

Article ▶ Screening Preschool Children for Visual Disorders: A Pilot Study

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ABSTRACT

Purpose: Ocular and/or vision defects are one of the most common reasons for the referral of young children to the hospital. Vision disorders are the fourth most common disability of children and the leading cause of handicapping conditions in childhood. In preschool-age children, amblyopia and amblyogenic risk factors, such as strabismus and significant refractive errors, are the most prevalent and important visual disorders. The purpose of this pilot study was to determine the prevalence of visual disorders in preschool children in Kathmandu Valley, Nepal.

Methods: Four hundred and eighty-four children attending eight preschools in Kathmandu Valley underwent detailed optometric examination. Visual acuity was assessed with either Sheridan Gardiner or Kay Picture chart monocularly. Binocularity was assessed with cover test and prism bar neutralisation. Refraction was carried out in all children. In most instances this was done without the use of a cycloplegic agent. Stereopsis was assessed with the Lang stereo test. Anterior and posterior segment abnormalities were assessed by using a pen light, hand-held slit lamp, and direct ophthalmoscope.

Results: Refractive error was the most common visual disorder. Considering our criteria of refractive error for myopia ≥ 0.50 D, hyperopia ≥ 1.50 D, astigmatism ≥ 1.00 D, and anisometropia ≥ 1.00 D, the overall prevalence of refractive error in our study was 31.82%. The overall prevalence of myopia, hyperopia, and astigmatism was 24.17%, 2.48%, and 5.17%, respectively. Anisometropia was present in 1.65% of the participants, and 2%, 1.4%, and 0.2% had strabismus, amblyopia, and nystagmus, respectively.

Conclusion: The relatively high prevalence of refractive error in our studied population needs more attention. The results suggest that there is a need for a large-scale community-based preschool screening program in Nepal so that affected children can be identified early and appropriate treatment can be started promptly.

Keywords: epidemiology, Nepal, preschool children, refractive error, vision screening

Introduction

It is estimated that there are 1.5 million blind children in the world, and that nearly 1 in 1,000 children are blind.^{1,2} Visual impairment has significant impact on the affected child with regard to education, future employment, and social welfare throughout life.³

Although eye examinations in early infancy are important, they cannot predict the occurrence of conditions that often appear after infancy, such as accommodative esotropia. Eye examinations/screenings are therefore also recommended prior to 3 years of age. By then, additional vision problems may have developed, and 3-year-olds are beginning to acquire the communication skills which allow them to be tested using methods similar to those used with adults. A particular advantage of examining vision in this age group is that it allows intervention at a time when the problems are highly amenable to treatment.⁴⁻¹²

The goals of preschool vision screening are to identify children who (a) have a vision impairment that may prevent them from obtaining maximum benefit from their educational opportunities and (b) may have an unidentified serious vision problem (i.e., amblyopia). The lack of universal and age-appropriate preschool vision screening continues to contribute to an unacceptable prevalence of permanent visual loss from disorders such as amblyopia, most of which are reversible if detected and treated early.¹³ Ocular and/or visual defects are one of the most common reasons for the referral of young children to a hospital.¹⁴ Preschool vision screening, with referral for treatment as needed, offers a unique opportunity to promote both vision health and the child's educational experience.

Visual defects should be identified as early in life as possible. Early detection provides the most favorable opportunity for effective treatment of a large number of conditions that

produce poor vision, including most types of amblyopia.¹⁵ The greater visual needs of the school age child, the greater social pressures on older children, and the difficulties encountered in obtaining their cooperation are additional reasons for treating amblyopia in the preschool period.¹⁶

Significant refractive errors should be identified early in life. The young child entering the school system should not have to endure the burden and stress of poor visual acuity due to uncorrected refractive errors which can interfere with learning. Children with less than optimally corrected vision need to be identified early so that teachers and caretakers can orient their activities to meet the special needs of these handicapped individuals.¹⁷

Conditions like amblyopia, strabismus, and nystagmus are found to be prevalent in large number in the various records of the school screening done in different parts of our country.¹⁸⁻²⁰ These conditions need to be treated earlier for the best prognosis. Amblyopia is a significant public health problem. Most studies estimate that the prevalence is between 2% and 5%.¹ In fact, amblyopia is the leading cause of monocular vision loss in the United States in people younger than 40 years. Preschool vision screening also detects a significant number of children without amblyopia who have reduced visual acuity due to refractive errors. This group of children must be included in any analysis of the cost effectiveness of a preschool vision screening.²¹

