Why are we not doing retinoscopy in the school eye screening? Is distant visual acuity a sensitive tool for making referrals?

Tonmoy Chottopadhyay[1], Hardeep Kaur[1], Amit J. Shinde[1], Parikshit M. Gogate[2,3]

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Abstract:

PURPOSE: School eye screening program is an integrated part of *SarvaShikshyaAbhiyan.* Distance visual acuity was the only tool used in such school eye screening for making referrals. We aim to evaluate the referral rate when only distance visual acuity was used as the screening tool versus using retinoscopy.

METHODS: School children were earlier screened using distant visual acuity as the sole criteria. They were again examined as per the guidelines recommended by State of Alaska and American Academy of Pediatrics, and the results of the two examinations were compared. Microsoft Excel 2007 was used for the statistical analysis.

RESULTS: Earlier 384 school children of class first to fourth (aged 6–10 years) had been screened using distant visual acuity. Of them, 87 (22.6%) were referred. The rest 297 (male 183 61.6%) students with a mean age of 7.8 years (standard deviation ± 1.23) were again examined and 42/384 (11%) were detected as having visual anomaly that were false negative/or missed during the initial screening. Refractive errors were detected in 33/42 (78.6%) students by retinoscopy. Retinoscopy showed the highest sensitivity (78.6%) and negative predictive value (96.6%) to detect all types of refractive error among all types of tests. Of 42 pair of eyes, 36 right eyes and 39 left eyes had refractive errors, mostly astigmatic, or hyperopic, which were missed earlier.

CONCLUSION: Only distance visual acuity failed to detect hyperopia and astigmatism properly. Introduction of retinoscopy would increase the validity of school eye screening.

Keywords:

Refractive error, retinoscopy, school eye screening, sensitivity, under referral

Introduction

Education is an important determinant in the quality of life of an individual, and subsequently, the progress of a nation. *Sarvashikshyaabhiyan* (Education for all movement) is an attempt to provide the elementary education to all the children of India.[1] Vision screening program is an appropriate and important part of school health services worldwide. Identifying and providing appropriate services to those students with poor visual conditions, particularly at an early age, appear to be cost-effective and beneficial in terms of enhancing the quality of life.[2,3]

In India, the school eye screening program concentrates on the children with refractive errors.[4] To keep the screening procedure as simple as possible and introduce a first level screening by teachers in the schools itself, it was decided to concentrate on distant vision only.[4]

School eye screening is the second (after cataract surgery) major activity of the National Program for Control of Blindness (NPCB). Not only that, school eye screening is now a very important aspect of *sarvashikshyaabhiyan*.[5]

School vision screening programs have higher efficacy to detect myopia but less sensitivity in detecting out other abnormalities.[6,7] As there is no gold standard for vision screening program, the overall quality/effectivity of such vision screening program has always been a topic of controversy world-wide.[7] Literature suggests that only distance visual acuity assessment/ screening is not effective to detect hyperopia

[1]School of Optometry, Bharati Vidyapeeth Medical College Deemed to be University, [2]Dr. Gogate's Eye Clinic, Community Eye Care Foundation, [3]Department of Ophthalmology, D. Y. Patil Medical College, Pune, Maharashtra, India

Address for correspondence: Tonmoy Chottopadhyay, School of Optometry, Bharati Vidyapeeth Medical College Deemed to be University, Pune - 411 043, Maharashtra, India. E-mail: tonmoy.c@bharatividyapeeth.edu

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or astigmatism.[6] Other studies also suggest that objective refraction like retinoscopy can play a vital role here, but retinoscopy requires advanced clinical training.[7,8] Moreover, many international organizations recommended more than one single test would be perform well to detect a refractive abnormality.[9]

In such circumstances, when the screening process itself needs standardization, using inexperienced nonclinical personnel for screening again raises a controversy. Researchers report that screenings done by the teachers had more false-positive results.[10,11]

School eye screening is a bridge between *sarvashikshyaabhiyan* and Vision 2020. A more accurate screening procedure/tool(s), which would ensure a minimum number of false-positive referrals and most importantly prevent missing a single child with undetected refractive anomaly; this is the need of the day. The aim of this study was to find out the most sensitive test/tool(s) and redesigning screening procedure which fulfils the need.

Methods

This was an observational, descriptive, cross-sectional study done in a school of Western India.

After getting the ethical approval from the Institutional Ethics Committee and written consent from the parents and the school authority, the screening was carried out. A combination of screening procedures recommended in "Alaska vision screening guidelines for the preschool/school population"[9] and "Eye examination in infants, children, and young adults by pediatricians"[12] was used as additional set of tests. Sensitivity and negative predictive values of every individual tests were calculated.

Students, who were considered as pass (don't require any referral) in eye screening done 1 month prior to this study, where only the distance visual acuity was used as screening tool (it was reported that students who failed the screening and referred, were having less than Snellen's visual acuity 6/9 in either eye. Unfortunately, they were not included in the actual study so detecting the false-positive rate was out of the scope). Those students between the age group of six to ten (Class I to IV) were included as subject (n = 297) for further screening with recommended additional tests to find out whether they were really true negative or not.

