Original Article

Validity of vision screening program conducted by preschool teachers: An interventional study

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ABSTRACT

Background: Clear vision is crucial for effective learning among preschool children. Hence, early detection of vision impairment and prompt treatment are required to improve prognosis. Currently, limited information is available, and no program exists to screen for vision impairment among preschoolers in Bangladesh. This study aimed to validate the KieVision™ Preschool Vision Screening Kit, translated into the Bengali language, to improve vision impairment detection among preschool children.

Methods: In this prospective case–control study, 60 preschool teachers from Chittagong were randomly selected. The study group was trained to conduct vision screening among preschool children using the translated kit, whereas the control group was trained using the Chittagong Eye Infirmary and Training Complex (CEITC) School Teachers' Training Module. Fifteen preschool children aged 4–6 years were screened by each preschool teacher and again by the optometrist.

Results: Sixty preschool teachers screened 900 children. The results showed a higher validity of vision screening findings by the preschool teachers in the study group (sensitivity, 68.00%; specificity, 92.75%) than in the control group (sensitivity 47.37%, specificity 70.39%). The level of agreement between the preschool teachers and optometrists was high for all tests (first-order agreement coefficient [AC1] ≥ 0.80 in the study group). The sensitivity and specificity of the visual acuity test for the study group were 59.65% and 94.15%, respectively, while in the control group it was 13.33% and 62.54%, respectively. A similar trend was noted in the general observation component and Hirschberg's test.

Conclusions: The Bengali Language KieVision™ Preschool Vision Screening Kit can be used effectively by preschool teachers in vision screening programs to improve the identification of vision impairment among preschool children in Bangladesh.

KEY WORDS

vision screening, children, preschool, teachers, specificity, sensitivity, visual acuity, Hirschberg's test, Bengali Language KieVision™ Preschool Vision Screening Kit

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INTRODUCTION

Clear vision is crucial for effective learning among preschool children. Hence, early detection of vision impairment and prompt treatment are required to improve prognosis [1]. The World Health Organization (WHO) recommends that vision screening of children for refractive errors be conducted at the community level and be integrated into school health programs [2]. Previous studies have suggested that training and knowledge programs, even when using different strategies, are cost-effective [3, 4].

Of the 160 million population in Bangladesh, children make up around 40%, accounting for more than 64 million of the population [5]. Uncorrected refractive errors are the main causes of childhood vision impairment [6]. This is a serious barrier to children's development, and also decreases school attendance [7]. A previous survey provided data on vision screening in Bangladeshi adults [8], but did not provide reliable data on preschool children. Some screening programs have recommended that vision screening should start as early as 4 years of age [9]. This would require a reliable, fast, and easy-to-conduct vision screening program for preschool teachers, with good specificity and sensitivity.

Visual impairment in children with amblyopia, if corrected immediately during the development of the visual system, may be reversible. Strabismus is a risk factor that can also inhibit the development of normal binocular vision, which can cause impaired fine motor skills [10, 11], which impedes school performance. In Bangladesh, a vision screening program was developed by the Chittagong Eye Infirmary and Training Complex (CEITC) to train government primary school teachers to identify school children with vision impairment [12]. Their training encompasses 2 hours of lectures, providing theoretical knowledge, but the program does not include a feedback mechanism to determine teachers' performance and competency.

Omar et al. reported that the KieVision™ Preschool Vision Screening Kit, designed for preschool teachers, was an effective and reliable method to identify vision impairment among preschool children aged 4–6 years in Malaysia [1]. This kit offers a comprehensive vision screening training method that contains theoretical and practical sessions. A translation of this vision screening kit into the Bengali language, may be useful for implementation in Bangladesh.

This study aimed to validate the use of the Bengali Language version of the KieVision™ Preschool Vision Screening Kit for vision impairment detection among preschool children.

METHODS

This was a prospective case–control interventional study that used stratified random sampling. The study followed the tenets of the Declaration of Helsinki for research on human subjects. Ethical approval was obtained from the Universiti Kebangsaan Malaysia (UKM) Secretariat for Research and Ethics (approval number UKM-1.5.3.5/244/NN0602015). Specific permission was obtained from the Regional Ministry of Health and Education Authority, Chittagong District Zone, Bangladesh. The involvement of the participants was voluntary, and participants' identities were kept confidential. Informed consent was obtained from all preschool teachers, optometrists, and preschool children's parents.

