, affecting over 32% of children with RE. This can make it difficult to see clearly at any distance. Headaches are also common, affecting over 15% of children with RE. This may be due to eye strain from trying to focus with blurry vision. Double vision, seeing two images of the same object, is reported by nearly 17% of children with RE. This can be a disorienting and frustrating symptom. Other symptoms like watery eyes, pain, irritation, and redness are less common but still occur in some children with RE. It is important to note that this table only shows the most common symptoms reported by children with RE. Not all children will experience all of these symptoms, some children may experience other symptoms not listed here and some may have more than one symptom mentioned in the above table. The severity of symptoms varied from child to child.

Table 5: Risk factors associated with the presence of Refractive Errors (RE) in school children

Risk Factor	RE (Yes) n=53	RE (NO) n=167	P values
Time spent on gadgets	45.28%	17.96%	0.0001
Time spent watching TV	30.19%	11.38%	0.021
Time spent in near work	13.21%	14.97%	0.224
Reading Posture	7.55%	5.99%	0.541
High BMI	15.09%	13.17%	0.614
Lower outdoor sports	11.32%	56.29%	0.002
Parental history of RE	15.09%	7.18%	0.013
Sibling history of RE	11.32%	7.78%	0.162

Table 5 identifies potential risk factors for developing RE in school children by comparing the percentage of participants with and without RE who engage in specific behaviors or have certain characteristics.

Significant Risk Factors:

Time spent in gadgets: Children with RE spend significantly more time on electronic devices (phones) compared to those without. This highlights the potential link between excessive screen time and vision problems.

Lower outdoor sports: Children with RE participate significantly less in outdoor activities compared to those without. Sunlight exposure is thought to be protective against myopia (near-sightedness), the most common RE.

Parental history of RE: Children with a parent with RE are more likely to develop it themselves, suggesting a possible genetic component.

Factors with Weak or No Association:

Time spent watching TV: While there's a difference in TV viewing between groups, it's not statistically significant, suggesting its impact on RE might be weaker than gadgets.

Time spent near work: No significant difference exists between RE groups, indicating other near work (reading, homework) might not be as influential as screen time.

Reading posture: Similar percentages in both groups suggest proper reading posture may not be a major risk factor.

High BMI: No significant difference suggests obesity might not be directly linked to RE development. Sibling history of RE: While slightly higher than the general population, the sibling effect isn't statistically significant compared to parental history.

Degree of refractive error: Retinoscopy of children was done by taking the students to the medical college and Hospital and refractive errors indicated 30/53 had refractive errors in the right eye and 23/53 had refractive errors in the left eye. For the right eye, 14/30(46.67%) had low myopia in the right eye. High myopia was found in 4/30(13.33%) right eye. Low hyperopia was found in 10/30(33.33%) children and 2/30 (6.67%) had high hyperopia in the right eye. On examination of the left eye, among total cases, 23/53 RE were in the left eye. 12/23(53.17%) had low myopia, and 3/23 (13.04%) had high myopia. 5/23(21.73%) had low hyperopia of left eye and 3/23(13.04%) had moderate and high hyperopia in left eye.

