



Original article

Validation of performance of certified medical assistants in preschool vision screening examination

Adhikari S, Shrestha U
Tilganga Institute of Ophthalmology, Gaushala Kathmandu, Nepal

Abstract

Introduction: Preschool vision screening examination is still a new concept in Nepal. There is a need for developing cost-effective tools for detecting amblyogenic factors in Nepalese children. Certified medical assistants (CMA) are health personnel who work in village health posts.

Objective: To find out the effectiveness of vision screening by certified medical assistants using simple tools like an HOTV chart and the Red Reflex test.

Materials and methods: A cross sectional and validation study was carried out in two phases. In the first phase, 20 CMAs from each Village Development Centre (VDC) of the Bhaktapur District were given training on visual acuity test by using an HOTV chart, Bruckner test by using a retinoscope and the test for ocular alignment by a torch light. In the second phase, children aged 3 - 7 years were examined by trained certified medical assistants in five remote VDCs of Bhaktapur District. These children underwent the gold standard examination by two pediatric ophthalmologists blind to the CMAs' findings.

Results: The mean age of children was 5.26 ± 376 years. The overall sensitivity of certified medical assistants examination was 58 % and the specificity was 98 %. While comparing the test characteristics of different examination tools, the HOTV test was found to be the most effective one with the sensitivity of 80 % and the specificity of 98 %.

Conclusion: Vision screening by certified medical assistants can help in detection and early referral of children having amblyogenic risk factors with high sensitivity. The HOTV test is the most effective one with high sensitivity and specificity. In developing countries like Nepal, where access to regular eye examination is a rare possibility, preschool vision screening using the HOTV test can be effective.

Keywords: preschool children, amblyopia, HOTV chart, Bruckner test

Introduction

Vision disorders are one of the most prevalent handicapping conditions in children. WHO has included childhood blindness as one of the five

priority diseases in its program Vision 2020. (WHO, 2005). Amblyopia, strabismus, and significant refractive error are the most common vision disorders of children (US Public Health Service, 1994; Moore B, 1997; Ciner EB et al 1998; American Orthoptic Association, 2002; American Academy of Ophthalmology, 2002). When detected early, amblyopia can be treated or even

Received on: 04.12.2010 Accepted on: 18.01.2011
Address for correspondence: Dr Srijana Adhikari, MD
Associate Professor (NAMS), Pediatric Ophthalmologist
Tilganga Institute of Ophthalmology, Gaushala, Kathmandu, Nepal
Email: srij_a@yahoo.com
Phone: +977-9849287387, +977-1-4493775

prevented. However, in developing countries like Nepal, very few children receive an eye examination and vision screening. There is a handful of school eye health programs running in different parts of Nepal. But there are no regular and formal school and preschool vision screening programs. Examination in children is challenging. There is a need for a very efficient and cost-effective method for identifying the preventable diseases in childhood. Currently, there is considerable controversy concerning the best way to identify preschool children with these conditions. There are many screening programs conducted in different parts of world with varied levels of sensitivity and specificity (Hartman et al 2001; Stewart et al, 2006 D; Becker et al 2006; Donahue et al 2006; Sacido et al, 2005; Mocan et al 2005; Kothari et al 2005; Vision In Preschooler (VIP) Study Group, 2004a). In Nepal also, there is a need for a sensitive, specific and cost-effective method of detecting amblyopia in early age. Certified medical assistants (CMAs) are the ones who work in village health posts. In each village, there is one sub-health post where these CMAs work. They are primarily in contact with the village children even before the children attend formal school which begins at around the age of 6 years in most rural parts. Hence, giving training to these health personnel in vision screening would directly benefit children who are deprived of these services. There are several studies done on red reflex asymmetry and HOTV tests as simple tools for detecting vision and amblyogenic factors (Gole et al 1995; VIP Study Group, 2004b; Kothari et al). We tried to find out the validation of performance of CMAs on detecting visual abnormalities in preschool children, which has never been tested in Nepal.

Materials and methods

A cross sectional, validation study was designed, which was approved by the Institutional Review Board (IRB) of Tilganga Institute of Ophthalmology (TIO) and received financial support from the "Himalyan Childhood Blindness Alleviation and Eye Health Initiative" project with support from USAID,

Nepal. The study was conducted in five village development centers (VDC) of Bhaktapur District, one of the three districts of Kathmandu valley. The place of study was village health posts and children 3 - 7 years were selected from each VDC. Informed consent was taken from either of the parents of the children who participated in the study. The study was conducted in the following two phases.

