

Original Research Article

Prevalence of refractive error among urban and rural middle school children in Tindivanam Taluk, Tamil Nadu – a cross-sectional study

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ABSTRACT

Background: Refractive errors are one of the major public health issues of school children and remain the important causes of preventable visual impairment. When left unnoticed, these vision problems can have a negative effect on a child's learning, social relationships and general wellbeing. Objectives were to find the prevalence of refractive error among urban and rural middle school children.

Methods: This cross-sectional study involved 456 school-going children aged 11–13 years who were sampled in a selected group of government schools. The approach used in the selection of participants was cluster sampling. Data were gathered with a pretested semi-structured questionnaire on socio-demographic information, ocular history and eye care practices. Visual acuity evaluation was done using the application World Health Organization (WHO) eyes, followed by basic ocular examination. Data was described with descriptive and inferential statistics.

Results: The prevalence rate of refractive error was 13.8% with the most common type of refractive error being myopia (10.8%), astigmatism (2.2%) and hypermetropia (0.9%). Ocular complaints were reported by 32.7% of the students, and they were mostly blurring of vision (13.8%). Most children had normal unaided visual acuity (86.2%). Refractive errors were significantly linked with ocular complaints, spectacle use, past ocular morbidity, previous eye treatment.

Conclusions: Refractive errors particularly myopia are common in school aged children, therefore the need for regular school-based vision screening, early detection and correction is essential in order to prevent long term visual problems.

Keywords: School children, Refractive error, Prevalence

INTRODUCTION

Globally, refractive errors are an important public health problem especially for school-age children. These errors, such as myopia, hyperopia and also astigmatism, can cause significant visual impairment if they are not corrected, which has a negative effect on educational outcomes and quality of life. Worldwide, the prevalence of refractive errors is a cause for concern, especially in the urban environment. A study carried out in Southern China highlighted the high prevalence of myopia in children, caused by environmental factors and lifestyle choices, such as increased near work, and decreased outdoor activity.¹ Similar trends have been noted in South Africa where studies have shown that the urban population have

significant levels of refractive errors than rural counterparts.² Comparative studies have suggested that children who live in cities have an increased risk of developing myopia and a meta-analysis has shown that in urban areas the prevalence of myopia can be around 11%, compared to 4.5% in rural areas.³

In India, according to recent literature, there is an urban-rural divide. A meta-analysis suggested that rural school children of India have lower myopia rates (about 3.5%) than children in urban areas (10.8%).³ Further, a study in Maharashtra reported the prevalence rates of 3.16% for myopia in urban settings as compared to only 1.45% in rural settings highlighting the public health implication of these findings.⁴ Additionally, studies done in Tamil Nadu

supported the higher prevalence of refractive errors in urban children as compared to the rural ones, highlighting the need for targeted eye health programs.⁵

Uncorrected refractive errors are a major hindrance to the development of children, not only in terms of their academic learning but also their ability to interact socially. Children who have refractive errors often experience difficulties with reading and writing and also with attention in the classroom. These problems occur because vision problems that are uncorrected may cause problems with seeing clearly which in turn affect learning capabilities. Uncorrected refractive errors have been directly linked to lower educational performance, as well as low confidence, social isolation and stigma with their peers.⁶⁻⁸

The larger context in epidemiology demonstrates that increasing rates of myopia are a continual worldwide issue as studies confirm a correlation between environmental factors like less time spent outdoors and increasing myopia rates among children.^{9,10} Findings from different places such as Vietnam and China support the hypothesis that urbanization and changes in lifestyle play a significant role in the visual impairment of school children.^{11,12} Moreover, not able to access the eye care services make the situation even more complex with many children in rural areas not having adequate screening and correction for refractive errors.^{11,13}

The purpose of the study is to come up with a detailed evaluation of refractive errors among the middle school children in Tindivanam Taluk to continue the role of identification and early correction strategies for specific regional demographics. A clear understanding of the differences of the refractive error prevalence in urban and

rural areas of Tamil Nadu can help inform and strengthen public health strategies aimed at improving eye health among school aged children.