The study population consisted of preschool teachers in Chittagong City, Bangladesh. The inclusion criteria were teachers aged 25–40 years, holding a bachelor's degree, having a minimum of 2 years' teaching experience with preschool children, and who were fluent in both Bengali and English. The sample size (n) required for this study was calculated using the Snedecor and Cochran formula [13]. We aimed to detect difference of 0.1 logarithm of the minimum angle of resolution (logMAR) in measuring visual acuity (VA) between two groups (study versus control) with 80% power at a 5% level of significance. Hence, the number of preschool teachers required in this study was 28 preschool teachers for each group. It was estimated that approximately 10% of the study participants may withdraw during the research period. Therefore, the final sample size determined for each group was 30 preschool teachers.

Sixty preschool teachers from Chittagong District were randomly selected using a random number table and divided into two groups. The study group was provided with theory and practice on how to conduct vision screening using the Bengali language-translated KieVision™ Preschool Vision Screening Kit, while the control group was only given verbal instructions on how to conduct the screening using the existing CEITC primary school teachers' training program. Each preschool teacher conducted vision screening on 15 preschool children aged 4–6 years at their center. These children were later again screened by an optometrist.

Screening involved observation of the external eye, Hirschberg's test, and VA measurement [14, 15]. External observation had two aspects: observation of abnormal behavior and observation of any eye abnormalities of the child. The behavioral observation was detecting any of the following: seeing frequent face turns when looking

at distant objects, constant blinking, constant rubbing of the eye, head tilts when looking at distant objects, constantly falling, tripping over or bumping into things, reading at a very close distance, squinting the eyes when looking at distant objects, closing one eye when looking at distant objects or in a bright condition, constant frowning, and refusing to play games that need distance viewing. Observation of any eye abnormalities of the child was detecting any of the following: swelling around the eyes, tearing, eye discharge, droopy eyes, red eyes, growth on the sclera, the difference in iris color between the right and left eye, distorted pupils, and white pupils. In this study, VA testing was performed by the preschool teachers under standardized lighting conditions in the children's own classroom using a Lea Symbols chart.

IBM Statistical Package for the Social Sciences (SPSS) Statistics for Windows, version 22.0 (IBM Corp., Armonk, NY, USA) was used to analyze the data. The normality of data distribution was determined using the Kolmogorov–Smirnov test (preschool teachers' data) or the Shapiro–Wilk test (preschool children's data). Descriptive analysis was performed for both preschool teachers' and optometrists' findings. The vision screening test results of these two groups were also compared with optometrists' findings. Cronbach's alpha and intraclass correlation coefficient (ICC) analysis were performed to determine the level of agreement of VA parameters, as tested by preschool teachers and optometrists. The McNemar test was used to compare the parameters of external observation and Hirschberg's test. A 2 × 2 table was constructed to determine the validity of each test, including the sensitivity, specificity, positive-predictive value (PPV), and negative-predictive value (NPV) [16] against the gold standard. The extent of agreement between assessors was determined using the first-order agreement coefficient (AC1). When the prevalence was high, an appropriate kappa value was used, whereas the AC1was used when the prevalence was low [17, 18].

RESULTS

Nine-hundred preschool children were screened by 60 preschool teachers. Each group screened 450 children. Of the 900 children, 504 (56%) were male. Sixty-seven (7.44%) preschool children were aged 4 years, 343 (38.11%) were aged 5 years, and 490 (54.45%) were aged 6 years. In the study group, of the children referred for further examination, 34 (7.55%) were identified by both the preschool teachers and optometrists. In the control group, only 18 (4.00%) were referred by both preschool teachers and optometrists for further examination. Table 1 shows the number of children in the study and control groups and the sensitivity and specificity of the vision screening program used in each group. These results indicated better sensitivity and PPV values for the study group than for the control group (Table 1).

