ORIGINAL ARTICLE

PREVALENCE OF REFRACTIVE ERRORS AMONG CHILDREN IN RURAL AREAS OF CHITTOOR DISTRICT, A.P.
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ABSTRACT: BACKGROUND: The uncorrected refractive errors are the main cause of low vision which hampers performance at school, reduces productivity and impairs quality of life. It is considered to be one of the most important priorities in the global initiation for the elimination of avoidable blindness. The refractive errors are especially common among children as they do not complain and adjust with circumstances. School children constitute an ideal group for study of refractive errors because most of them go to school, easily accessible and offer excellent opportunity for services and health education. MATERIAL & METHODS: This is a cross sectional study conducted among 2,568 children attending various government schools in the rural areas of Chittoor district. The study was carried out during January to June 2015. A preliminary examination of visual acuity was determined by Snellen’s chart and those with defective vision were subjected to detailed eye examination by a specialist. The results were analyzed using MS excel software and Epiinfo 7 software version using percentages and Chi-square test. RESULTS: The overall prevalence of refractive errors among children was found to be 11.3%. (Astigmatism-5.8%; myopia-4.2%; hypermetropia-1.4%). The prevalence of refractive errors increased steadily from 5.7% in 5-7 years age group to 14.7% in 14-16 years group. The prevalence was found to be similar in male and female children. The prevalence of myopia and astigmatism was found to increase steadily with age while hypermetropia showed an inverse trend CONCLUSIONS: Examination of school children for refractive errors is a useful strategy for early diagnosis and intervention.
KEYWORDS: Refractive errors, School children, Chittoor, Rural areas, Myopia, Astigmatism, Hypermetropia.

INTRODUCTION: It was estimated that globally 314 million people are visually impaired from all causes with uncorrected refractive errors accounting for 153 million. Thus uncorrected refractive errors is the main cause of low vision which hampers performance at school, reduces productivity and impairs quality of life. It is also regarded as the second largest cause of treatable blindness after cataract if blindness was diagnosed on the basis of presenting visual acuity. It is considered to be one of the most important priorities in the global initiation for the elimination of avoidable blindness. The age and gender adjusted prevalence of blindness based on presenting visual acuity in Andhra Pradesh was found to be 1.8% with proportion of treatable blindness as 60.3% (Cataract-44.0% and refractive errors -16.3%). Thus it was estimated that if 95% of the refractive error blindness is treated, it would result in the reduction of 7.4 million blind person years. Data on prevalence, magnitude, causes of blindness and visual impairment in children are needed for planning and evaluating preventive and curative services for children and for planning special education and low vision services.
The available data suggest that there may be a tenfold difference in the prevalence between the wealthiest countries of the world and the poorest, ranging from as low as 0.1 per 1000 children aged 0-15 years in the wealthiest countries to 1.1 per 1000 children in the poorest. The refractive errors are especially common among children as they do not complain and adjust with circumstances. School children constitute an ideal group for study of refractive errors because most of them (more than 80%) go to school, easily accessible and offer excellent opportunity for services and health education.

A study in Shimla has found an overall ocular prevalence of 31.6% with refractive errors constituting the major portion (22.0%). A study in Bangalore has found an overall prevalence of 4.4% of myopia, 1.6% of astigmatism and 1.0% of hypermetropia with higher prevalence in higher age groups and urban areas. A study in Chittoor district, has found an overall prevalence of 7.4% with astigmatism in 2.7% and myopia in 2.4% children. Both myopia and astigmatism increased with age while an inverse relation was found with regard to hypermetropia.

This present study is an attempt to find out the prevalence of refractive errors among school children in Chittoor district of Andhra Pradesh and its association with age, gender and educational standard.

**MATERIAL & METHODS:** This is a cross sectional study conducted among 2,568 children attending various government schools in the rural areas of Chittoor district. This study is done as a part of Andhra Pradesh Government’s programme of “Chinnari Choopu” (Children’s vision) which envisages identification and treatment of refractive errors and other cause of defective vision among children attending government schools in rural areas. Permission for conducting the study was obtained from the health as well as education authorities. In each school, permission was obtained from the head of the institution concerned. Ethical clearance was obtained from the Institutional Ethics Committee of SV Medical College, Tirupati. The study was carried out during January to June 2015 including the analysis of the results and report writing.