METHODS

The current research used the cross-sectional design on the urban and rural school children of Tindivanam Taluk, Tamil Nadu, India. The study was conducted in selected government schools from February to July 2025. The study population was the school children from 11 and 13 years in the selected urban and rural schools. Children who could understand and respond to instructions in Tamil or English; whose parents or guardians gave written informed consent, as well as child assent, were included in the study. Children who had a history of ocular surgery or major eye treatment, systemic illnesses that affect vision, or those that could not undergo visual acuity testing because of cognitive or physical disabilities were not considered in the study.

The sample size was calculated keeping in view a similar study conducted by Kumar et al considering the expected proportion of refractive errors as 11% in urban areas and 4% in rural areas.¹⁴ Using 95% confidence level and with the power of 80%, the estimated total sample size was 456, out of which 228 participants came from urban areas and 228 from rural areas. Participants are selected by cluster sampling technique. A total of eight clusters were selected from which four urban and four rural government schools were selected. From each school selected 57 students were recruited, equal number of students from 6th, 7th and 8th standards with the help of simple random sampling, with permission from the District Educational Officer (Figure 1).

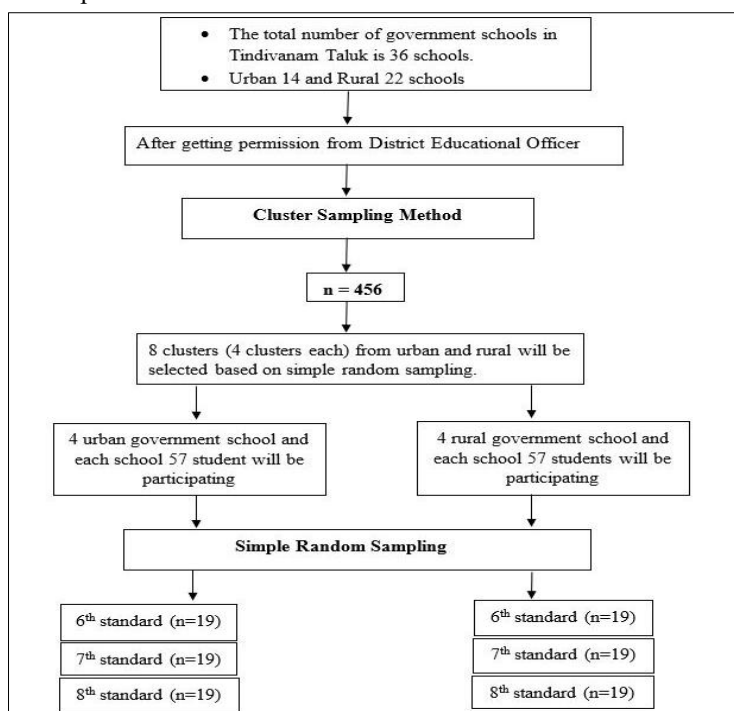


Figure 1: Sample selection flowchart.

Data were collected using predesigned and pretested semi-structured questionnaire that was developed and validated by technical experts. The tool had four sections including demographic characteristics, digital screen usage as it related to visual impairment, ocular history, and vision screening. Visual acuity screening was performed with the World Health Organization (WHO) eyes application on an iPad supported by torchlight examination, magnifying loupe, trial frame, occluder, pinhole and Ishihara chart for color vision screening. Refractive errors were categorized according to the criteria of the WHO for distance and near vision impairment.

Prior permission was taken from education department and school authorities prior to data collection. Participant information sheets, consent forms and assent forms were handed to students two days before data collection. The procedure of the study was clearly explained to the participants and written consent and assent were obtained. Data collection was conducted through face-to-face administration of the questionnaires and subsequent vision screening using the WHO eyes application with each of these assessments taking about 15 minutes per child. The study was carried out after the approval of the Institutional Ethics Committee (ECR/847/Inst/PY/2016/RR-20). Confidentiality and anonymity of the participants was assured throughout the study and participation was fully voluntary.

