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Research Article

Efficacy of School Screening by Photoscreeners and Prevalence of Amblyopia in Primary School Children in Karnataka

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Abstract

Aim of the Study: To evaluate the accuracy of photoscreeners in identifying children at-risk for amblyopia and to assess the prevalence of amblyopia in Karnataka, India.

Materials and Methods: Prospective study done on urban and rural primary schools around Bangalore, India from October 2015 to February 2016 in co-ordination with NANNA KANNU school screening project. Following parental consent, each child received both a full eye examination (visual acuity with Snellen's visual acuity chart, torch light examination of the eyes, Mohindra retinoscopy) by the study optometrist and vision screening by one of the volunteer examiners (Lay screener) using Photoscreeners (Plusoptix and Topcon Autorefractor). The children diagnosed with the vision problems were further evaluated in the base hospital. Sensitivity, specificity, positive and negative predictive value of the Photoscreeners were calculated and compared with the Mohindra retinoscopy.

Results: 6000 children in the age group of 7 - 11 yrs were screened in the schools. Females were 49%. 61.18% were in the age group of 9 - 10 yrs. Topcon autorefractor and Mohindra retinoscopy were performed in all 6000 children. Plusoptix A09 photoscreening performed randomly in 2910 children out of 6000 children in our study. Topcon Autorefractor was found to have the sensitivity of 83% and plusoptix 70%. 254 (4.24%) children were found to have at risk amblyopia. 7 (0.1%) had sensory deprivation amblyopia, 7(0.1%) had strabismic amblyopia, 3 (0.1%) had anisometropic and rest 240 (98.4%) had ametropic amblyopia.

Conclusion: Amblyopia is the most frequent visual disorder in children. The prevalence of amblyopia in Karnataka was found to be 4.24%. School screening program plays an important role in identifying refractive errors, amblyopia and other eye disorders in the children at the earliest. The performance of Photoscreeners in detecting amblyopia risk factors are satisfactory and it is a very useful tool in screening Indian children.

Keywords: *Photoscreeners; Amblyopia; Karnataka*

Introduction

World Health Organization (WHO) statistics revealed that approximately 1.4 million children in the world are blind, and of these, three-quarters live in poorest regions of Africa and Asia. Very few studies have been done in India to estimate the prevalence of childhood blindness but available evidence suggests that one out of every 1000 children is blind [1-3].

Amblyopia is the most common visual disorder in children and can lead to permanent visual impairment if treatment is not initiated early. Amblyopia is present in 2 - 4% of the general population [4-6]. The incidence in Indian school children has been stated to be 0.67%. Of the examined eyes, 60% had the onset of amblyopia between the ages of 1 - 5 years [6]. Significant refractive errors and strabismus are important amblyogenic risk factors [7,8]. Screening for visual impairment and identification of the children suffering from refractive errors and encouraging them to take corrective measures in the form of spectacles and occlusion therapy can therefore play an important role in preventing long-term visual disability [9]. Considering the magnitude of childhood blindness and prevalence of at-risk amblyopia, importance of school screening plays a major role. Instrument-based screening is a quick process that needs little cooperation of children and has been regarded as the preferred option for vision screening especially for developmentally delayed and preverbal children [10]. Photoscreeners have various advantages in school screening programs. First, it is performed approximately one meter from the children which keeps them relaxed and is convenient for those with disabilities such as poliomyelitis and autism. Second, both eyes are examined simultaneously. Third, it is automated and can be used by lay screeners which is very useful in countries like India where there are very few professional eyecare specialists for the huge population. Fourth, the device is battery-operated and portable, making it comfortable for field works.

Aim of the Study

The aim of our study was to evaluate the accuracy of Photoscreeners in identifying children at-risk amblyopia and to assess the magnitude of amblyopia in Karnataka.

Materials and Methods

This is a prospective, open-label, randomized controlled study done on urban and rural primary schools around Bangalore from October 2015 to February 2016 in co-ordination with NANNA KANNU school screening project. The study was approved by the scientific and ethical committee. Following parental consent, each child received both a full eye examination (visual acuity with Snellen's visual acuity chart, torch light examination of the eyes, Mohindra retinoscopy) by the study optometrist and vision screening by one of the volunteer examiners (Lay screener) using Photoscreeners (Plusoptix and Topcon Autorefractor). The lay screeners were given a basic training regarding the use of photoscreeners to measure the parameters. In Mohindra retinoscopy, the dim retinoscope light acts as the fixation target that does not stimulate accommodation. The examiner positioned at 50cm neutralizes the two principal meridians of the retinal reflexes to get the refractive error. The children who were found to have high refractive error and other eye disorders were referred back to the base hospital for detailed evaluation under slit lamp, cycloplegic retinoscopy and fundus examination.