Phase I : Training of CMAs

There are 20 VDCs in Bhaktapur District with one CMA working in each sub-health post. A day long training was given to these 20 CMAs in Tilganga Institute of Ophthalmology. Both theory and practical sessions were carried out on the following tests.

- Bruckner (red reflex test) by Heine (Germany) retinoscope held at 1 meter distance.
- Visual Acuity examination with an HOTV chart in 3 meter distance (Precision Vision America)
- Test for ocular alignment using a torch light.

Phase II : The examination of children

The examination of children was done in five remote VDCs of Bhaktapur District. Children aged 3 - 7 years were examined by trained CMAs in the local village health post. There were a total of five visits to the five different VDCs. In each visit, 100 children were examined (except in Chhaling VDC where 128 children were examined) by 4 trained CMAs in four different rooms. The gold standard examination was done by pediatric ophthalmologist in a separate room, blind to CMAs' findings. The criteria for a failed screening examination by the CMAs were any one of the following.

- Visual acuity below 6/12 line in either eye using an HOTV chart with matching plates;
- Abnormal red reflex test;
- Presence of ocular misalignment or any obvious ocular pathology (ptosis, red eye etc).



The gold standard examination included the following.

- Visual acuity examination by using an HOTV chart at a 3 meter distance;
- Extraocular movement and test for ocular alignment by using a torch light;
- Anterior segment examination by using a hand-held slit-lamp;
- Cycloplegic retinoscopy by using 1 % cyclopentolate eye drops;
- Fundus evaluation by direct ophthalmoscope.

Statistics: Data collection was done using standard pro formas and data entry by using Microsoft excel. Data analysis was done by using SPSS version 16.0.

Results

A total of 528 children aged 3 - 7 years were examined by 20 trained CMAs. The gold standard examination was done by two pediatric ophthalmologists. The mean age was 5.26 ± 1.376 years. Most of the children (25.4 % , n = 134) were in the age group of 7 years ($p < 0.001$). The male : female ratio was 1.30:1.

The CMAs' examination: Out of 528 children examined, in 4.34 % (n = 23) visual acuity could not be assessed and thus the assessments were labelled as inconclusive. These children were excluded when calculating the validity of the study. Most of the children in this inconclusive group were of age 3 - 4 years ($p < 0.001$). On examination of children by the CMAs, 4.34 % (n = 23) children failed the screening examination. Among the children who failed vision screening, 1.14 % (n = 6) children could not pass the HOTV examination, 2.27 % (n = 12) had abnormal red reflex test and 0.37 % (n = 2) had both red reflex abnormality and failed visual acuity test. In 0.56 % (n = 3) of these children, ocular misalignment was detected.

The gold standard examination: There were 2.6 % (n = 14) children having visual disability. Out of these children 1.32 % (n = 7) had refractive error, 0.56 % (n = 3) children had amblyopia due to uncorrected refractive error, 0.56 % (n = 3) had strabismus and 0.18 % (n = 1) corneal scar. Out of the 23 children with the inconclusive results in the CMA examination, 21 children had normal ocular examination and two children had refractive error.

The overall validity of the performance of the CMAs has been shown in **Table 1**. Examination by CMAs was 58 % sensitive and 96 % specific. While calculating the test characteristics of different tools, it was found that the HOTV test had a sensitivity of 80 % and the specificity of 98 %.

Table 1

The validity of examination done by certified medical assistants

Examination by CMAs	Gold standard examination	
	Abnormal	Normal
Abnormal (Failed Screening)	7 (a)	16 (b)
Normal	5 (c)	467 (d)
Sensitivity(a/a+c)	58.3%	
Specificity(d/b+d)	96.7%	
Positive Predictive value(a/a+b)	30.43%	
Negative predictive value(d/d+c)	98.75%	

The red reflex test had a sensitivity of 16 % and the specificity of 97 %. All the children having ocular misalignment in the CMA examination had the strabismus cases with the sensitivity of 50 % and the specificity of 100 %. (**Table 2**).

Among three screening tests, there was not much significant difference in the examination by CMAs and the gold standard examination using the HOTV chart ($p = 0.56$). The positive and negative predictive values of the different tests have been shown in table 2.