A child's quality of life and neurological development are highly dependent on adequate vision, with compromised vision having serious implications on a child's overall progress.²²⁻²⁴ In the UK, 74% to 80% of orthoptic departments are providing some sort of preschool visual screening, with the majority (88%) of screenings in the three to four year old age group. In the U.S. it is estimated that 21% of children receive preschool screenings.^{25,26} In Nepal, no preschool vision screening policy or program exists.

Children may not complain of symptoms related to their eyes and may not realize they cannot see well, so early detection of ocular abnormalities will aid in early intervention. Ocular findings can indicate the presence of more serious conditions, for example retinoblastoma; early detection of these conditions can save lives. Ocular problems create a negative impact on the child's learning and academic achievements in the future, leading to a decreased quality of life. The aim of this study was to determine the prevalence of visual problems and ocular abnormalities in randomly selected groups of preschool children in order to explore the magnitude of the problem and the need for a large scale preschool screening program in Nepal.

Methods

This study included 484 preschool children from eight randomly selected preschools of Kathmandu Valley. Kathmandu Valley, the capital city of Nepal, has three main districts: Kathmandu, Lalitpur, and Bhaktapur. Due to time constraints and limited resources, four schools each, from

only two districts (Kathmandu and Bhaktapur), were selected for inclusion in our study. The children were examined under the supervision of their teachers and/or parents in their respective schools. Comparatively, a darker room was used for retinoscopy and another room with adequate lighting was used for other examination components. Prior to the examination, an informed consent was obtained from the teachers and/or the parents. Children requiring further evaluation were referred to B.P. Koirala Lions Center for Ophthalmic Studies. Declaration of Tenets of Helsinki was followed.

Ocular Examination

Patient demographics including age, gender, race, and address were recorded in a preset research form designed for this study. A brief history, including visual and ocular complaints, previous eye examination, and use of glasses and medications, was recorded.

Visual Acuity

Monocular visual acuity (VA) testing was performed either using the Sheridan Gardiner (SG) test or Kay picture (KP) test (3 m crowded book) in accordance with the cooperation of the child.

Refraction

Refractive status was determined by performing distance static retinoscopy at a working distance of 50 cm. Cycloplegic refraction was done only in selected cases where the examiner felt this to be the most appropriate (e.g., fluctuating errors, very dim retinoscopic reflex). Myopia was considered as the spherical equivalent ≥ -0.50 D, hyperopia as $\geq +1.50$ D in magnitude, astigmatism as ≥ 1.00 D, and anisometropia as spherical equivalent difference between the two eyes of at least 1.00 D. Amblyopia was defined as visual acuity less than 6/12 (0.3 log MAR), unilateral or bilateral, with best refraction and not attributable to ocular pathology.

Binocularity

Oculomotor imbalance was evaluated by means of the cover test at distance and near or the Hirschberg test if the child was uncooperative during the cover test. Only manifest deviation was noted, and the magnitude was measured either by prism neutralisation test, Hirschberg, or Krimsky tests. Presence or absence of nystagmus was also noted. Extraocular motility was tested in all cardinal positions of gaze by using a pen light or an interesting toy.

Stereopsis

Stereopsis was measured in normal daylight conditions for the cooperative cases with the Lang Stereo test. The test consists of car, star, and cat images with disparities of 550, 600, and 1200 seconds of arc, respectively. The children were asked to show the location of the images with their finger one by one, and their response was noted.