The sample size was calculated based on the assumed prevalence of 8% (As reported in Chittoor study), with an allowable error of 20% and alpha error of 0.05 and beta error of 0.20. Thus he sample size estimated was found to be 2,536. The actual sample size for the study was 2,568 which fulfills the requirement of minimum sample size. The age, standard of education of children was obtained from the school records. The visual acuity was determined by Snellen’s chart by optometrist. The data collection was supervised and checked by one of the authors throughout the study period. All cases with suspected refractive error defined as visual acuity of 6/9 or less in any eye were instructed to come to the department of Ophthalmology, SV Medical College, Tirupati. It was found that out of a total of 2,568 children subjected for preliminary examination, 642 children were found to have some defective vision or other ocular health problems. These cases were subjected to detailed eye examination by an Assistant Professor of Ophthalmology and refraction was determined by using homatropine 2% eye drops and fundus evaluation. The results were analyzed using MS excel software and Epiinfo 7 software version using percentages and Chi-square test. A probability value of less than 0.05 was considered as statistically significant.
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RESULTS: Majority of the children belonged to 11-13 years age group (37.3%) followed by 14-16 years (29.5%). The gender distribution was similar with 51.0% female and 49.0% male children. In terms of educational standard, majority of them were in secondary level (39.0%) (Table 1). The prevalence of refractive errors in right eye was found to be 10.8% while in left eye, it was found to be 11.0% Simple myopia, simple myopic astigmatism, compound myopic astigmatism were found to be the common refractive errors in that order in both eyes (Table 2). The overall prevalence of refractive errors among children was found to be 11.3% taking the visual acuity in the worst eye. The commonest refractive error was found to be astigmatism (5.8%) followed by myopia (4.2%) while hypermetropia was found to be least common (1.4%) (Table 3).

The prevalence of refractive errors increased steadily from 5.7% in 5-7 years age group to 14.7% in 14-16 years group. The prevalence of myopia was found to increase with age from 1.3% in 5-7 years age group to 5.8% in 14-16 years’ age group. The astigmatism also showed similar trend being lowest in 5-7 years (2.2%) and highest in 14-16 years (7.9%). However, the prevalence of hypermetropia showed inverse trend with age being highest in 5-7 years (2.2%) and least in 14-16 years (0.9%). The differences in the prevalence of various refractive errors by age group were also found to be statistically significant (Table 4). The prevalence of myopia and astigmatism were also found to be significantly highest in secondary education level children compared to primary and middle level while hypermetropia was found to be common in primary level compared to middle and secondary level educational standards (Table 5). However the prevalence was similar in males (11.2%) compared to female (11.4%) with no differences in the prevalence of various refractive errors in both genders (Table 6).

DISCUSSION: The overall prevalence of refractive errors among children in this present study was found to be 11.3%. A similar prevalence of 11.3% was found in an South India,(8) and New Delhi (13.1%),(9) and Uganda study (11.7%).(10) Higher prevalence was reported in studies in Shimla (22.0%),(5) New Delhi (15.1%),,(11) Kancheepuram (31.6%)(12) while lower prevalences were reported in studies at Bangalore (7.0%),(6) rural India (4.2%),(2) Pune (6.2%),(13) Kashmir (6.9%)(14) and Nepal (8.6%).(15) In the present study, the commonest refractive error was found to be astigmatism (5.8%) followed by myopia (4.2%) while hypermetropia was found to be least common (1.4%) Similar pattern was found in Chittor study,(7) with astigmatism in 2.7% and myopia in 2.0% and hypermetropia in 1.0% children.

A similar higher proportion of myopia (4.4%) compared to astigmatism (1.6%) was found in Bangalore study.(6) A relatively high proportion of astigmatism (6.9%) compared to myopia (4.4%) was found in a South India study(8). Nepal study,(15) also showed higher relative proportion of myopia and astigmatism compared to hypermetropia. Equal proportion of myopia (7.4%) and hypermetropia (7.7%) was found in New Delhi study.(11) However, higher relative proportion of hypermetropia compared to myopia was found in the Ethiopia study.(16) A similar pattern of higher proportion of astigmatism (6.1%) and hypermetropia (4.3%) compared to myopia (1.3%) was found in Uganda study.(10)

Thus in studies in various parts of India generally showed higher prevalence of myopia and astigmatism compared to hypermetropia while in Africa, the proportion of hypermetropia was found to be higher than myopia and astigmatism. The differences in the overall prevalence and
that of various types of refractive errors between the present study and other studies may be due to differences in the region, age group, methodology and classifications used.

In the current study, the prevalence of myopia was found to increase steadily with age from 1.3% in 5-7 years age group to 5.8% in 14-16 years’ age group. The astigmatism also showed similar trend being lowest in 5-7 years (2.2%) and highest in 14-16 years (7.9%). However, the prevalence of hypermetropia showed inverse trend with age being highest in 5-7 years (2.2%) and least in 14-16 years (0.9%). Similar trend was reported in studies in Chittoor, Bangalore and New Delhi.(6,7,15) There was no difference in the prevalence by gender in this present study. Several other studies also reported no significant difference by gender.(6,7,9) However, a study in New Delhi has found a significantly higher prevalence in female children.(9) Thus various studies in India had reported increase in prevalence of refractive errors like myopia and astigmatism with age while the prevalence was similar in male and female children.

**CONCLUSIONS:** The overall prevalence of refractive errors in this present study was 11.3% with relatively higher proportion of astigmatism (5.8%) and myopia (4.2%) compared to hypermetropia which was least common (1.4%). The prevalence of both myopia and astigmatism increased with age and standard of education of children while the proportion of hypermetropia was common in young age groups than higher age group children. Periodical examination of school children for early detection and treatment of refractive errors is a feasible, cost effective strategy which may help in improvement of scholastic performance.