External observation had two aspects: observation of abnormal behavior and observation of any abnormalities around the eyes of the child. In the study group, 21 (4.66%) children with behavioral or external eye abnormalities were detected by both the preschool teachers and the optometrists. In the control group, only 13 (2.88%) children with behavioral or external eye abnormalities were identified by both preschool teachers and optometrists. Table 2 shows the results of the external observation performed by the study and control teacher groups as compared to those performed by optometrists. The sensitivity and PPV of the external observation in the study group were better than those of the control group (Table 2).

Table 1. Validity of the vision screening programs used in the study and control groups

Group		Optometrists		
		Referred	Not referred	Total
Preschool teachers (Study)	**Referred**	34	29	63
	Not referred	16	371	387
	Total	50	400	450
Sensitivity = 68.00 (95% CI = 55.07–80.93), Specificity = 92.75 (95% CI = 90.21–95.29), PPV = 53.97 (95% CI = 41.66–66.28), NPV = 95.86 (95% CI = 93.88–97.85)				
Preschool teachers (Control)	**Referred**	18	122	140
	Not referred	20	290	310
	Total	38	412	450
Sensitivity = 47.37 (95% CI = 31.49–63.24), Specificity = 70.39 (95% CI = 65.98–74.80), PPV = 12.86 (95% CI = 7.312–18.40), NPV = 93.55 (95% CI = 90.81–96.28)				

Abbreviations: PPV, positive -predictive value; NPV, negative-predictive value; CI, confidence interval. Note: The vision screening program in the study group was the Bengali language-translated version of the KieVision™ Preschool Vision Screening Kit. The vision screening program used in the control group was the Chittagong Eye Infirmary and Training Complex (CEITC) primary school teachers training program, following only verbal instruction.

A McNemar test and approval levels were determined using the AC1 based on the 2 × 2 tables. The analyses showed a significant difference between the results of external observation of both groups when compared to optometrists (both $P < 0.05$). The level of approval for the findings of the study group and optometrists was high (AC1 = 0.88 in the study group; AC1 = 0.43 in the control group).

Hirschberg's test was performed to detect the presence of strabismus. Nineteen (4.22%) preschool children did not undergo Hirschberg's test in the study group. For this group, nine (2.09%) of 431 preschool children failed Hirschberg's test when conducted by teachers. Of these nine children, four (45.45%) were diagnosed with strabismus using standard tests by optometrists, and five (55.55%) were found to be normal. The optometrists also found another five (1.16%) children who should have failed the Hirschberg test when conducted by the study preschool teacher group. Preschool teachers in the control group did not perform the Hirschberg test in 129 (28.66%) of the 450 preschool children. Of those tested, 15 (4.67%) failed Hirschberg's test as performed by the teachers. Among these 15 children, two (13.33%) were diagnosed with strabismus using standard tests by the optometrists, while of the remaining 13 (86.67%) children, 12 (80.00%) were found to be normal, while one (6.66%) child did not attend the examination. The optometrists also found another 12 children who should have failed the Hirschberg test when conducted by the control preschool teacher group.

Table 2. Abnormalities in children's behavior and external eye examination as reported by the study and control group of preschool teachers as compared to those noted by optometrists, for validation

Group		Optometrists		
		Referred	Not referred	Total
Preschool teachers (Study)	**Referred**	21	32	53
	Not referred	12	385	397
	Total	33	417	450
Sensitivity = 63.64 (95% CI = 47.22–80.05), Specificity = 92.33 (95% CI = 89.77–94.88), PPV = 39.62 (95% CI = 26.46–52.79), NPV = 96.98 (95% CI = 95.29–98.66)				
Preschool teachers (Control)	**Referred**	13	140	153
	Not referred	30	267	297
	Total	43	407	450
Sensitivity = 30.23 (95% CI = 16.51–43.96), Specificity = 65.60 (95% CI = 60.99–70.22), PPV = 8.50 (95% CI = 4.10–12.92), NPV = 89.90 (95% CI = 86.47–93.33)				

Abbreviations: PPV, positive -predictive value; NPV, negative-predictive value; CI, confidence interval. Note: The vision screening program in the study group was the Bengali language-translated version of the KieVision™ Preschool Vision Screening Kit. The vision screening program used in the control group was the Chittagong Eye Infirmary and Training Complex (CEITC) primary school teachers training program, following only verbal instruction.