Table 2
Validation of different examination tools

Examination by CMAs	Gold standard Examination	
Visual acuity with HOTV chart	Abnormal	Normal
Abnormal	4(a)	4(b)
Normal	1(c)	496(d)
Sensitivity(a/ a+c)		80%
Specificity(b/b+d)		99%
Red Reflex test		
Abnormal	2(a)	12(b)
Normal	10(c)	481(d)
Sensitivity(a/ a+c)		16%
Specificity(b/b+d)		97%
Test for ocular misalignment		
Abnormal	3(a)	0(b)
Normal	3(c)	505(d)
Sensitivity(a/ a+c)		50%
Specificity(b/b+d)		100%

Discussion

Preschool vision screening examination is still a new concept in Nepal. There is a need for developing cost-effective tools for detecting amblyogenic factors in Nepalese children. This study was conceptualised with the view of these facts. We included children from 3 to 7 years of age as preschool children in our study because in most rural areas of Nepal, formal school begins at around 6 - 7 years of age. Other similar studies have included children of 3 to 5 years of age (VIP study Group, 2009; Khandekar et al 2009). The number of male children was more than that of female children, which shows the male-dominating society of our country where females are not encouraged to go to school. There are no formal school and preschool vision screening programs in Nepal. Children, especially in rural areas, never get an opportunity to have their eye examined before it is too late for the treatment.

This study was carried out to find out whether the CMAs are adequately competent to carry out effective vision screening after they receive the pre-requisite training. Many studies have shown the

validity of vision screening by non-ophthalmic personnel. In the Vision in Preschooler (VIP) study, vision screening by lay screeners and nurse screeners has been compared. The study found that lay screeners and nurse screeners were equally competent in conducting vision screening by autorefractors and lea symbol with reduced distance (VIP Study Group, 2005). In our study, we compared three different tests: red reflex, test for ocular alignment and the HOTV vision screening test. This study showed that the HOTV visual acuity is more sensitive than the red reflex test and the test for ocular alignment. Similarly, there is one study where vision screening done by pediatric residents using red reflex test and the photoscreeners were compared (Evelyn et al 2001). They found that pediatric residents were better at detecting amblyopia by using MTI photoscreening than by using the Bruckner test.

The study done by Lica Chui et al found that simple vision screening tools are effective in children 41 months and older when done by non-ophthalmic personnel (Lica et al, 2004).²² We found that in children 3 - 4 years old, the visual acuity testing was more inconclusive than in the older children. Similarly, the studies done in effectiveness many have varied sensitivity and specificity of different screening tools. The red reflex is a simple tool in detecting amblyogenic factors in preschool children. The study done by Graf M et al (2008) has found the Bruckner test an effective method in identifying children with strabismus and amblyopia.. Also, a study done in India by Mihir Kothari et al have shown that the bruckner reflex has 71 % sensitivity in detecting amblyogenic risk factors (Kothari et al, 2007).²⁴ Testing visual acuity in preverbal children is always challenging. Lea symbol and HOTV charts have been in use in many countries with good results (VIP study group 2010; Arnold et al 2008). We used the HOTV chart manufactured by Precision Vision America for a three-meter distance. The sensitivity is more than that of the Bruckner test. The main limitation of our study is the relatively small sample size. Also, we could have tested the validity of some other simpler tools like stereoacuity tests which have been



widely used in other studies (VIP Study Group 2009, JC et al 2003). Similarly, the use of photoscreening can also be considered as a simple vision screening tool though this would be a little costly in country like Nepal.

Conclusion: In Nepal, since there is very poor access to health services in many rural areas, vision screening by trained certified medical assistants can result in timely detection and referral of children with amblyogenic risk factors. The HOTV chart can be distributed to every health post where these CMAs are posted, so that all the children would get periodic vision screening examination before it is too late for the treatment.

Acknowledgement: The study was conducted with the grant received from the Himalayan Childhood Blindness and Alleviation Project supported by the USAID through the Himalayan Cataract Project, one of the partner organizations of Tilganga Institute of Ophthalmology. We acknowledge Mr Mohan Shrestha, Research Associate, Mr Nhukesh Maharjan, Research Officer, Mr Deepak Khadka, Field Officer, Miss Dilasa Shrestha and Miss Pratikshya Dahal (Ophthalmic Nurses) for their contribution to this project.

References

American Academy of Ophthalmology Preferred Practice Patterns Pediatric Ophthalmology Panel (2002). Pediatric Eye Evaluations. Preferred Practice Pattern. San Francisco: American Academy of Ophthalmology.

American Optometric Association Consensus Panel on Pediatric Eye and Vision Examination (2002). Pediatric Eye and Vision Examinations. 2nd ed. St. Louis: American Optometric Association.

Arnold RW, Stark L, Leman R, Arnold KK, et al (2008). Tent photoscreening and patched HOTV visual acuity by school nurses: validation of the ASD-ABCD protocol. (Anchorage School District-

Alaska Blind Child Discovery program). *Binocul Vis Strabismus Q.*; 23(2):83-94.