Collected data were entered into data sheets, coded and analyzed using the help of IBM statistical package for the social sciences (SPSS) statistics version 28. Analysis done using descriptive and inferential statistics.

RESULTS

The distribution of age groups among 456 students was nearly equal with 11-year-old students 33.8%, 12 years old students 32.9% and 13-years old students 33.3%. Boys were 52.0% and girls were 48.0% of the sample. The number of urban and rural students was equal (50.0%), respectively. Students from 6th, 7th and 8th standards were distributed equally (33.3% of each). More than half of the students reported no regular physical activity (55.9%) and they did not play any games (55.9%). Television viewing of 1-4 hours a day was reported by 71.2% of students and use of mobile phones of 1-2 hours was observed in 38.6%; interestingly 28.7% said that they don't use mobile phones (Table 1).

Current ocular complaints were reported by 32.7% of the students and 67.3% of them had no complaints. Blurring of vision was the most frequent symptom (13.8%) followed by headache (9.2%) and eye irritation (7.7%). The majority of the students had normal vision without spectacles (86.2%); only 5.9% wore spectacles day-to-day, and 7.9% did not wear spectacles however they had a prescription. A family history of eye problems was not common at 5.5% with 94.5% reporting none. Regarding the eye care

practices, 48.5% had an eye check-up in the past one year while 25.0% had never had an eye examination (Table 2).

Table 1: Socio-demographic details of the students (n=456).

Category	Frequency (N)	Percentage (%)
Age (years)		
11	154	33.8
12	150	32.9
13	152	33.3
Gender		
Boys	237	52.0
Girls	219	48.0
Region		
Urban	228	50.0
Rural	228	50.0
Standard		
6th	152	33.3
7th	152	33.3
8th	152	33.3
Physical activity		
Yes	201	44.1
No	255	55.9
Game type		
Outdoor	121	26.5
Indoor	80	17.5
None	255	55.9
Watching TV (hours)		
1-2	162	35.5
2-4	163	35.7
<1	59	12.9
>4	43	9.4
Do not watch	29	6.4
Mobile usage (hours)		
1-2	176	38.6
3-4	46	10.1
<1	103	22.6
Do not use	131	28.7

Refractive error was found in 13.8% of the students whereas 86.2% had no refractive error. The prevalence was found to be higher among the urban students (47 students) as compared to the rural students (16 students) stating that there is higher burden of refractive error in the urban population (Table 3).

Refractive error in children was detected in 13.8% of children while majority (86.2%) had no refractive error. Myopia was the common cause and occurred in 10.8% of the children followed by astigmatism in 2.2% and hypermetropia in 0.9%. These results show that the major refractive error in the study population is myopia (Figure 2).

Table 2: Ocular history and complaints of the students (n=456).

Category	N	%
Ocular complaints at present		
Yes	149	32.7
No	307	67.3
Type of complaint		
Blurring of vision	63	13.8
Headache	42	9.2
Irritation of eyes	35	7.7
Bitot's spot	4	0.9
Stye	5	1.1
No complaint	307	67.3
Spectacle usage		
Wear spectacles every day	27	5.9
Do not wear spectacles (though prescribed)	36	7.9
Normal vision (no spectacles)	393	86.2
Family history of eye problems		
Father	5	1.1
Mother	6	1.3
Sibling	14	3.1
None	431	94.5
Last eye check-up (months)		
Within 6	68	14.9
7-12	153	33.6
>12	121	26.5
Never	114	25.0

Eye examination was normal (predominantly) among the students. Eyelid examination was found normal in 96.0% while abnormality was detected in 4.0%. Conjunctival examination abnormalities in 7.9%, 92.1% - 92.1% - normal. All students had normal results for cornea, iris, pupil and lens (100.0%) which indicates that significant pathology is not present in these structures (Table 4).