Table 3. Validity of Hirschberg's test conducted by preschool teachers in the study and control groups against the optometrists

Group		Optometrists		
		Referred	Not referred	Total
Preschool teachers (Study)	**Referred**	4	5	9
	Not referred	5	417	422
	Total	9	422	431
Sensitivity = 44.44 (95% CI = 11.98–76.91), Specificity = 98.82 (95% CI = 97.78–99.85), PPV = 44.44 (95% CI = 11.98–76.91), NPV = 98.82 (95% CI = 97.78–99.85)				
Preschool teachers (Control)	**Referred**	2	13	15
	Not referred	12	294	306
	Total	14	307	321
Sensitivity = 14.29 (95% CI = - 4.04–32.62), Specificity = 95.76 (95% CI = 93.51–98.02), PPV = 13.33 (95% CI = - 3.87–30.54), NPV = 96.08 (95% CI = 93.90–98.25)				

Abbreviations: PPV, positive -predictive value; NPV, negative-predictive value; CI, confidence interval. Note: The vision screening program in the study group was the Bengali language-translated version of the KieVision™ Preschool Vision Screening Kit. The vision screening program used in the control group was the Chittagong Eye Infirmary and Training Complex (CEITC) primary school teachers training program, following only verbal instruction.

The level of agreement between the Hirschberg test results obtained by the study group and by optometrists was higher (AC1 = 0.98) than that for the control group and optometrists (AC1 = 0.91). The validity of the Hirschberg's test results in both teacher groups as compared to optometrists is shown in Table 3. The validity of the Hirschberg's test results determined by optometrists as compared to that determined by the standardised Hirschberg's test at clinic is shown in Table 4. The sensitivity and PPV of the Hirschberg test in the study group were better than those in the control group (Table 3).

In the study group, the teachers identified 57 (12.66%) children who failed the VA test, while the optometrists confirmed that 34 (7.55%) of these children failed the VA test. Additionally, the optometrists identified another 23 (5.11%) children who failed the VA test but were not detected by the study group. In the control group, 136 (30.22%) children failed the teacher-administered VA test, which 118 of them were actually false positive (Table 6). The optometrists found 135 (30.00%) children who actually failed the VA test. Of these 135 children, only 18 (4.00%) had been identified by the preschool teachers in the control group. In the study group, 393 (87.33%) children were found to have normal VA by optometrists, but 23 of them were identified as false positives on the VA test by the preschool teachers. In the control group, 315 (70.00%) children were found to have normal VA by optometrists, whereas 118 children were detected as false positives on the VA test by the preschool teachers. The means and standard deviations of the VA test results of both groups and optometrists are summarized in Table 5.

ICC tests were performed to analyze the right eye (RE) and left eye (LE) distance VA results obtained by both groups of preschool teachers as compared with those obtained by optometrists. The ICC for the RE VA and LE VA between the study group and optometrists were 0.69 and 0.75, respectively, and 0.48 and 0.52, respectively, for the control group and optometrists. Thus, the level of agreement between the results of distance VA for preschool teachers and optometrists was high for the study group (AC1 = 0.87), but low for the control group (AC1 = 0.10). The results of the McNemar test showed a significant difference between the results of the VA tests administered by the study group ($P < 0.050$) and by the control group ($P < 0.050$) as compared to those

Table 4. Validity of Hirschberg's test conducted by as well as visual acuity (VA) test results by optometrists against standardised Hirschberg's test and standard VA test at clinic

Optometrists (Hirschberg's test)		**Standardised Hirschberg's test (Clinic)**		
		Referred	**Not referred**	**Total**
Screening	**Referred**	11	1	12
	Not referred	0	740	740
	Total	11	741	752
Sensitivity = 100.00 (95% CI = 100.00–100.00), Specificity = 99.86 (95% CI = 99.60–100.13), PPV = 91.67 (95% CI = 76.03–107.30), NPV = 100.00 (95% CI = 100.00–100.00)				
Optometrists (VA)		**Standard VA test (Clinic)**		
		Referred	**Not referred**	**Total**
Screening	**Referred**	85	1	86
	Not referred	1	813	814
	Total	86	814	900
Sensitivity = 98.84 (95% CI = 96.57–101.10), Specificity = 99.88 (95% CI = 99.64–100.12), PPV = 98.84 (95% CI = 96.57–101.10), NPV = 99.88 (95% CI = 99.64–100.12)				

Abbreviations: PPV, positive -predictive value; NPV, negative-predictive value; CI, confidence interval.