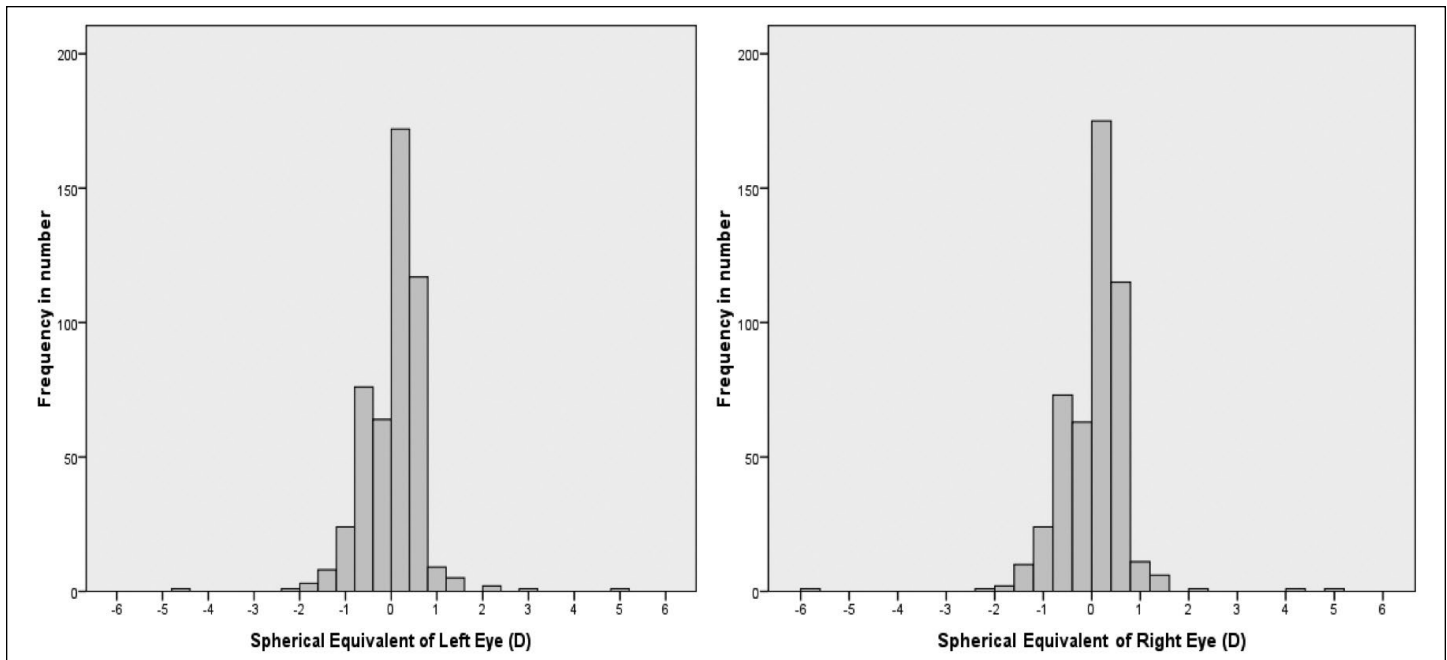


Figure 1. Spherical equivalent distribution of right and left eyes

Table 1: Data recorded for each child at the time of examination

| Ocular measurement | Test used | Notes |
|--|---|--|
| Visual acuity | Sheridan-Gardiner test and Kay Picture test | |
| Refractive error | Retinoscopy and subjective refraction | Cycloplegic refraction was done in selected cases |
| Strabismus presence | Cover test for distance and near, Hirschberg and Krimsky test for near. | Prism neutralisation was used for the measurement of the magnitude of strabismus |
| Nystagmus | Observation | |
| Stereopsis | Lang stereo test | |
| Ocular adnexa, anterior and posterior segment findings | Torch light, hand-held slit lamp, direct ophthalmoscope | |

Other Ocular Findings

Detailed anterior segment evaluation was done with the help of a hand held slit lamp or a pen light. The posterior segment evaluation was performed with a monocular direct ophthalmoscope or a binocular indirect ophthalmoscope.

Findings of ocular adnexa, anterior segment, and posterior segment were recorded. Table 1 shows the variables and the methods used for collecting data in our study group.

Results:

The mean age of the participants was 3.80 ± 0.80 years. The majority of the children (215, 44.42%) were three years of age. Among all of the children, 53.7% (260) were males and 46.3% (224) were females. More than three fourths (77%) of the total participants were Mongols and the rest

were Caucasians. Only 9.3% (45) of the preschool children included in our study had prior eye examinations performed. The previous history of eye check-up was less in the younger children, which was statistically significant ($\chi^2 = 33.70$, $df = 2$, $p < 0.05$).

Overall Ocular Morbidity

Refractive error was the most prevalent ocular morbidity, followed by ocular adnexal abnormalities and anterior segment abnormalities. Suspicion of glaucoma was based on the screening examination and referred directly to the tertiary hospital.