Children were classified as having strabismus if any tropia was present at distance or near, with or without spectacles. Amblyopia is clinically defined as the difference in best corrected visual acuity of two or more lines of acuity between two eyes.

A determination of amblyopia risk factors was based upon the 2003 AAPOS referral criteria [11]:

- Anisometropia (spherical or cylindrical) > 1.5D
- Hyperopia > 3.5D in any meridian
- Myopia > 3.0D in any meridian
- Astigmatism > 1.5D at 90 degrees or 180 degrees; > 1.0D in oblique axis (more than 10 degrees from 90 degrees or 180 degrees)
- Any manifest strabismus
- Any media opacity > 1 mm in size
- Ptosis ≤ 1 mm margin reflex distance.

Ametropic amblyopia was defined as best VA in both eyes < 6/12 (LogMAR 0.3), in the presence of amblyogenic factors such as hyperopia ≥ 4D, myopia ≤ -6.00D, or astigmatism ≥ 2.50D, or past or present obstruction of the visual axis [12].

Sensitivity, specificity, positive and negative predictive value of the Photoscreeners were calculated and compared with the Mohindra retinoscopy. The statistical analyses were performed by STATA 11.2 (College station TX USA). P < 0.05 considered as statistically significant.

Results

6000 children in the age group of 7-11 years were included in the study. There were 3069 (51.15%) males. Topcon autorefractor and Mohindra retinoscopy were performed in all 6000 children. Plusoptix A09 photoscreening performed randomly in 2910 children out of 6000 children in our study. Were any other visual functions like CS and specific tests for amblyopia done??

Majority of children seen were between 8 to 10 years (78.8%).

Among 6000 children studied the standard procedure Mohindra retinoscopy detected 254 children as having at risk amblyopia. In comparison to Mohindra, Topcon detected 426 children as having at risk amblyopia. Topcon autorefractor had false positives in 172 children.

Topcon autorefractor	Mohindra retinoscopy			p-value
	At risk amblyopia	Not at risk	Total	
At risk amblyopia	212 (3.5%)	214 (3.5%)	426 (7.1%)	< 0.001
Not at risk	42 (0.7%)	5532 (92.2%)	5574 (92.9%)	
Total	254 (4.2%)	5746 (95.7%)	6000 (100%)	

Table 1: *Comparison between the Mohindra retinoscopy and Topcon autorefractor in children with at risk amblyopia.*

Both the techniques detected at risk amblyopia in 212 (3.5%) children and Topcon detected at risk amblyopia in 426 (7.1%).

Sensitivity	83.46%
Specificity	96.03%
Positive predicted value	48.18%
Negative predicted value	99.24%

Table 2: *Sensitivity, specificity, positive predictive value and negative value of Topcon autorefractor.*

Prevalence of at risk amblyopia	Number of Cases	Percentage	95% Confidence Interval
Not at risk amblyopia	5746	95.77%	
Anisometropia	3	0.05%	0.01% - 0.10%
Hyperopia	24	0.40%	0.30% - 0.60%
Myopia	57	0.95%	0.72% - 1.23%
Astigmatism	156	2.60%	2.21% - 3.03%
Squint	7	0.12%	0.05% - 0.24%
Media opacity	7	0.12%	0.05% - 0.24%
Total	6000	100%	

Table 3: *Prevalence estimation of at risk amblyopia children by Mohindra retinoscopy.*

Out of 6000 children, 5746 were identified to be at risk for amblyopia. Astigmatism (2.60%) was the commonest refractive error detected followed by myopia.

Sensitivity	70.71%
Specificity	96.51%
Positive predicted value	41.67%
Negative predicted value	98.94%

Table 4: *Sensitivity, specificity, positive predictive value and negative predictive value of Plusoptix.*

Prevalence of at risk amblyopia children in our study is estimated to be 4.24%.

Prevalence of uncorrected refractive errors found to be 4%.

