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Discrepancy in the Accuracy of Vision Screening Program Performed by Allied Health Personnel in a Preschool

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ABSTRACT

The purpose of this study is to assess the performance of allied health personnel, after attending a training programme, in conducting vision screening for preschool children. A total of 43 allied health personnel (20 assistant medical officers (AMOs) and 23 nurses) attended a two-day training program prior to conducting vision screening for preschool children. Vision screening was conducted among 136 preschool children using four similar HOTV visual acuity chart at 6 m. The cut-off referral criterion for visual acuity (VA) testing was 6/9 or worse in either eye. All children were referred to two qualified optometrists for a comprehensive eye examination. The accuracy was based on the sensitivity and specificity of screening by each group of personnel. The overall prevalence of reduced VA in the studied population was about 10%. The sensitivity and specificity of vision screening performed by AMOs were 100% and 98% respectively while that performed by nurses were 56% and 94% respectively. Thus, there were discrepancies in the sensitivity of visual acuity testing despite them being conducted by healthcare providers with similar background and training. This suggests that their performance might be influenced by factors other than their professional training.

Keywords: Accuracy, nurses, preschool, vision screening

INTRODUCTION

Visual acuity testing is the most common method used in preschool vision screening worldwide (Adhikari & Shrestha, 2011; Khandekar et al., 2004; Sabri et al., 2016; Teerawattananon et al., 2014; The Vision in Preschoolers Study Group, 2005). Precision and accuracy of visual acuity testing is important as it may affect the efficacy of the

programme. The accuracy of vision testing, especially among young children, is be determined by several factors such as tool selection, competency of vision screener and appropriate response by children. Findings of Vision in Preschooler (VIP) pointed to the discrepancy in visual acuity testing which depended on the format of the test, the screening environment and the vision screener (The Vision in Preschoolers Study Group, 2005).

Age-appropriate vision screening tool selection and modification of visual acuity testing techniques and procedures among young children have led to marked improvement in the testability and sensitivity of these tests regardless of the personnel assigned as vision screener (Anstice & Thompson, 2014; Fern & Manny, 1986). These findings imply that a child's physical and cognitive ability as well as its psychology might also influence the outcome of visual acuity testing.

Visual acuity testing was reported to be one of the most effective methods when performed by professional eyecare practitioners but showed much less effectiveness when performed by non-eyecare practitioners (The Vision in Preschoolers Study Group, 2005). However, screenings conducted by professionals in the national vision screening programme might not be ideal and practical considering their limited numbers as well as the issue of cost-effectiveness. The engagement of non-eyecare practitioners as vision screeners might be more suitable despite the competency issue as it could be managed through proper training (Adhikari & Shrestha, 2011; Khandekar et al., 2004; Sabri et al., 2016; The Vision in Preschoolers Study Group, 2005).

This study was aimed at assessing the performance of allied health personnel (nurses and AMOs) in conducting vision screening for preschool children after attending a two-day training program. The AMOs are classified as "medical assistant practitioners" in the International Standard Classification of Occupations, 2008 revision (World Health Organization (WHO), 2008). Both groups of allied health personnel completed a diploma programme under the Ministry of Health, Malaysia and have work experience of more than three years. The two groups of vision screeners were chosen because they were currently involved in the National School Health Service and in the Maternal and Child Health clinics.

METHOD

This cross-sectional study examined data collected in a preschool vision screening programme conducted in Sri Aman, Sarawak in October 2013. This project adhered to ethical considerations that were put forth in the Declaration of Helsinki, 1975. The approval to conduct vision examination was obtained from Sri Aman Department of Health and parental consent of all children who underwent the visual screening.

A total of 43 allied health personnel (20 assistant medical officers (AMOs) and 23 nurses) attended a two-day training programme prior to conducting vision screening for preschool children. In the training programme, the vision screeners were exposed to the objective of vision screening, brief description of the anatomy, physiology and pathology of the eye of young children as well as vision screening guidelines. The vision screening guidelines include

the planning and preparation for screening, vision screening methods and procedures, referral procedures and tips on effective communication with young children. All vision screeners were evaluated before and after training programme based on a theory examination which consisted of 20 multiple–choice questions.

All preschools in Sri Aman Division were invited to participate in a one-day vision screening programme. Five preschools responded and vision screening was conducted among 136 children aged between 4 and 6 years from participating preschools. All children underwent visual acuity (VA) testing using four similar HOTV visual acuity chart at 6 meters performed randomly either by AMOs or nurses. Visual acuity testing was performed under normal room illumination by using letter-matching technique. The cut-off referral criterion for VA testing was 6/9 or worse in either eye. The children were randomly selected for screening. However, their call number was given according to their age during registration and they were screened in groups according to age to reduce the possibility of screening more children in a certain age group. Based on the total number of registered children, the screening assessment was designed to ensure that each screener screened at least two children instead of three because there were screeners who were also involved in the registration procedures.

