Prevalence of Refractive Error and Spectacle Compliance in Children of Tokha Municipality

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ABSTRACT

Background

Refractive error is considered as an important component of the priority disease "childhood blindness" within the Vision 2020' initiative to eliminate avoidable blindness. The large majority of vision impairment in school aged children is due to uncorrected refractive error. Hence, refractive errors are considered as a public health challenge. The aim of this study was to estimate the prevalence of refractive error and spectacle compliance among children in Tokha municipality, Kathmandu.

Objective

The aim of this study was to estimate the prevalence of refractive error and spectacle compliance among children from Tokha municipality, Kathmandu.

Method

A descriptive, cross-sectional study was conducted by enrolling 1366 children from Tokha municipality from 1st to 3rd week of April 2022 after obtaining the Institutional Review Board (Reference number:60/2079/80). Assent was taken from all children and informed consent was signed by the legal guardians of the children. All the samples underwent a comprehensive ocular history taking, visual acuity and refraction and ocular health assessments. The inclusion criteria was school going children within age group 5-16 years.

Result

Out of a total of 1366 samples, 10.91% (149) of the school children were identified to have refractive error. The primary type of refractive error observed was compound myopic astigmatism, which accounted for 52.3% (78) of the cases. A spectacle compliance rate of 72.15% was found.

Conclusion

Refractive error prevalence in this study is consistent with findings from other part of Nepal. The most common type of refractive error was compound myopic astigmatism. The frequency of refractive errors was notably higher among individuals who frequently use electronic devices, attend private schools, and reside in densely populated areas. It is recommended to organize regular community eye camps and conduct vision screenings to identify and promptly address refractive errors in children.

KEY WORDS

Ametropia, Prevalence, Refractive error, Visual impairment, Vision screening

INTRODUCTION

Refractive error constitutes a crucial facet of the "childhood blindness" concern under the Vision 2020 initiative, aimed at eradicating avoidable blindness.[1] The predominant source of visual impairment among school-aged children stems from uncorrected refractive errors, making these errors a substantial public health challenge. The significance of this issue is amplified by the fact that students and young working adults often engage in extensive close-up tasks, where binocular dysfunction can lead to visual symptoms affecting both work and leisure.[2] Recent investigations and WHO reports corroborate that refractive errors rank as the primary cause of visual impairment and second leading cause of visual loss worldwide, accounting for 43% of visual impairments.[3] Globally, an estimated 12.8 million children aged 5 to 15 suffer from visual impairment attributable to uncorrected or sub-optimally corrected refractive errors, resulting in a prevalence of 0.96%, with higher occurrences in China and urban regions of Southeastern Asia.[4] Notably, uncorrected refractive errors stand out as the most prevalent contributors to visual disability in schoolchildren around the world.[5] These refractive errors have the potential to curtail children's academic performance, a situation exacerbated by prolonged use of mobile devices, computers, video games, and television.

The economic implications are substantial, with the annual global cost in productivity losses due to preventable distance vision impairment estimated at roughly US$202 billion in 2009.[6] In the Nepalese context, statistics from the mid-term review of the Nepal Blindness Survey indicate that around 1,013,141 children under the age of 16 contend with refractive errors, with an assumed prevalence rate of 10% based on a spectrum of studies ranging from 3% to 20%.[7] The Refractive Error Study in Children (RESC) group's investigation divulged that refractive error served as the major cause of visual acuity worse than 0.5 (20/40) in at least one eye among 56% of Nepalese children.[8] Additionally, a Nepal-based study uncovered a meager compliance rate of 28%, underscoring the predicament that a significant portion of children do not benefit from refractive corrections.[9] The success of corrective lens provision hinges upon robust compliance, lest well-intentioned efforts go to waste.

This study aims to gauge the prevalence of refractive errors and spectacle adherence among children in Tokha municipality. Furthermore, it endeavors to assess compliance rates among children previously prescribed with spectacles.