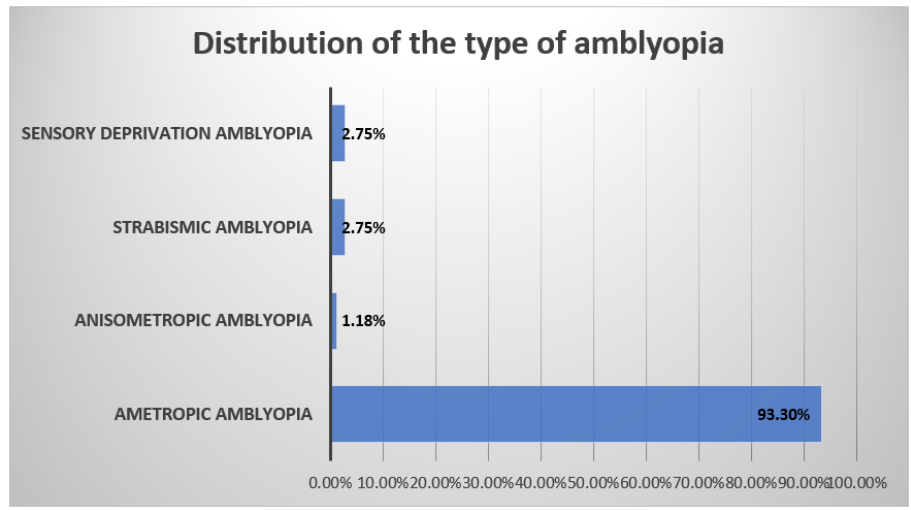

Figure 1: *Showing the distribution of amblyopia.*

Ametropic amblyopia (93.30%) was commonly diagnosed followed by strabismic and sensory deprivation amblyopia.

Discussion

Our prospective study analyzed the prevalence of amblyopia and the effectiveness of photoscreening in identifying at-risk amblyopic children in school screening program.

In South-Asian region the Chinese studies showed amblyopia prevalence rate to be between 0.8% to 2.5% in different subsets of population [13]. Sapkota., *et al.* showed the prevalence rate to be 1% in a hospital based study in Nepal [14]. The prevalence rates in various parts of India was showed to be between 1.1% - 6.6% [15-17]. In our study, the prevalence of at-risk amblyopia in south India was found to be 4.24%. Prevalence of amblyopia varies because of different age-group of studied populations and different factors prevailing in that region, like literacy rate, socio-economic conditions, awareness of the people, frequency of visual screening programs and geographical factors.

Priya M., *et al.* conducted screening in urban and rural areas of south Karnataka in children between 11 to 15 years and they found that the socio economic factors is the most important barrier for the children which may end up in amblyopia and permanent visual disability [18]. Considering these factors we trained the primary school teachers and volunteers for identifying at-risk amblyopia children in schools.

The ideal screening device would have 100% sensitivity (the ability to detect all targeted disease) and 100% specificity (the ability to ignore all non-targeted disease). In the real world, no screener has reached such a level of perfection. Community screening programs and/or pediatrician offices should choose referral cut-offs that provide the best combination of sensitivity and specificity for their goals [19]. Zale Rajavi., *et al.* studied accuracy of photorefraction and autorefraction as compared to cycloautorefraction. The overall agreement between photorefraction and cycloautorefraction was over 81% for all refractive errors [20]. Photorefractometry had acceptable sensitivity and specificity. Demirci G., *et al.* investigated the reliability of Plusoptix S08, the newest photoscreener and Topcon autorefractometer by comparing them with cycloplegic retinoscopy. This study showed that the cycloplegic autorefractometer and retinoscopy results are similar [21]. Our study showed similar results with the Topcon autorefractor showing 83% sensitivity and plusoptix with 70% sensitivity, which are acceptable for screening. We evaluated the effectiveness of Photoscreeners, so that it could be used by lay screeners who would need basic training regarding how to record the refractive errors and refer those who meet the standard AAPOS criteria. We have no financial interest.

Uncorrected refractive errors are the commonest cause of visual loss in children [22]. Astigmatism is the commonest refractive error followed by myopia and then by hyperopia, in our study. This is in coherence with other studies [14,23].

In our study, ametropic amblyopia is commonly found in these children which require only glasses to bring about a change in their life. This can be diagnosed at the earliest by regular vision screening for amblyopia in schools.

In developing countries like India, where people to doctors ratio is very high, layscreeners definitely have a role in identifying at-risk children for amblyopia, whom when treatment initiated earlier have better visual functions.

In Vision 2020, amblyopia is a major preventable and treatable cause of visual impairment [24,25]. If treated appropriately, it can improve the visual functions and hence the quality of life of these children in adulthood.

Conclusion

Amblyopia is the most frequent visual disorder in children. The prevalence of amblyopia in Karnataka was found to be 4.24%. School screening program plays an important role in identifying refractive errors, amblyopia and other eye disorders in the children at the earliest. The performance of Photoscreeners in detecting amblyopia risk factors are satisfactory and it is a very useful tool in screening Indian children.