Table 5. Mean and standard deviation values of visual acuity in preschool children for the right and left eyes

Group	**VA measured by Preschool Teachers (Mean logMAR ± SD)**	**VA measured by Optometrists (Mean logMAR ± SD)**
Study group	RE 0.74 ± 2.08 LE 0.68 ± 1.95	RE 0.36 ± 1.18 LE 0.45 ± 1.18
Control group	RE 1.30 ± 2.29 LE 1.22 ± 2.15	RE 0.38 ± 1.30 LE 0.41 ± 1.42

Abbreviations: logMAR, the logarithm of the Minimum Angle of Resolution; RE, Right Eye; LE, Left Eye. Note: The vision screening program in the study group was the Bengali language-translated version of the KieVision™ Preschool Vision Screening Kit. The vision screening program used in the control group was the Chittagong Eye Infirmary and Training Complex (CEITC) primary school teachers training program, following only verbal instruction.

Table 6. Validity of screening results for visual acuity (VA) test in the study and control groups as compared to the results obtained by optometrists

Group		Optometrists		
		Referred	Not referred	Total
Preschool teachers (Study)	Referred	34	23	57
	Not referred	23	370	393
	Total	57	393	450
Sensitivity = 59.65 (95% CI = 46.91–72.38), Specificity = 94.15 (95% CI = 91.83–96.47), PPV = 59.65 (95% CI = 46.91–72.38), NPV = 94.15 (95% CI = 91.83–96.47)				
Preschool teachers (Control)	Referred	18	118	136
	Not referred	117	197	314
	Total	135	315	450
Sensitivity = 13.33 (95% CI = 7.60–19.07), Specificity = 62.54 (95% CI = 57.20–67.88), PPV = 13.24 (95% CI = 7.54–18.93), NPV = 62.74 (95% CI = 57.39–68.09)				

Abbreviations: PPV, positive -predictive value; NPV, negative-predictive value; CI, confidence interval. Note: The vision screening program in the study group was the Bengali language-translated version of the KieVision™ Preschool Vision Screening Kit. The vision screening program used in the control group was the Chittagong Eye Infirmary and Training Complex (CEITC) primary school teachers training program, following only verbal instruction.

administered by optometrists. The distance VA test results and its validity in both groups versus optometrists (Table 6) and optometrists versus standard VA test at clinic (Table 4) were computed. The sensitivity and PPV of the VA tests in the study group were better than those in the control group (Table 6).

DISCUSSION

Our results indicated that preschool teachers were able to conduct vision screening using either the Bengali language version of the KieVision™ Preschool Vision Screening Kit (in the study group) or the CEITC Vision Screening Program (in the control group). However, the preschool teachers in the study group performed better than those in the control group.

Our findings were consistent with those of a previous study, which reported referral rates of 9.2% to 10% [19], indicating a satisfactory vision screening program. The analyses in this study also showed that the validity of the vision screening program, as determined by sensitivity, specificity, PPV, and NPV, was greater in the study group than in the control group. These findings indicated that the study group was more competent in conducting vision screening than the control group.

Working with younger children can be time-consuming because of their limited attention span and cooperation challenges. These children are also usually shy with unfamiliar individuals, complicating screening [20, 21]. The school-based approach revealed an accurate VA assessment by trained teachers [22]. Our findings showed that results indicating the need for referral obtained by the study group teachers were more consistent with the results obtained by optometrists than those obtained by the control group. This was reflected by the AC1 analyses of external observation, where the control group performed worse than the study group. Possible explanations could be the shorter training duration, theory-only training, and possibly a lack of understanding among the control group teachers in identifying abnormalities of the external parts of the eyes.