METHODS

This was a descriptive, cross sectional, population-based study conducted for 15 days from 1st week of April to 3rd week, 2022 as a part of community eye health diagnosis of optometry and vision science students involving 1366 school aged children from Tokha Municipality, Kathmandu. The study was conducted following ethical approval by Institutional Review Board (IRB) of National Academy of Medical Sciences (NAMS) (Reference number: 60/2079/80). All the methods adhered to the tenets of The Declaration of Helsinki. Informed consent was obtained from the guardians of all the subjects prior to their enrollment in the study. Assent was obtained from all the children. The selection criteria for the enrollment of the subjects were:

Inclusion Criteria:

1. Children age 5 to 16 years old from Tokha municipality who attend school

Exclusion Criteria:

1. Children who had active infection of ocular structures during ocular assessment

2. Non-verbal or intellectually disabled children

The sample size was estimated by formula:

Formula: $S = Z^2 (p) (1-p)/e^2$

Where,

S= sample size for infinite population

Z= Absolute Precision

P= prevalence rate

e= margin of error

For this prevalence study, the value of variables are taken as:

Z=1.96 (i.e. CI of 95%)

p = 19.8%, which can be taken as 20% (Previously reported by Pokhrel et al.[10])

e=3%

Calculated sample: 682.95, which can be taken as 683

To balance design effect and adjustment for expected non-response rate, sample size was increased by 2 times, which gave the final required sample as 1366

Refractive error was classified based on criteria by Kaiti et al.[11]:

1. Hypermetropia:

a. If refractive error is of magnitude ≥ +0.50 D.

b. Hypermetropia will be further classified into:

i. low hypermetropia (>+0.50D to <+ 3.0D)

ii. moderate hypermetropia (>+3.0 D to <+6.0D)

iii. high hypermetropia (>+6.0D).

2. Myopia:

a. If refractive error is of magnitude ≤-0.50D.

b. Myopia will be further classified into:

i. low myopia (≤ -0.50D to > -3.0D)

ii. moderate myopia (≤-3.0D to >-6.0D)

iii. high myopia (≤- 6.0D)

3. Astigmatism:

a. If any cylindrical error ≥ ±0.5

b. Astigmatism was further classified into:

i. simple myopic astigmatism

ii. simple hyperopic astigmatism

iii. compound hypermetropic astigmatism

iv. compound myopic astigmatism

v. mixed astigmatism

All the selected samples had undergone following tests:

1. A comprehensive history taking involving previous eye examination, history of use of spectacle in the past, type of schooling, history of gadget use, and housing condition.

2. Presenting Visual acuity (PVA), best corrected visual acuity (BCVA) and visual acuity with pinhole (PVA) in each eye with Snellen's chart at 6 meter was measured.

3. Static retinoscopy was performed at 50 cm distance in moderately illuminated room light with the help of Heine retinoscope and lens bar and the finding were recorded after deducting the working distance of +2.00 D.

4. Subjective refraction was carried out to find out the best correction which was determined by the optimal visual acuity improvement with the refractive correction.

5. The anterior segment screening was done using torching light under magnification provided by Optivisor which provides 2X magnification

6. Binocular single vision assessment was performed which included Hirschberg test, cover test, alternate cover and ocular motility

7. Funduscopy was performed using monocular direct ophthalmoscope in undilated pupil

Spectacle compliance was calculated by the formula:

Spectacle compliance = (children wearing spectacle at the time of survey)/ (children who were previously either prescribed /dispensed with spectacle)*100

All the statistical was done using IMB SPSS Version 22 (software). The data was expressed in terms of percentage. The significance of a prevalence study was evaluated by calculating the confidence limits of the observed rate. The 95 percent confidence band was used.

RESULTS

A total of 1366 subjects (male: 751; female: 615) were studied. The mean age of the sample was 10.3 ± 3.17 years, with majority of samples within age group of 13-16 years. 77.96% (n=1065) attended private school while 22.04% (n=301) attended community school. And 91% (n=1243) were using gadgets at least 3 hours or more per day while only 9% (n=23) did not have access to mobile phone and gadget use. Based on the settlement, 70% (n=956) of the children lived in densely compact household while 30% (n=410) of the children lived in scattered household.

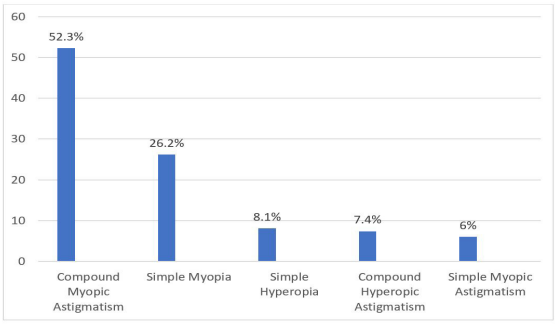

Figure 1. Distribution of Refractive Error

Prevalence of Refractive Error

The refractive error was found in 10.91% (CI: 10.36 – 11.45; SE: 0.28%) (n=149) subjects. The most common type of refractive error was compound myopic astigmatism (52.3%), (n = 78) (Fig. 1). We didn't report any cases of mixed astigmatism and simple hyperopic astigmatism.