Becker R, Graf M, Landolt C et al (2006). Differences in strabismus amblyopia. *Klin Monatsbl Augenheilkd*; 223 (1):24-8.

Berry JC, Konig HH (2003). Test characteristics of orthoptics screening examination in 3 year old kindergarten children. *BrJ Ophthalmol.* 87((7): 909-916.

Chui L, Fraser T, Hoar K et al (2004). Negative Predictive Value of a Vision Screening Program Aimed at Children Aged 3 to 4 Years Old *Journal of AAPOS*; 8(6): 566-570.

Ciner EB, Schmidt PP, Orel-Bixler D et al (1998). Vision screening of preschool children: evaluating the past, looking toward the future. *Optom Vis Sci*; 75(8):571-84.

Donahue SP, Baker JD, Scott WE, Rychwalski P, Neely DE, Tong P et al (2006). Lions Clubs International Foundation Core Four Photoscreening: Results from 17 programs and 400,000 preschool children. *J AAPOS*; 10(1):44-8.

Evelyn A. Paysse, Gayle C. Williams, David K. Coats and Eric A (2001). Williams Detection of Red Reflex Asymmetry by Pediatric Residents Using the Brückner Reflex Versus the MTI Photoscreener *Pediatrics*; 108(4);e74.

Gole GA, Douglas LM. (1995). Validity of the Bruckner reflex in the detection of amblyopia. *Aust N Z J Ophthalmol*; 23(4):281-5.

Gräf M, Jung A (2008). The Brückner test: extended distance improves sensitivity for ametropia. *Graefes Arch Clin Exp Ophthalmol*; 246(1):135-41. Epub 2007 Jun 30.

Hartmann EE, Dobson V, Hainline L, Marsh-Tootle W, Quinn GE, Ruttum MS et al (2001). Maternal and child health bureau and national eye institute task force on vision screening in the preschool child: Preschool vision screening: Summary of a task force report. *Ophthalmology*; 108(3):479-86.



- Khandekar R, Parast N, Arabi A (2009). Evaluation of 'vision screening' program for three to six-year-old children in the Republic of Iran. *Indian J Ophthalmol*; 57(6):437-42.
- Kothari MT (2007). Can the Bruckner test be used as a rapid screening test to detect significant refractive errors in children? *Indian J Ophthalmol*; 55(2):213-5.
- Mocan MC, Najera-Covarrubias M, Wright KW (2005). Comparison of visual acuity levels in pediatric patients with amblyopia using Wright figures, Allen optotypes, and Snellen letters. *J AAPOS*; 9(1):48-52.
- Moore B (1997). *Eye Care for Infants and Young Children*. Boston: Butterworth-Heinemann; 175-89.
- Salcido AA, Bradley J, Donahue SP (2005). Predictive value of photoscreening and traditional screening of preschool children. *J AAPOS*; 9(2):114-20.
- Stewart CE, Hussey A, Davies N, Moseley MJ (2006). Comparison of logMAR ETDRS chart and a new computerised staircased procedure for assessment of the visual acuity of children. *Ophthalmic Physiol Opt*; 26(4):597-601.
- The Vision in Preschoolers Study Group (2005). Preschool Vision Screening Tests Administered by Nurse Screeners Compared with Lay Screeners in the Vision in Preschoolers Study. *Investigative Ophthalmology & Visual Science*; 46(8):2639-48.
- U.S. Public Health Service (1994). Vision screening in children. *Am Fam Physician*; 50(3):587-90.
- Vision in Preschooler Study Group (2004a). Comparison of Preschool Vision Screening Tests as Administered by Licensed Eye Care Professionals in the Vision in Preschoolers Study. *Am Acad Ophthalmol*; 111(4):637-650.
- Vision in Preschoolers (VIP) Study Group (2009). Findings from the Vision in Preschoolers (VIP) Study. *Optometry and Vision Science*; 86(6):619-623.
- Vision in Preschoolers (VIP) Study Group (2010). Effect of Age Using Lea Symbols or HOTV for Preschool Vision Screening. *Optometry & Vision Science*; 87(2):87-95.
- Vision in Preschoolers Study Group (2004b). Preschool visual acuity screening with HOTV and Lea symbols: testability and between-test agreement. *Optom Vis Sci*; 81(9):678-83.
- WHO publication. *The State of the World's Sight, VISION 2020: the Right to Sight 1999-2005*.

Source of support: declared. Conflict of interest: none