Bibliography

1. Dandona R and Dandona L. "Childhood blindness in India: A population based perspective". *British Journal of Ophthalmology* 87.3 (2003): 263-265.

2. Murthy GV., *et al*. "Refractive error in children in an urban population in New Delhi". *Investigative Ophthalmology and Visual Science* 43 (2002): 623-631.

3. Dandona R., *et al*. "Refractive error in children in a rural population in India". *Investigative Ophthalmology and Visual Science* 43 (2002): 615-622.

4. Eibschitz-Tsimhoni M., *et al*. "Early screening for amblyogenic risk factors lowers the prevalence and severity of amblyopia". *Journal of AAPOS* 4.4 (2000): 194-199.

5. Newman DK and East MM. "Prevalence of amblyopia among defaulters of preschool vision screening". *Ophthalmology Epidemiology* 7.1 (2000): 67-71.

6. Karki KJD. "Prevalence of amblyopia in ametropias in a clinical set-up". *Kathmandu University Medical Journal* 4.4 (2006): 470-473.

7. Zhale Rajavi., *et al*. "Is Non cycloplegic Photorefraction Applicable for Screening Refractive Amblyopia Risk Factors?" *Journal of Ophthalmic and Vision Research* 7.1 (2012): 3-9.

8. Paff T., *et al*. "Screening for refractive errors in children: the PlusoptiX S08 and the Retinomax K-plus2 performed by a lay screener compared to cycloplegic retinoscopy". *Journal of AAPOS* 14.6 (2010): 478-483.

9. Rustagi N., *et al*. "Screening for visual impairment: outcome among school children in a rural area of Delhi". *Indian Journal of Ophthalmology* 60.3 (2012): 203-206.

10. "Vision screening for children 1 to 5 years of age: US Preventive Services Task Force Recommendation statement". *Pediatrics* 127.2 (2011): 340-346.

11. Donahue SP., *et al*. "Preschool vision screening: what should we be detecting and how should we report it? Uniform guidelines for reporting results of preschool vision screening studies". *Journal of AAPOS* 7 (2003): 314-316.

12. Multi-ethnic Pediatric Eye Disease Study Group. "Prevalence of amblyopia and strabismus in African American and Hispanic children aged 6 to 72 months". *Ophthalmology* 115.7 (2008): 1229-1236.

13. Chia A., *et al*. "Risk factors for strabismus and amblyopia in young Singapore Chinese children". *Ophthalmic Epidemiology* 20 (2013).

14. Sapkota K., *et al*. "Prevalence of amblyopia and pattern of refractive error". *Nepalese Journal of Ophthalmology* 5.9 (2013): 38-44.

15. Kalikiyavi V., *et al*. "Visual impairment in school children in South India". *Indian Journal of Ophthalmology* 45 (1997): 129-134.

16. Murthy GV., *et al*. "Refractive error in children in an urban population in New Delhi". *Investigative Ophthalmology and Visual Science* 43.3 (2002): 623-631.

17. Anjaneyulu K and Narendranath Reddy G. "Prevalence of Amblyopia in Children Aged from 5-15 Years in Rural Population Kurnool Dist. Andhra Pradesh, India". *International Journal of Science and Research (IJSR)* 4 (2015): 99-100.

18. Priya Morjaria., *et al*. "Spectacle wearing in children randomised to ready-made or custom spectacles, and potential cost savings to programmes: study protocol for a randomised controlled trial". *Trials* 17 (2016): 36.

19. Eric Singman., *et al*. "A Comparison of Referral Criteria used by the PlusoptiX Photoscreener". *Strabismus* 21.3 (2013).

20. Zhale Rajavi., *et al*. "Is Non cycloplegic Photorefraction Applicable for Screening Refractive Amblyopia Risk Factors?" *Journal of Ophthalmic and Vision Research* 7.1 (2012): 3-9.

21. Demirci G., *et al*. "Comparison of photorefraction, autorefractometry and retinoscopy in children". *International Ophthalmology* 34.4 (2014): 739-746.

22. Resnikoff S., *et al*. "Global magnitude of visual impairment caused by uncorrected refractive errors in 2004". *Bulletin of the World Health Organization* 86.1 (2008): 63-70.

23. Xiao X., *et al*. "Prevalence of astigmatism in 2023 children with amblyopia". *Zhongguo Dang Dai Er Ke Za Zhi* 13 (2011): 462-465.

24. Dandona R., *et al*. "Planning Low Vision Services in India: A Population based perspective". *Ophthalmology* 109 (2002): 1871-1878.

25. Murthy GV., *et al*. "Current estimates of blindness in India". *British Journal of Ophthalmology* 89 (2005): 257-260.

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