Discussion

The present investigation constitutes a cross-sectional study conducted within a school setting, aiming to determine the prevalence of refractive errors and analyze the distribution of associated factors among school children. This study holds significance due to the considerable number of uncorrected refractive errors among school children, representing a substantial yet easily addressable issue. The identification and treatment of refractive errors can be efficiently carried out at the primary healthcare level. A total of 220 students participated in the study, out of which 124(56.36%) were male students and 96(43.63%) were female students. The age range of the participants ranged from 11 to 14 years. Predominantly, the study participants were of Hindu faith Hindus n=194(88.18%) followed by Muslims n=18(8.18%) and Christians n=8(3.36%). while the majority belonged to nuclear families (70%), and 5% were part of three-generation families. In the examined group, 24.09% (N=53) of children were identified as having refractive errors. Nevertheless, only 18.86% (N=10) of those with diagnosed refractive errors were actively using corrective spectacles, leaving the majority (81.13%) unaware of their vision issues. The prevalence of refractive error varies across different studies, with rates reported as follows: 5.6% in the study by Kamath et al. [9] 6.43% in the research conducted by Niroula et al. [10] 7.57% in R Naik et al's [10] study, 11.9% in the cross-sectional study by Shrestha et al. [11] The most common refractive error in the study population was myopia 19.7% and only 0.7% of hypermetropia was observed. In this study, we found the common refractive error was myopia in 33/53(62.26%) followed by hyperopia in 20/53(37.73%). Lin LL et al. [12] on the prevalence among school children, revealing that the rate of myopia increased from 20% at 7 years to 61% at 12 years and further to 81% at 15 years. Mutti et al. [13] found that among eighth-grade children, the prevalence of myopia was 18.3%, while hyperopia stood at 7.7%. In Niroula et al's study, [9] the prevalence of myopia was 4.05%, hyperopia at 1.24%, and astigmatism at 1.14%. The cross-sectional study by Chu et al. [14] in Taiwanese school children reported a myopia prevalence of 33%, which was higher than the prevalence observed in the current study. [13] A meta-analysis conducted by Castagno et al. [15] indicated that the prevalence of hyperopia was 2-3% between ages 9 and 14. In studies employing the 5-15 age group and a cut-off of ≥ +2.00 D (RESC), hyperopia prevalence ranged from 2.1% to 19.3%. In the present investigation, the prevalence of refractive error at the ages of 11, 12, 13, and 14 years was recorded as 15.09%, 18.87%, 28.30%, and 37.73%, respectively.

This finding was consistent with the study by Sun Y et al. [16] in which an increase in age was associated with an increased risk of having myopia. Also, in Saw et al. [17] study on near work and early onset myopia in Singapore observed that the prevalence rate of myopia increased with age. In a study by Sonam Sethi et al. [18] refractive error increased with age with only 1.4% prevalence at 5 years of age, increasing to 13.8% at 10 years, 18.4% at 11 years, 23.5% at 12 years, 17.7% at 13 years and again decreased to 5.1% at 14 yrs. In this study, we found out of 53 cases of refractive errors 35(66.03%) were in males and 18(33.96%) were in females the p values were (0.012) and significant. Singh et al, [19] and Lin LL et al. [12], observed that girls exhibited a significantly higher odds ratio compared to boys. However, this gender difference

contrasts with the findings of a school-based survey by Chandramohan et al. [20] where refractive error prevalence was higher among male children (21.5%) than female children (17%). In this study, it was noted that with an improvement in socio-economic class, there is a corresponding increase in the prevalence rate of refractive error. Class V participants exhibited a higher prevalence, accounting for 40 out of 53 cases (75.47%). A statistically significant association was established between the prevalence of refractive error and socio-economic class, with a p-value of 0.001 (S). Factors like heightened involvement in near-work activities, extensive TV watching, video game playing, and diminished outdoor activities may contribute to a higher susceptibility to refractive error among students from elevated socio-economic classes.

In this current study, a notable association was identified between refractive error in children and a parental history of refractive error, as evidenced by a p-value of 0.013. When either one or both parents had a refractive error, the prevalence was higher in their children. A similar association was observed in a study conducted by Prema, where a significant relationship was present with a p-value of <0.001. [21] In China, Yi Sun et al. [16] noted a higher prevalence in children with a parental history of myopia, with a p-value of 0.002. Mutti et al's [13] study also reported similar findings. Saw et al. in their research, identified a statistically significant relation between refractive error and parental myopia, with a p-value of <0.001. The SMS study indicated a higher risk in children with one or two myopic parents. [22] In this study we found Excessive gadget use is the strongest risk factor for RE in school children. Lack of outdoor sports is another significant risk factor. Parental history of RE increases the risk, potentially due to genetics. Other factors like TV viewing, near work, reading posture, BMI, and sibling history show weak or no statistically significant associations with RE.

Conclusion

Numerous ocular diseases originate in childhood, and the resulting morbidity may go unnoticed, negatively impacting a child's academic performance and potentially leading to severe ocular disability later in life. This study emphasizes the elevated prevalence of undetected refractive errors in school children and underscores the significance of early detection and treatment through corrective spectacles to impede the further progression of refractive errors. To minimize the risk, it is advisable to limit the use of gadgets, computers, and other near-work activities. Parents are encouraged to ensure their children engage in a substantial number of outdoor activities. The timely access to high-quality eye care significantly influences the impact of eye conditions and their progression.

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