All children were referred to and examined by two qualified optometrists for refractive assessment as well as ocular function and ocular health examination after the screening procedure. Two similar VA chart were used by optometrists. Children were considered as having reduced vision if their habitual VA is 6/9 or worse in either eye caused by any refractive errors or ocular health conditions. Both vision screening and optometrist's examination results were double blinded by using different recording forms and conducted in separate rooms. The age and ethnicity of the children were determined based on information contained in their birth certificates.

Data entry and analysis were performed using SPSS version 15.0 (SPSS Inc., Chicago, IL, US). A non-parametric Wilcoxon Sign Rank test was used in the analysis of pre-and post-training evaluation score because data was not normally distributed. The evaluation on the performance of the vision screeners was based on the sensitivity and specificity of visual acuity testing confirmed by optometric examination.

RESULTS

A majority of children were 6-year olds (57%), were females (55%) and were Malay (94%). About 6% of the children were Iban. The distribution of the children according to their age is shown in Figure 1. Almost all children completed the screening test. Only one child was uncooperative during the vision screening and was considered as failed the screening test. The overall prevalence of reduced VA among the population was about 10%. All children (13 children) with reduced VA had refractive error. Two of the children were found to have refractive error and amblyopia while one child had strabismic amblyopia.
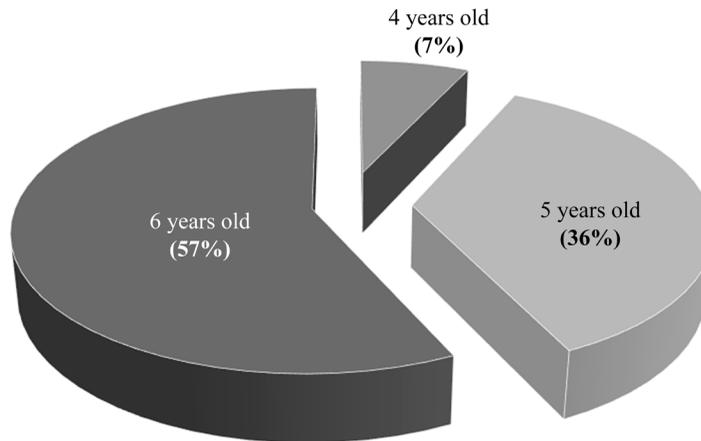
Figure 1. The age distribution of preschool children (n = 136)

The outcome of vision screening is shown in Table 1. A relatively higher number of false positive and false negative among nurses group in comparison to AMOs group might indicate lower accuracy of vision screening performed by nurses group. The total sensitivity and specificity of the vision screening was 69% and 95% respectively. The sensitivity and specificity of vision screening performed by AMOs were 100% and 98% respectively while that done by nurses were 56% and 94% respectively.

An analysis on the pre- and post-training evaluation test score showed that the mean score for the pre-test and post-test evaluation were 5.05±2.10 and 8.54±1.47 respectively. The Wilcoxon Sign Rank test showed a significant improvement between pre-and post-test evaluation score (p<0.001).

Table 1
The outcome of vision screening

Vision screener	True positive (n)	False positive (n)	False negative (n)	True negative (n)
Nurses	5	5	4	72
Assistant medical officers (AMOs)	4	1	0	45

DISCUSSION

About 99% of the children successfully completed the vision screening test in this study. It has to be noted that age-appropriate tool selection and vision testing techniques may improve outcome. This finding suggests the use of distance visual acuity chart with letter-matching technique in visual acuity testing among pre-school children was an appropriate method as supported by previous research (Anstice & Thompson, 2014; Fern & Manny, 1986; The Vision in Preschoolers Study Group, 2005). Young children in this study have limited communicative

ability that affected reliability of their verbal responses. The lower accuracy of vision screening using Snellen notation chart by verbal response among younger children compared with older children in the government primary school was also previously reported (Abu Bakar et al., 2012).

This study showed that there was a discrepancy in the sensitivity of the visual acuity testing despite it being conducted by healthcare providers with similar educational and professional background as well as training programme. The nurses group exhibited a higher number of under referral cases, in fact, the AMO group detected all cases of reduced vision accurately in this study. High accuracy of visual acuity screening performed by AMOs was supported by previous study (Adhikari & Shrestha, 2011). However, inconsistent findings were found among nurses (Khandekar et al., 2004; The Vision in Preschoolers Study Group, 2005; Tong et al., 2004). Certain studies reported lower accuracy of vision screening by nurses which resulted in high over referral, such as in USA (sensitivity: 49%) and Malaysia (Accurate referrals: 51%) (Abu Bakar et al., 2012; The Vision in Preschoolers Study, 2005). While studies in Oman (Sensitivity: 72%) and Singapore (Sensitivity: 86%) have reported high accuracy after training programme (Khandekar et al., 2004; Tong et al., 2004).