Visual acuity without correction (6/6) was noted in most of the children in the right and left eyes - 86.4% and 86.2% respectively. Mild reduction in vision (6/9) was observed in 3.7% of eye (right eye) and 3.1% of left eye whereas 6/12 vision was observed in 4.4% and 4.8%. Visual acuity of 6/18 was equally present in both eyes (3.3%). More serious reduction was rare with 6/24 vision in 1.5% of right eyes and 2.2% of left eyes and 6/36 vision in less than 1% of children (right eye: 0.7%, left eye: 0.4%). Overall, the results show that the vast majority of children had normal unaided vision (Table 5).

There was a significant association between ocular complaints and their types with refractive errors ($p < 0.001$ and $p = 0.002$). The use of spectacles was also related closely with refractive errors ($p < 0.001$). Past history of ocular morbidity ($\chi^2 = 12.48$, $p = 0.006$) and past treatment or surgery on the eye ($\chi^2 = 10.37$, $p = 0.012$) were also significantly associated with refractive errors. However, family history of spectacle use did not show significant association with refractive errors ($\chi^2 = 3.92$, $p = 0.141$) (Table 5).

Table 3: Prevalence of refractive error (n=456).

Response	Urban	Rural	Frequency	Percentage
Yes	47	16	63	13.8
No	209	240	393	86.2
Total	256	256	456	100.0

Table 4: Eye examination of the school children (n=456).

Eye examination	Frequency, normal	Percentage, normal	Frequency, abnormal	Percentage, abnormal
Eyelid	438	96.0	18	4.0
Conjunctiva	420	92.1	36	7.9
Cornea	456	100.0	-	-
Iris	456	100.0	-	-
Pupil	456	100.0	-	-
Lens	456	100.0	-	-

Table 5: WHO eyes app unaided right and left eyes visual acuity of the school children.

Right eye vision	Frequency	Percentage	Left eye vision	Frequency	Percentage
6/6	394	86.4	6/6	393	86.2
6/9	17	3.7	6/9	14	3.1
6/12	20	4.4	6/12	22	4.8
6/18	15	3.3	6/18	15	3.3
6/24	7	1.5	6/24	10	2.2
6/36	3	0.7	6/36	2	0.4
Total	456	100	Total	456	100

Table 6: Association between ocular complaints with refractive errors.

Category	Chi-square	P value	Significant/not significant
Presence of ocular complaints and refractive errors	18.62	<0.001	Significant
Type of ocular complaint and refractive errors	14.75	0.002	Significant
Spectacle usage and refractive errors	25.38	<0.001	Significant
Family history of spectacle use and refractive errors	3.92	0.141	Not Significant
Past history of ocular morbidity and refractive errors	12.48	0.006	Significant
Past eye treatment/surgery and refractive errors	10.37	0.012	Significant