Magnitude of Refractive Error

Among both myopes and hyperopes (n =39 and n =12 respectively), the most common degree of myopia and hyperopia was moderate type (n=19 and n =6 respectively) followed by mild myopia and hyperopia (n=13 and n = 3 respectively) (Table 1).

Table 1. Magnitude of refractive error

Refractive error subtypes	
Myopia	**39 (26.20)**
Mild Myopia	13 (8.72)
Moderate Myopia	19 (12.75)
High Myopia	7 (4.69)
Hypermetropia	**12 (8.05)**
Mild Hypermetropia	3 (2.01)
Moderate Hypermetropia	6 (4.02)
High Hypermetropia	3 (2.01)
Astigmatism	**98 (65.77)**
Compound Myopic Astigmatism	78 (52.34)
Compound Hypermetropic Astigmatism	11 (7.38)
Simple Myopic Astigmatism	9 (6.04)

Gender-wise distribution of refractive error

Out of 751 males, refractive error was found in 14.24% (n = 107) of the cases. Similarly, out of 615 females, refractive error was found in 6.83% (n=42) of the cases. Out of total cases of refractive error (n = 149), 71.8% were male and 28.2% were female giving a male preponderance.

Age-wise distribution of refractive error

The age-wise distribution of refractive error is shown in figure 2. 46.97% (n=70) of samples diagnosed with refractive error belonged to age group 13-16 years.

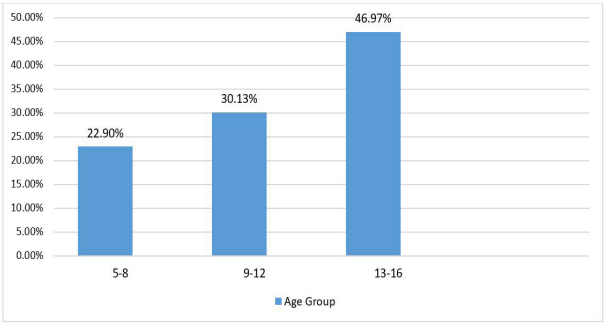

Figure 2. Age-wise Distribution of Refractive Error

School-wise distribution of refractive error

Among 1065 children who attended private schools, refractive error was found in 11.45% (n= 122) children. Similarly, out of 301 children who attended community schools, refractive error was seen in 8.97% (n= 27) children. In both community and private school, majority of samples had compound myopic astigmatism.

Distribution of refractive error in gadgets

Refractive error was seen in 10.61% (n=132) who were using gadgets for at least 3 hours or more per day. Out of total gadgets users, 59.53% (n=74) were found to have compound myopic astigmatism followed by 29.77% (n=37) myopia and least was 0.42% (n=6) compound hyperopic astigmatism and hyperopia.

Distribution of refractive error based on housing system

Out of total refractive error, 79 (53.02%) children had concrete housing and whereas 46.98% (n=70) had thatched roof. Similarly, 105 (70.46%) children who were diagnosed with refractive error were from dense settlement, whereas 44 (29.54%) were from scattered settlement.

Spectacle compliance

Based on history from the parents and children, 45.07% (n=615) of the children had previous history of eye examination, and 36% (n=492) of children were prescribed or dispensed spectacles earlier. During the survey, 26% (n=355) of children were found wearing spectacle during the examination. Thus, the spectacle compliance was found to be 72.15%. 27.84% of children who were previously prescribed with spectacle were not found to be wearing them during the survey.