Visual Acuity

Two hundred and thirty (47.5%) children cooperated with the SG VA test, and the remaining 254 (52.5%) children cooperated with the KP VA test. The measured VA was then converted to logMAR. The mean presenting VA was 0.12 ± 0.18 logMAR in the right and left eyes. Thirty-two percent (155) of the children required glasses, but only 2.3% (11) of them were found to be using glasses at the time of examination.

Prevalence of Refractive Error

The overall prevalence of refractive error in our study was 31.82%. The prevalence of myopia, hyperopia, and astigmatism was 24.17%, 2.48%, and 5.17%, respectively. Anisometropia was present in 1.65% of the children. The pattern of magnitude of spherical equivalent refractive error of total eyes of the participants in this study is shown in Figure 1.

Most of the children's spherical equivalent refractive error was between +1.00 D and -1.00 D in both the eyes. The spherical equivalent refractive error of right and left eyes was not normally distributed ($p < 0.05$; Kolmogorov-Smirnov

Table 2: Prevalence of myopia and hyperopia in school-entry age children reported from selected population-based studies

| Study | Country | Sample size | Age range (yr) | Hyperopia definition | Hyperopia prevalence % | Myopia definition | Myopia prevalence% |
|------------------------------|---------------|-------------|----------------|----------------------|------------------------|-------------------|--------------------|
| Barnes et al. ³⁰ | Great Britain | 7600 | 7 | >2.00 D | 5.9 | ≤-1.00 D | 1.1 |
| Preslan et al. ³¹ | United States | 680 | 4-7 | >4.00 D | 0.9 | <-0.5 D | 3.1 |
| Naidoo et al. ²⁷ | South Africa | 458 | 6 | ≥2.00 D | 3.8 | ≤-0.5 D | 1.6 |
| He et al. ²⁸ | China | 295 | 6 | ≥2.00 D | 14.6 | ≤-0.5 D | 2.7 |
| Murthy et al. ²⁹ | India | 494 | 6 | ≥2.00 D | 13.0 | ≤-0.5 D | 5.9 |
| Jamali et al. ²⁵ | Iran | 815 | 6 | ≥2.00 D | 20.7 | ≤-0.5 D | 1.7 |
| Our study | Nepal | 484 | 3-5 | ≥1.50 D | 2.48 | ≤-0.5 D | 24.17 |

Goodness of fit test). There was no significant difference between the spherical equivalent of right eye and left eye ($p > 0.05$ Wilcoxon Signed-Rank test). The astigmatic value in most of the cases was between 1.00 and 1.50 D. With-the-rule astigmatism in both the eyes was the most common type of astigmatism. There was not any particular pattern of astigmatic axis change according to age in our study population.

Strabismus

Two percent of the total children participating in our study had strabismus. In most of the cases, myopic refractive error was associated with exodeviation and hyperopic refractive error with esodeviation. The prevalence of strabismus was found to be higher in females (7) than males (3).

Amblyopia and Nystagmus

Amblyopia was present in 1.4% (7) of the total participants. The breakdown by type is as follows: 0.82% (4), strabismic amblyopia; 0.41% (2), anisometropic amblyopia; 0.20% (1), meridional amblyopia. Nystagmus was present in only one child who was three years of age.

Other Ocular Findings

Epicantal folds were present in 9.3% (45) of the cases. After refractive error, this was the most common ocular finding, followed by ocular allergy (13, 2.68%) and suspicion of glaucoma (11, 2.27%). Congenital nasolacrimal duct obstruction was present in 1.65% (8) of the children; blepharitis and conjunctivitis were each found in 1.24% (6) of the children. Chalazion, corneal opacity, and entropion were present in 0.61% (3), 0.41% (2), and 0.20% (1), respectively.

Discussion

This was a cross sectional, descriptive, hospital and community-based study which was carried out in 484 children admitted in the preschools of Kathmandu Valley. The mean age of the children was 3.80 ± 0.80 years. Among 484 participants, 77% (372) were Mongolians and the remaining 23% were Caucasians. This may be due to the fact that this study included more schools from Bhaktapur district, where many Mongols reside.