The most common behavioral abnormalities noted by both groups were frequent rubbing of the eyes and reading at a very close distance. It is possible that other behavioral abnormalities may not have been detected by either group, as the examination of this age group is challenging. Home screening tests conducted by familiar persons were helpful in detecting behavioral irregularities in the Seoul Metropolitan Preschool Vision Screening Programme [23], highlighting the good cooperation between children and familiar persons. Furthermore, parents' assessment may more closely reflect the behavioral abnormalities of children than those of a stranger [24]. Other symptoms that may manifest include frequent tearing, eye redness, and headaches [25]. In the current study, the most frequent external eye abnormalities observed by the study group teachers were tearing, ocular discharge, red eyes, swelling around the eyes, growth on the sclera, iris color differences, and distorted pupils. However, the control group teachers only observed more tearing, eye discharge, and red eyes. The study group was able to detect more abnormalities because these abnormalities were listed in the vision screening form and were actively looked for by the teachers during the screening process. Ocular conditions in children, such

as tearing, redness, corneal scarring, microphthalmos, iris coloboma, and squint, could be identified by teachers after a specialised training program [26]. Thus, instruction in external eye observations to enable teachers to identify children's eye abnormalities must be considered as an important component of any vision screening program for teachers.

Hirschberg's corneal linght reflex test is a method for easily identifying strabismus when performed by professionals; however, it can be a challenge even for trained preschool teachers [27]. Despite the study group teachers having been given a demonstration and training before conducting Hirschberg's test, they still made errors. This was seen in the comparison of their results with those of optometrists. A possible explanation is that there may have been an error in the children's fixation when the test was conducted. However, Hirschberg's test requires skill, training, and experience to obtain accurate results, and it is expected that the teachers would improve with practice [27]. Our results also showed that more children were identified as having anomalies in the study group than in the control group. Although the level of agreement between the results of Hirschberg's tests for either the study or control group and optometrists was high, the agreement between the study group and optometrists (AC1 = 0.98) was much higher than that of the control group and optometrists (AC1 = 0.91), which showed that teachers in the study group could obtain results very similar to those obtained by optometrists, proving that training played an important role in achieving accurate results. The Hirschberg's test sensitivity and PPV, as conducted by study group teachers, were better than those of control group teachers; therefore, with proper and adequate training, preschool teachers would be able to perform Hirschberg's test reliably. A study by Tung et al. revealed that strabismus screening methods, including Hirschberg's test, had high specificity (98.9%), with a sensitivity of 75.0% and PPV of 27.9% [27]. This study suggested that, while Hirschberg's test is commonly used and is an easy method to detect strabismus, screeners still need comprehensive instruction and sufficient practice to obtain consistent results [27]. Our study supported this finding, as the strabismus detection rate in the control group was low as compared to that in the study group. Thus, we propose that more intensive training over a longer period of time should be provided to ensure that the teachers are able to obtain more accurate results and thus achieve greater screening sensitivity.

In our study, the VA test performed by the study group had a specificity of 94.15% and a sensitivity of 59.65%. This high specificity and sensitivity against a lower specificity (62.54%) and sensitivity (13.33%) in the control group, indicated that preschool teachers were capable of performing VA tests to detect visual impairment in the study group. Previously, primary school screening studies have been conducted in other countries [28, 29]. In Iran, the sensitivity and specificity of teacher-conducted vision screenings for 3–6-year-old children were 74.5% and 97.2%, respectively [28], while in another study in China, these rates were 93.5% and 91.2%, respectively [29].

In a study performed in Thailand, Teerawattananon et al. compared the detection rate of refractive error by trained teachers and healthcare professionals in a screening of pre-primary school children. The detection of refractive errors by teachers was lower than that of healthcare professionals in most cases with mild visual impairment, yet it was reasonable and feasible overall [30]. The current study showed high specificity and a relatively low PPV, because a small proportion of children with abnormal vision were missed by the study group. In addition, preschool teachers could effectively perform preschool vision screening and were able to refer the children with eye problems for proper management. However, the control group results showed low sensitivity, indicating that practical training had a significant impact on the competency of preschool teachers when conducting vision screening. Tung et al. found that the VA test values they obtained had a sensitivity of 88.2%, but a PPV of only 27.3% because teachers in that study were only able to identify children with severe visual problems [27]. In another study, OstadiMoghaddam et al. found a higher specificity (92.03%), but a lower sensitivity (37.5%) of vision screening by teachers as compared to that by optometrists, with a PPV of 25.0%. They suggested implementing training methods for teachers to enhance the sensitivity of screening examinations, as this is expected to achieve a better predictive value for the screening method used [31]. Marmamula et al. reported an overall sensitivity of 72.3% for trained teachers, as compared to a vision technician, in the detection of vision problems among schoolchildren with a mean age of 9.8 years. The PPV was 92.3%, specificity was above 99%, and NPV ranged from 96.8% to 99.6% [32]. The current study proved that the sensitivity of VA screening obtained by the control group teachers was low (13.33%), as compared to that of the study group teachers (59.65%), because practical training in conducting the vision screening tests were not given to the control group. These results were consistent with findings from another preschool study by Sharma et al., who found that the VA test sensitivity value, when performed by preschool teachers, could be improved if the teachers received more emphasis on practical training [29]. These results also support the findings of Ying et al., who also used the Lea symbol chart to measure VA and obtained low sensitivity, comparable with our results [33].

