MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.59218/makrjms.2023.12.1.5

Prevalence and Determinants of Refractive Errors in School Children

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ABSTRACT

Refractive error (RE) stands as a prevailing cause of visual impairment worldwide, ranking as the second most prominent reason for treatable blindness. The surge in its occurrence at an early age can be attributed to inadequate awareness of associated risk factors and complications. The primary objective of this investigation was to discern the impact of risk factors on RE prevalence among schoolchildren residing in both rural and urban settings. A comprehensive screening effort encompassed 678 schoolchildren aged between 6 and 12 years. Children exhibiting visual acuity below 6/9 were subjected to objective refraction assessment. The assessment of diverse risk factors was conducted using a meticulously pretested questionnaire. The data revealed a significantly higher prevalence of RE among urban schoolchildren in comparison to their rural counterparts. Notably, myopia emerged as the most prevalent form of RE among both rural and urban children. Among the risk factors analyzed, the duration of television viewing, viewing distance from the television screen, the extent of engagement in computer, video, or mobile games and the time spent outdoors for physical activities exhibited statistically significant associations with RE prevalence. This investigation underscores the preventable nature of risk factors linked to RE and underscores their role in fostering awareness among children, parents and notably, educators who wield significant influence in molding a child's development and conduct. It further underscores the importance of ensuring consistent and appropriate use of corrective eyewear.

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Key Words
Refractive errors, mobile video games, applications, television, computers

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Received: 17 September 2023
Accepted: 15 October 2023
Published: 16 October 2023

Citation: Priyankkumar Patel, Heena Pannalal Kalasva, Meghna Poonia and Akshay Berad, 2023. Prevalence and Determinants of Refractive Errors in School Children. Res. J. Med. Sci., 17: 1-5, doi: 10.59218/makrjms.2023.12.1.5

INTRODUCTION

Refractive error (RE) stands as a prevalent global cause of visual impairment, ranking as the second most common treatable cause of blindness[1]. Estimates indicate that approximately 2.3 billion individuals worldwide are affected by RE, yet only 1.8 billion have access to both eye examinations and affordable correction[2]. The World Health Organization (WHO) has initiated a campaign aimed at addressing RE management by the year 2020, underscoring its significance[3,4]. In the broader context of the 2020 global initiative to eliminate avoidable blindness, REs share the spotlight with other ocular disorders such as cataracts, trachoma and onchocerciasis[5].

Numerous studies conducted in South India have documented RE prevalence, spanning from 5-25%[6-9]. Amongst vulnerable groups, school-age children merit special attention due to the profound impact uncorrected RE can exert on their learning abilities and educational potential[10]. It's worth noting that some educators, unaware of the underlying issue, may mislabel these children as lazy. Children with RE, who are identified by either parents or teachers and subsequently referred to ophthalmologists, remain relatively few in number. Although vision screenings do not offer a diagnostic verdict, their results serve as indicators for potential further assessment. The provision of optical correction through spectacles is a cost-effective solution.

The proportion of children facing visual impairment as a consequence of RE serves as a yardstick for evaluating the extent of eye care services development within a country. Consequently, it is imperative to systematically evaluate and correct vision with appropriate eyewear from an early age. Despite national programs aimed at controlling blindness, the incidence of RE among children continues to rise, largely due to inadequate awareness of associated risk factors and potential complications. Furthermore, the documented prevalence of RE among rural and urban schoolchildren aged 6-12 years remains limited. Therefore, our study was designed to ascertain the prevalence of RE in this specific demographic and to evaluate and contrast the impact of risk factors on RE among rural and urban schoolchildren.

MATERIALS AND METHODS

In this cross-sectional investigation, a study was conducted among a cohort of schoolchildren aged 6-12 years, following the necessary approvals. To ensure a representative sample, a cluster sampling approach was adopted. The list of schools within the region was meticulously collected, from which two schools in urban areas and two in rural areas were randomly selected. Each of the selected schools was regarded as a cluster and all students aged 6-12 years were subjected to screening for refractive errors (REs), aiming for a sample size of approximately 700, allowing for potential dropouts. Prior to the screening, each participating school was visited two weeks in advance to make necessary arrangements for a well-lit examination room. Every participant received a consent form, a personal information sheet and a pretested questionnaire to be taken home to their parents. Only children who returned duly signed consent forms and expressed willingness to participate were included in the study. Children with a history of eye surgery, squint, fever, or previous eye injuries were excluded.