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| Sl. No. | Parameter               | Number of Children | Percentage |
|--------|-------------------------|--------------------|------------|
| 1      | Age Group               |                    |            |
| (a)    | 5 – 7                   | 229                | 8.9        |
| (b)    | 8 – 10                  | 624                | 24.3       |
| (c)    | 11 – 13                 | 958                | 37.3       |
| (d)    | 14 - 16                 | 757                | 29.5       |

2. Gender

| (a)    | Male                    | 1258               | 49.0       |
| (b)    | Female                  | 1310               | 51.0       |

3. Standard of Education

| (a)    | Primary                 | 976                | 38.0       |
| (b)    | Middle                  | 591                | 23.0       |
| (c)    | Secondary               | 1001               | 39.0       |

Table 1: Age group, gender and standard of education of children (N=2568)

| Type of Refractive Error | Right Eye (N=2551)* | Left Eye (N=2558)* |
|--------------------------|----------------------|---------------------|
|                          | Number of Children   | Percentage          | Number of Children | Percentage          |
| Normal                   | 2276                 | 89.2                | 2276               | 89.0                |
| Simple Myopia            | 98                   | 3.8                 | 108                | 4.1                 |
| Simple Myopic Astigmatism| 84                   | 3.3                 | 81                 | 3.2                 |
| Compound Myopic Astigmatism| 54                 | 2.1                 | 55                 | 2.2                 |
Table 2: Type of Refractive errors in children

| Type of Refractive Errors | Number of Children |
|---------------------------|--------------------|
| Simple Hypermetropia      | 34                 |
| Compound Myopia           | 5                  |

Note: Visual acuity in right eye among 17 children and visual acuity in left eye among 10 children could not be determined.

Table 3: Overall prevalence of refractive errors among children

| Overall Refractive Error | Number of Children | Percentage |
|--------------------------|--------------------|------------|
| Normal                   | 2276               | 88.7       |
| Astigmatism              | 148                | 5.8        |
| Myopia                   | 107                | 4.2        |
| Hypermetropia             | 35                 | 1.4        |
| Total                    | 2566               | 100.0      |

Note: The presence of refractive error is estimated using the visual acuity in the worst eye (Without spectacles if any). Simple Myopia includes only myopia, Simple hypermetropia includes only Hypermetropia while astigmatism includes astigmatism alone or combination of myopia with astigmatism or hypermetropia with astigmatism. Further, 2 children are excluded as visual acuity in both eyes could not be determined.

Table 4: Prevalence of refractive errors by age group of children

| Age group (Years) | Number of children | Normal (%) | Myopia (%) | Astigmatism (%) | Hypermetropia (%) |
|-------------------|--------------------|------------|------------|-----------------|-------------------|
| 5 – 7             | 229                | 216(94.3)  | 3(1.3)     | 5(2.2)          | 5(2.2)            |
| 8 – 10            | 624                | 567(90.9)  | 18(2.9)    | 27(4.3)         | 12(1.9)           |
| 11 – 13           | 957                | 848(88.6)  | 42(4.4)    | 56(5.9)         | 11(1.1)           |
| 14 – 16           | 756                | 645(85.3)  | 58(7.9)    | 7(0.9)          |                   |
| **Total**         | **2566**           | **2276(88.7)** | **107(4.2)** | **148(5.5)**   | **35(1.4)**       |

$\chi^2=31.6; P<0.001; S$

Table 5: Prevalence of refractive errors by educational standard of children

| Education Standard | Number of children | Normal (%) | Myopia (%) | Astigmatism (%) | Hypermetropia (%) |
|--------------------|--------------------|------------|------------|-----------------|-------------------|
| Primary            | 974                | 894(91.6)  | 25(2.6)    | 37(3.8)         | 20(2.0)           |
| Middle             | 590                | 516(87.5)  | 31(5.3)    | 36(6.1)         | 7(1.2)            |
| Secondary          | 1000               | 866(86.6)  | 51(5.1)    | 75(7.5)         | 8(0.8)            |
| **Total**          | **2566**           | **2276 (88.7)** | **107(4.2)** | **148 (5.5)**  | **35 (1.4)**      |

$\chi^2=29.1; P<0.001; S$
| Gender | Number of children | Normal (%) | Myopia (%) | Astigmatism (%) | Hypermetropia (%) |
|--------|-------------------|------------|------------|-----------------|------------------|
| Male   | 1257              | 1116 (88.8)| 54 (4.3)   | 69 (5.5)        | 18 (1.5)         |
| Female | 1309              | 1160 (88.6)| 53 (4.0)   | 79 (6.0)        | 17 (1.3)         |
| Total  | 2566              | 2276 (88.7)| 107 (4.2)  | 148 (5.5)       | 35 (1.4)         |

Table 6: Prevalence of refractive errors among children by gender

χ²=0.51; P=0.91; NS

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