From the descriptive analysis, we found that following VA screening by teachers, 57 (12.66%) children were referred for further evaluation by the study group, while 136 (30.22%) children were referred by the control group. Hence, the control group referred a larger number of cases than the study group. We believe that proper training would help teachers to conduct an accurate vision screening program, which would reduce the number of misreferred cases. There was a statistically significant difference between the two groups in terms of the RE and LE distance VA test results. Based on these results, the translated KieVision™ Preschool Vision Screening Kit had good content that enabled the study group teachers to gain a better understanding of the practical aspects and theoretical understanding of vision screening methods than the CEITC. This may be due to the increased content and appropriate training hours provided. The VA test identifies visual impairment conditions that are amenable to early intervention. The vision screening program is thus justified, because it can provide the means to a better quality of life for children and can save on disability-adjusted life years [34]. VA testing is the most widely used method for screening vision among preschool children [35, 36]. The Lea Symbols chart has been experimentally verified to be both a valid and reliable measure of VA. As is desirable in a good vision test kit, each of the four optotypes used in this symbol test has been proven to measure VA similarly and to blur equally, thus supporting the test's internal consistency [37, 38]. A previous study by Bertuzzi et al. showed that the Lea Symbols 15-line folding distance chart was clinically useful in detecting deficiencies in VA among preschool children [39]. This suggests that the Lea Symbols chart can be used confidently as an alternative to other pediatric VA tests. The current study found that 42.88% of preschool children were referred by both groups of teachers for further examination because of a failed distance VA test.

The outcomes of this study could improve vision screening programs conducted by preschool teachers and may indicate that a certain training frequency should be established for preschool teachers to improve their competence in conducting vision screening. The vision screening program should be conducted annually to reduce the occurrence of missed cases from earlier screenings, as well as to identify new cases that may arise as the child matures. However, there is a lack of long-term assessment of preschool teachers' performance and knowledge in the current study. In future studies, it will be important to determine preschool teachers' performance and knowledge retention by 6, 12, and 24 months after the vision screening training program.

CONCLUSIONS

There were significant differences between the results obtained by the study group teachers and optometrists for external observation, Hirschberg's test, and the distance VA test. However, the level of agreement between both the study and control groups of preschool teachers and optometrists showed that the study group achieved a higher value for all three tests than the control group. The specificity, PPV, and NPV were found to be higher in the study group of preschool teachers, which indicates that only a small proportion of children with abnormal vision were missed by these teachers. Therefore, the translated KieVision™ kit can be used effectively for training teachers to perform vision screening. Overall, the Bengali Language version of the KieVision™ Preschool Vision Screening Kit was effective and suitable for use by Bangladeshi preschool teachers to identify preschool children with vision impairment.

ETHICAL DECLARATIONS

Ethical approval: This study followed the tenets of the Declaration of Helsinki for human subjects. Ethical approval was obtained from the UKM Secretariat for Research and Ethics (approval number UKM-1.5.3.5/244/NN0602015). Specific permission was obtained from the Regional Ministry of Health and Education Authority, Chittagong District Zone, Bangladesh. The involvement of the participants was voluntary, and participants' identities were kept confidential. Informed consent was obtained from all preschool teachers, optometrists, and preschool children's parents.

Conflict of interest: None.

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