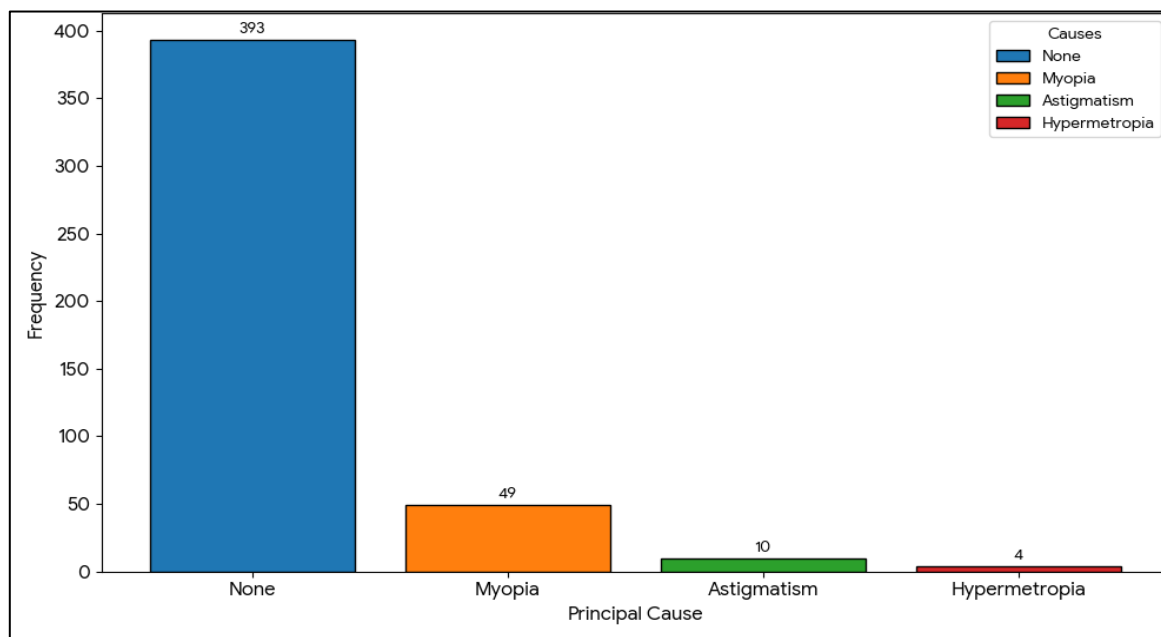


Figure 2: Principal cause of refractive error in children.

DISCUSSION

A study of ocular status of 456 school children reveals the prevalence of refractive error as 13.8% with the predominance being myopia with a prevalence of 10.8%. This finding highlights an important public health issue and is consistent with other studies performed worldwide that found refractive errors and especially myopia to be a major cause of visual impairment in children. A study by Vashist et al found that refractive error was a leading cause of visual impairment in a population-based study in North India, reinforcing the common nature of this cause of visual impairment.¹⁵

The reported prevalence of myopia is consistent with other studies conducted in Bhutan and Kazakhstan, which depict the increasing incidence of myopia due to environmental factors, such as increased screen time and reduced outdoor activity.^{16,17} The conclusion that myopia is a key issue in the visual health of childhood is an important conclusion although the present study did not show a statistically significant correlation with family history of spectacle use, which is in contrast with observations from other studies.^{18,19}

The high prevalence of current ocular complaints (32.7%), mostly blurred vision (13.8%), is a cause for concern about unrecognized visual impairments which may have negative consequences for academic performance and quality of life, as has been highlighted in the previous literature on the implications of untreated vision problems on learning outcomes.^{20,21}

Despite this majority of children showed normal visual acuity (both eyes) unaided abnormal visual acuity (86.2%) suggesting an overall good ocular status, possibly effective screening, in the same line with the results reported by Sharma et al among school children in urban slum settings.¹⁸ The low prevalence of eyelid (4.0%) and conjunctival abnormalities (7.9%) further supports this observation and is in agreement with the reports from similar cohorts.²²

The significant association noted between ocular complaints and refractive errors stresses the cyclical nature of uncorrected refractive errors and visual symptoms and therefore the importance of early detection and spectacle use as previously stated in other studies.^{16,23} Although 67.3% of children did not complain of having any ocular problem, this could indicate under-recognition of visual

problems or lack of awareness about the eye health, which has been observed in previous studies as well.^{20,22}

Differences between access to eye care and environmental exposures (i.e. greater screen time in urban environments) may contribute to variation in myopia prevalence.^{24,25} Overall, these results emphasize the importance of strengthening public health strategies with the goal of school-based vision screening, awareness generation and better access to corrective services that support the available evidence on the important role of educational institutions in reducing the burden of undiagnosed refractive errors among children.^{26,27}

CONCLUSION

The study concludes that the prevalence of refractive error among school children was 13.8% with myopia appearing as the most common refractive error, revealing an important yet most easily preventable public health problem. Although most children had normal unaided visual acuity, a significant proportion of them reported ocular complaints indicating the potential for undetected or uncorrected visual problems which can have a negative impact on academic performance and quality of life. The high correlation of refractive errors with eye complaints, spectacle use and past ocular morbidity highlights the importance of early diagnosis and early intervention. Therefore, it is recommended that regular school-based vision screening programs be strengthened, awareness relating to the eye health be improved amongst children, parents and teachers, and access to affordable eye care services and corrective spectacles are ensured, to reduce the burden of refractive errors and promote optimal visual health in school aged children.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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