The personal information sheet provided comprehensive details regarding the study's purpose, procedures and demographic information, including the participant's name, age, parents' education, occupation, family size and monthly family income. The questionnaire encompassed various risk factors, such as housing type, lighting conditions, the duration and distance of computer/television usage, near work duration, past spectacle usage and a family history of REs.

Eye examinations for each child were conducted using the Snellen's chart at a standard distance of 6 m. Visual acuity less than 6/9 in either or both eyes was established as the cutoff for visual impairment and these children underwent subjective refraction with an auto refractometer[11]. Subsequently, they were referred for objective refraction using streak retinoscopy after instillation of 1% cyclopentolate drops in each eye twice, with a 15 min interval, for a minimum of half an hour before examination. Follow-up assessments were carried out one week and fifteen days after the initial examination at the school to ensure that referred children had undergone a comprehensive ophthalmic evaluation and were consistently wearing their prescribed spectacles.

Data were meticulously recorded in a Microsoft Excel spreadsheet and analysis was performed using SPSS software version 17. The prevalence of REs among children in both groups was determined and the impact of a family history of refractive status on children's REs was assessed using the Chi-square test. Unpaired t-tests were used to compare means of risk factor variables, such as duration and distance.

RESULTS

In this research endeavor, a cohort of 700 children was initially enrolled. However, it's worth noting that 12 children were absent from school on the day of the screening due to various unrelated reasons, 6 children failed to return the completed forms and of the returned forms, 4 were inadequately filled out.

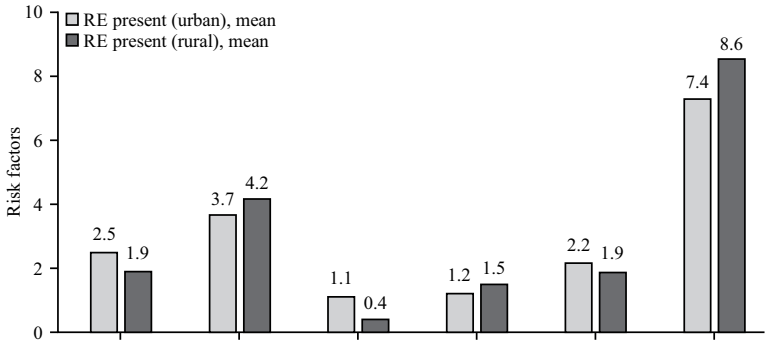

Fig. 1: Comparison of risk factors for RE among rural and urban area

Table 1: Gender wise prevalence of RE

		RE Present		RE Absent		Total	
Area	Gender	No.	Percentage	No.	Percentage	No.	Percentage
Urban	Male	139	40.88	28	8.24	167	49.12
	Female	142	41.76	31	9.12	173	50.88
Rural	Male	149	44.08	21	6.21	170	50.30
	Female	148	43.79	20	5.92	168	49.70

Table 2: Positive family history and Prevalence of RE

		RE present		RE absent	
Area	Positive family history	No.	Percentage	No.	Percentage
Rural	One parent n = 52	29	55.77	23	44.23
	Two parent n = 5	2	40.00	3	60.00
	None n = 281	252	89.68	29	10.32
Urban	One parent n = 81	62	76.54	19	23.46
	Two parent n = 14	6	42.86	8	57.14
	None n = 245	212	86.53	33	13.47

Table 3: Association of Risk factors for RE

	Urban (Mean±SD)		Rural (Mean±SD)	
Risk factors	RE absent	RE present	RE absent	RE present
TV viewing duration (hrs)	2.0±1.0	2.5±1.1*	1.2±1.5	1.9±1.1*
Distance of TV Viewing (feet)	4.8±1.0	3.7±1.7*	5.4±1.5	4.2±1.8
Computer game playtime (hrs)	0.5±0.4	1.1±0.7*	0.2±0.3	0.4±0.3
Engagement in outdoor activities (hrs)	2.1±1.2	1.2±0.9*	2.0±1.1	1.5±1.0*
Study hours	2.0±1.3	2.2±1.7	1.9±1.2	1.9±1.1
Sleep duration (hrs)	7.7±1.0	7.4±0.9*	8.8±1.0	8.6±0.9

*p<0.05

Ultimately, a total of 678 children underwent screening for refractive errors (REs), with 340 hailing from an urban school and 338 from a rural school.

The prevalence of RE among children was found to differ significantly between urban and rural areas, with 16.8% of urban children affected compared to 11.8% of their rural counterparts. However, when considering gender, no significant differences were observed (Table 1).