The accuracy of vision screening among children could be influenced by the types of vision test and age of children besides the selection of the screener as described in Table 2 (Adhikari & Shrestha, 2011; Khandekar et al., 2004; OstadiMoghaddam et al., 2012; Sabri et al., 2016; Teerawattananon et al., 2014; The Vision in Preschoolers Study Group, 2005; Tong et al., 2004). The accuracy of vision screening was reported higher among older children of target population and simplified visual acuity testing (Khandekar et al., 2004; Teerawattananon et al., 2014; The Vision in Preschoolers Study Group, 2005; Tong et al., 2004). Vision screening done by nurses in Oman showed a lower accuracy among younger children (sensitivity: 55%) compared to older children (Sensitivity: 72%) despite similar training provided (Khandekar et al., 2004). These findings suggest that the differences in the performance of vision screeners might be influenced by other factors, such as the reliability of the child's response and inter-personal attitudes of the screener rather than their professional background.

Visual acuity testing is a psychophysical procedure that requires a subject to relate the perception of the physical characteristics of a stimulus and the outcome responses (Bailey & Lovie-Kitchin, 2013). Therefore, the physical ability, cognitive aptitude and psychological factors may influence the performance of visual acuity testing among young children (Abu Bakar & Chen, 2014; Anstice & Thompson, 2014). The variability in the sensitivity of the VA testing between the two groups of personnel may be associated with those aspects. Young children may present certain kinds of behavioural problem which is a normal part of their developmental progress. Professions dealing with young children should be properly trained and competent to handle them. Vision screeners for young children should be provided a good understanding of children's conditions and should be encouraged to sustain their attentiveness during the screening (Sharma et al., 2008).

Table 2
Sensitivity and specificity of vision acuity screening performed by non-eyecare professional

Country (Study)	Screener	Target population	Visual acuity test	Sensitivity	Specificity
Nepal (Adhikari & Shrestha, 2011)	Medical assistant	3-7 years old	HOTV Chart	80%	98%
USA (The Vision in Preschoolers Study Group, 2005)	Lay screener	3-5 years old	Linear Lea Symbol (10ft)	37%	90%
			Single Lea Symbol (5ft)	61%	91%
	Nurse		Linear Lea Symbol (10ft)	49%	90%
Oman (Khandekar et al., 2004)	Nurse	6-10 years old	Snellen E	55%	99%
		12-17 years old	Snellen E	72%	99%
Iran (OstadiMoghaddam et al., 2012)	Teacher	School-aged	E Chart	38%	92%
Canada (Sabri et al., 2016)	Trained technician	6-14 years old	Snellen Chart	96%	71%
China (Sharma et al., 2008)	Teacher	School-aged	Tumbling E Chart	93%	91%
Thailand (Teerawattananon et al., 2014)	Teacher	4-6 years old	Lea Symbol	35%	98%
		7-12 years old	E chart (7 years old) & Snellen Chart (8-12 years old)	65%	97%
Singapore (Tong et al., 2004)	Nurse	8-11 years	Simplified visual acuity screening	86%	92%
Malaysia (Current study)	Nurse	4-6 years old	HOTV chart	56%	94%
	Assistant Medical Officer	4-6 years old	HOTV chart	100%	98%

The improvement in post training evaluation score but lower accuracy of vision testing outcome among the nurses in this study suggests that the significant increment of post training evaluation score should not be the only indicator for the effectiveness of the training program as it only portrayed the general theoretical competency. Therefore, the evaluation of the effectiveness of a training program should include theoretical and practical assessments. The improvement on the current training module was recommended to enhance the performance of vision screening outcomes.

Although the screening assessment was designed to reduce age biases and number of children screened by each group of vision screeners, the nurse group screened relatively more children compared with the AMO group which suggest that the nurses group might perform vision screening faster than the AMOs. Shorter duration in conducting vision screening also could influence the quality and accuracy of screening because young children usually

need more time to understand the instruction and accurately respond to the vision screening procedure. However, no further discussion was made with the screeners post screening in order to determine the factors causing under or over referral to limit the claims.

CONCLUSION

The discrepancy in the sensitivity of visual acuity testing conducted by health providers with similar professional background who also attended a similar training programmes suggests that their performance might be influenced by factors other than their professional background. To achieve an effective and sustainable programme, preschool vision screening should be continuously evaluated, structured, and have quality control mechanisms. However, evaluation of the efficacy of the tool-based vision screening should be made collectively and should consider every aspect, including tools selection, target population and competency of vision screener. Evaluating each aspect discretely may affect the operational judgment of the screening program.

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