Only 9.3% (45) of the children had history of an eye examination. The reason for this may be due to the younger age of the children. Lack of awareness among parents and the lack of any complaints from the children might be contributing factors. The examination in these children was done in their respective schools using their classes as the examination room so that they would be more cooperative in their familiar environment. Those who required further examination and evaluation were referred.

Visual acuity was assessed in all the children; however, it was very difficult to obtain adequate cooperation from all of the participants with a single visual acuity testing method. The SG test was used for the cooperative children, and the KP test was used for those who were less cooperative. However, all of the children were cooperative enough to allow their VA to be taken with one of the two tests.

Jamali et al.²⁵ recorded VA of only 91.7% of the children in his study. Only 3.6% of the participants had presenting VA $\leq 6/12$ in his study, but in our study 7% of the children had a presenting VA of $\leq 6/12$ in one or both of their eyes. The presence of refractive error, strabismus, or amblyopia might have been contributing factors for the reduction in VA. The prevalence of refractive error in our study was less than that in the study done by Jamali et al.²⁵ in Iran. We also compared our data with the study done by Adhikari et al.²⁶ who studied the ocular morbidity of 1100 school aged children (5-15 years) in the Kathmandu and Bhaktapur District of Nepal. Our refractive error finding was significantly higher than the study by Adhikari et al.²⁶ ($p < 0.05$). Similar studies have been done in different parts of the world but with a variety of age ranges and different criteria for refractive errors (Table 2).

It is often difficult to compare one study to another due to the different methodological designs used. The prevalence of hyperopia was higher in Chinese and Iranian children than in British, American, African, and Nepalese children. However, it was interesting to note that the prevalence of myopia was significantly higher in our studies than amongst European, American, and other Asian children.

In our study, the prevalence of myopia was 24.17%, which is more prevalent than in studies done in Great Britain,³⁰ the United States,³¹ South Africa,²⁷ and India.²⁹ This may be

due to the fact that in the present study almost 77% of the patients were Mongolian. It has been concluded in various studies that myopia is more prevalent in this group of people. We agree that there might have been some overestimation of myopia in our study as most of the refraction was non-cycloplegic; however, we did take measures to minimize such errors whenever possible. Nevertheless, this higher prevalence of myopia needs immediate attention so that the problem can be identified early and the children do not suffer longer periods of time with poor VA, which may hamper their overall development. The prevalence of hyperopia in our study was considerably lower in comparison to the studies done in India,²⁹ China,²⁸ and Iran.²⁵ Astigmatism was present in 5.17% of the total participants, which proved to be slightly more common than in Australia³⁴ and Iran.²⁵

Among 154 children who had significant refractive errors according to our criteria, we found the use of spectacles only in 11 children when they presented for the examination. This may be due to no history of any ocular checkup done previously and also may be due to non-compliance with the use of glasses because of the lower age. Strabismus was present in 2.1% of the total participants in our study, which is slightly more than in the study done by Jamali et al. (1.2%)²⁵ and Adhikari et al. (1.6%).²⁶ A smaller number of participants in our study than that of the aforementioned studies may be the reason for the higher prevalence of strabismus. The most common type of strabismus was alternate divergent strabismus, which is in accordance with the study done by Adhikari et al.²⁶

The prevalence of amblyopia in our study was 1.4% (7). The children were diagnosed as having amblyopia if they had visual acuity of 6/12 (0.3), unilaterally or bilaterally, with the best refractive correction in place and not attributable to any ocular pathology. In a study done by Yu-Hung Lai et al,³² the prevalence was 5%. The differences in the age group of the study population and the criteria for diagnosing amblyopia may have contributed to the difference.

Epicanthal folds were present in 9.3% of the children, which was the most common ocular finding after refractive error. This may be due to the significant number of Mongolian children in our study.

Conclusion

Our results showed that a significant percentage of preschool children have refractive error, especially myopia. If untreated, this may impair their future learning capability and learning potential. The earlier the diagnosis, the better the visual prognosis and intervention.

Children should not have to endure the burden and stress of poor VA due to uncorrected refractive errors which can interfere with learning. Awareness by the parents and teachers is very important to make the quality of life of these children better. In view of the above facts, this kind of screening along with a prevention, promotion, and

treatment program with periodic evaluation seems to be appropriate to reduce ocular morbidity in the children in countries like Nepal.

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