DISCUSSION

In our study, the prevalence of refractive error among the pediatric population of Tokha municipality was determined to be 10.91% (n=149). While no prior investigations regarding refractive error exist for this specific region of Nepal, our findings are consistent with Shankar et al.'s prevalence of approximately 8.58% among school children in the Jhapa district.[12] In comparison to Kaiti et al. descriptive hospital-based study, our study identified a significantly higher refractive error prevalence of 7.74%.[11] Although Kaiti et al. evaluated a larger sample size (1498 vs. 1366), the prevalence rate was approximately 1.4 times higher in our study, potentially due to differences in age range (3-14 vs. 5-16), refraction method (dry vs. wet), and classification protocols for refractive error.[11] Conversely, our reported prevalence rate is notably lower than that found by Pokhrel et al. (19.8%).[10] Similarities in our findings with studies from China, Chile, and India, involving comparable age populations (5-15 years), demonstrate the widespread nature of these results.[13-15]

The prevailing type of refractive error in our study was compound myopic astigmatism (52.3%). This aligns with Kaiti et al.'s reported astigmatism prevalence of 48.06%, whereas Shankar et al. and Pokhrel et al. noted myopia as the dominant refractive error.[10-12] It's important to note that we defined astigmatism with a cylindrical error ≥ ± 0.5, while most studies employ either spherical equivalent or cylindrical error > 0.75 for this classification, potentially refining our categorization. Remarkably, our study did not identify any instances of mixed astigmatism or simple hyperopic astigmatism. The prevalence of myopia and myopic astigmatism consistently prevails not only in Nepal but worldwide, particularly among Asian populations, possibly due to genetic predisposition.[16]

Our research indicated a higher prevalence of refractive error in males compared to females, a trend observed by Pokharel et al.[17] Although this aligns with prior studies, the considerable disparity in prevalence rates between genders in our study may stem from a larger male sample size. Yet, studies such as Kaiti et al. and Tuladhar et al. also suggest female predominance in refractive error prevalence.[11,18] Further exploration is needed to understand the underlying gender-based causes, promoting gender-sensitive refractive services in Nepal. Prevalence peaked in the 13-16 age group, followed by 9-12 and 5-8, potentially reflecting the increasing academic demands and grade progression. This pattern is substantiated by similar findings from studies at Lumbini Eye Institute and Solukhumbu, Nepal.[19,20]

Private school attendees exhibited a higher refractive error prevalence (11.45%) than those from community schools (8.97%), paralleling Shrestha et al. and Niroula's outcomes.[12,17] The distinction might be attributed to greater privileges and opportunities for gadget use, computer education, and extra-curricular activities among private school students. Factors such as distinct educational systems, audio-visual aids, and the recent shift towards online classes amid the COVID-19 pandemic could contribute.

Our research also indicated a higher prevalence of refractive error among children with a history of gadget use, consistent with Lumbini Medical College's findings, suggesting that continuous near work could be more influential than total near work duration.[21] Furthermore, the extended indoor periods resulting from lockdown measures could have contributed to refractive error development. In relation to housing, children in concrete houses demonstrated higher refractive error prevalence than those in thatched roof houses, possibly indirectly linked to economic status.

Finally, our study demonstrated that denser settlements displayed higher refractive error prevalence compared to scattered ones, potentially linked to increased outdoor exposure. This indirectly highlights the higher prevalence of refractive error in urban settings compared to semi-urban or rural regions, in line with Pokhrel et al. findings of 15.5% myopia prevalence among urban students versus 8.2% among rural counterparts.[10]

The study's cross-sectional design, limited to identifying associations and prevalence rates, restricts causal inference. To address this, future research should adopt longitudinal designs for examining causal pathways. Single-point assessments introduce recall bias and hinder capturing temporal variations. To enhance accuracy, incorporating multiple assessment points and objective measures is recommended. Geographical confinement to Tokha municipality limits generalizability. Future studies should encompass diverse regions for increased external validity. Absence of a regional baseline for refractive error prevalence restricts contextualization. Incorporating historical data or baseline assessments can provide a broader understanding. Inability to conduct long-term follow-up constrains assessing spectacle compliance's impact on refractive error progression. Longitudinal studies are crucial for evaluating sustained intervention effectiveness. Therefore, while our study contributes insights, addressing these limitations via methodological enhancements in future research leveraging longitudinal designs, broader geographic representation, and extended observation periods is imperative for advancing understanding of childhood refractive error dynamics and corrective strategies.

CONCLUSION

The prevalence of refractive error in school going children of Tokha municipality was 10.91%. The findings from this study are comparable with that from other regions of Nepal. The most common type of refractive error was compound myopic astigmatism. The prevalence of refractive error was found greater among gadgets users, private schoolers and in children from dense settlement. The overall spectacle compliance among children was 72.15%. Community eye health diagnosis combined with eye screening along prevention, promotion, and treatment program with periodic evaluation seems to be appropriate to reduce ocular problems, primarily refractive error in school aged children of Nepal.

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