Analyzing the specific types of RE in urban areas among the affected children, it was revealed that 8.51% had myopia, 1.1% had hypermetropia, 3.3% had simple myopic astigmatism, 0.05% had simple hypermetropic astigmatism, 3.01% had compound myopic astigmatism and 0.31% had compound hypermetropic astigmatism. In contrast, in rural areas, 5.8% had myopia, 0.4% had hypermetropia, 1.89% had simple myopic astigmatism, 0.45% had simple hypermetropic astigmatism, 1.89% had compound myopic astigmatism and 0.18% had compound hypermetropic astigmatism.

Table 2 illustrates the refractive status of children with parents having RE, revealing a significant association between parental RE and the child's RE status.

Socioeconomic status, as analyzed, did not exert any discernible influence on the prevalence of RE in either urban or rural areas.

Among the risk factors under scrutiny, it was found that the duration of watching TV, the distance from which TV was watched, the duration of engagement in computer/video/mobile games and the duration of outdoor play exhibited statistically significant associations with the prevalence of RE, as indicated in Table 3. Furthermore, a comparison of these risk factors between urban and rural schoolchildren revealed that the duration of near work was significantly higher among children in urban areas, as illustrated in Fig. 1.

Interestingly, a notable proportion of parents in both urban and rural areas, specifically 68% in the urban area and79% in the rural area, did not place

significant emphasis on the consistent wearing of spectacles by their children. Additionally, 21% of parents in the urban area and 17% in the rural area expressed concerns that persistent spectacle use could lead to an altered appearance of their children.

DISCUSSIONS

The World Health Organization (WHO) reported in 2002 that an estimated 153 million individuals worldwide suffer from visual impairment due to uncorrected refractive errors (REs)[12]. These errors are prevalent among children and represent the most common cause of visual impairment globally, ranking as the second leading cause of treatable blindness[13,14]. A study involving schoolchildren aged 5-15 in rural Delhi identified an RE prevalence of 7.4%[15]. Similarly, an investigation in Hyderabad assessed the prevalence of RE and common ocular diseases in urban school-aged children, revealing an uncorrected RE prevalence of 9.8%, along with a hyperopia prevalence of 3.4%[16]. In a Chennai school, it was noted that out of 123 students, only 77 (62.61%) had good vision, while the remaining 46 (37.39%) were affected by Prema[6]. Prevalence of RE appeared higher in our study comparison to other studies in South India. This discrepancy may be attributed to the utilization of a visual acuity criterion of <6/9 in our study, while other studies employed a <6/12 criterion for screening, which might explain the differences in prevalence. Although, some studies reported a significant gender difference in myopia prevalence, such as the study from Davangere, our results showed no gender predisposition to RE[17]. A study in Kolkata observed that among schoolchildren aged 5-10, 25.11% had REs, with myopia being the most common (14.02%), followed by astigmatism (3.93%). In our study, myopia was more prevalent compared to other types of RE and this could possibly be related to genetic factors influencing the axial length of the eye. Our research suggested that children with both parents having RE had a higher likelihood of developing RE themselves, implying a significant genetic role. Other studies have noted that children with high myopia spent more time on reading and studying and less on sports, which could contribute to the development of RE. Additionally, children who watched TV from a distance of less than 3.5 feet and engaged in longer durations of computer/video/mobile games were more likely to have RE, indicating a correlation between increased near work and RE. Conversely, children who spent more time playing outdoor games were less likely to have RE. This contrast between urban and rural children could be due to urbanization and spatial constraints. Notably, socioeconomic status did not have a statistically significant influence on RE, contrary to some other studies. It is noteworthy that a significant percentage of parents, both in urban and rural areas, did not emphasize the consistent wearing of spectacles. Concerns about the altered appearance of the child, potentially affecting their psychological well-being, were cited as reasons. This study is instrumental in raising awareness of RE risk factors among children, teachers and parents. It underscores the importance of vision screening for schoolchildren in detecting correctable causes of vision impairment, especially REs and in reducing long-term visual disability. An important limitation of this study was the inability to reach children who do not attend school, a challenge that may be addressed by increasing the frequency of school screening. Long-term studies are required to ensure the proper use and maintenance of spectacles. In light of RE being the second leading cause of visual impairment, it is essential for parents, children and teachers to be aware of potential risk factors and the importance of consistent spectacle wear.

CONCLUSION

This study underscores the significance of identifying and addressing avoidable risk factors associated with RE. It serves as a means to raise awareness among children, parents and , notably, educators, who play a pivotal role in shaping a child's academic and behavioral development. Emphasizing the importance of consistent and proper spectacle wear is a key takeaway from this research, as it can contribute to the optimal eye health of children and their overall well-being.

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