The way those additional tests were performed were as follows

A. Distance visual acuity test with 3 meter HOTV chart was done under normal day light illumination. Students who were using glass presently, visual acuity test was done with their correction first, then without the correction. A pin-hole visual acuity was also taken in case of failure to read the 6/7.5 acuity line, with or without glasses
B. Ocular adnexa examination was done by torch light
C. Near visual acuity was assessed by two different tests. They were:
    1. Plus lens method– A +2.50 dioptre spherical lens was put on the trial frame with either eye occluded. In case of spectacle, the correction (with the help of hand neutralization) was kept on trial lens first, then +2.50 diopter lens over it. The students were asked to read the distance vision chart. Ability to read the chart indicates abnormality
    2. Near acuity chart (HOTV) was used to assess the near visual acuity. In case of students with spectacle, trail frame was used with habitual correction placed on it (occluder over either eye), otherwise simply occluding either eye with the hand held occluder the test was carried out. The reading distance was also point of consideration and recorded accordingly.
D. Objective refraction was done by retinoscope (Heine Beta 200) and followed by subjective acceptance
E. Ocular alignment test was assessed by three different tests. They were:
    1. Cover test done for 6 meters and 40 centimeters in primary gaze with the habitual correction, if any. Prism Bar cover test was done to measure the deviation
    2. Brückner test with Heine direct ophthalmoscope
    3. TNO stereo acuity test.
F. Ishihara plates and score card were used for color vision test
G. Ocular media examination was done by using (Heine Beta 200) distance direct ophthalmoscopy. Fundus examination was done by near direct ophthalmoscopy simultaneously.

For each and every test, a standard referral guideline was followed and to eliminate interpersonal variation a particular test was assigned to one of the four optometrists only throughout the screening.

Microsoft Excel 2007 was used to data entry and cross checked on three occasions. Data analysis was also done with Microsoft Excel 2007. Negative predictive values and sensitivities of the various tests were derived from the true negatives, false negatives and the true positives, false negatives values, respectively.

Results

Earlier 384 school children of the age group of 6–10 years had been screened only by checking their visual acuity. They belonged to Class I–IV. Out of them, 87 were referred for further examination. The rest 297 (male 183, female114) students with a mean age of 7.8 years (standard deviation ±1.23) were again screened. Out of 297 students, 42 (10.9% out of 384) were detected as false negative. Out of 42 pair of eyes, 36 right eyes (myopia 04, hyperopia 15, and 17 astigmatism) and 39 left eyes (myopia 04, hyperopia 15, and astigmatism 20) were having refractive error. The rests were either emmetropic eyes or detected for other anomalies that is color vision deficiency, abnormal cover test findings, or sub normal stereoacuity.

Retinoscopy showed highest efficacy of making a referral or detecting an anomaly.

Table 1: Number of students detected as required further referral by each test

Test detail	Number of detected students out of 42	Sensitivity (%)	Negative predictive value (%)
Distance vision acuity	17	40.5	91.1
Plus lens	3	7.1	86.7
Near vision acuity	2	4.8	86.4
Retinoscopy	33	78.6	96.6
Stereo acuity	5	11.9	87.3
Cover test	5	11.9	87.3
Colour vision	1	2.4	86.1
Ocular adnexa	0	0	85.9

Table 2: Efficacy of the individual tests or the combinations of the tests for a referral

Tests	Number students detected out of 42	Percentage out of 42
Colour vision	1	2.4
Cover test	3	7.1
Distance vision + cover test	1	2.4
Distance vision + plus lens + retinoscopy	1	2.4
Distance vision + retinoscopy	13	30.9
Plus lens + retinoscopy	1	2.4
Retinoscopy	15	35.7
Retinoscopy + cover test	1	2.4
Stereo acuity	4	9.5
Distance vision + near vision + plus lens + retinoscopy + ophthalmoscopy + stereo acuity	1	2.4
Distance vision + near vision + retinoscopy	1	2.4

In Tables 1 and 2, sensitivity, negative predictive value, and efficacy of the individual or combinations of the tests were shown, respectively. Fifteen referrals were solely made by retinoscopy. Tables 3 and 4 showed the details of refractive status of the detected 15 participants. Hyperopia and with the rule astigmatism were best detected by retinoscopy only.

Table 3: Types of refractive error solely detected by retinoscopy

Types of refractive error	Eye	*n*	Percentage out of 42	Percentage out of 384
Hyperopia	Right	7	17	1.8
	Left	7	17	1.8
With the rule astigmatism	Right	4	10	1.0
	Left	5	11.90	1.3
Against the rule astigmatism	Right	2	4.76	0.5
	Left	3	7.14	0.8

2 Right eyes were emmetropic

Discussion

The Government of India started utilizing school teachers for identifying children with eye problems, using visual acuity as a tool, since 1978.[13] Various studies had been conducted to assess the quality of such school eye screening conducted under NPCB.[13] Those studies conclude that though using school teachers for primary screening was cost effective and helpful to overcome the lack of professional vision care personnel,[10,11,14] but the outcomes showed that false positives were relatively high.[10] Visual acuity screening using teachers was effective in detecting myopia with high sensitivity and specificity; but it failed to detect children who have reading related problems, hyperopia, or astigmatism. Children who have high degrees of hyperopia (>5 dioptre) and astigmatism (>1.5 dioptre) were still able to read a 6/6 (20/20) Snellen equivalent.[6] A screening test should ideally have 100% specificity, sensitivity, and positive predictive value for all kinds of refractive errors.[7]

Recent researches do not agree with the so called gold standard status of modified clinical technique model of Orinda study.[15] Therefore, for a successful school eye screening, a proper test(s) or tool(s) or procedure(s) is required to identify the children with eye problem(s), which in-turn demand optometrists rather than noneye care personnel (school teachers in case of school eye screening).

In this study, (an) alternative or (a) complimentary test(s) or tool(s) to distance visual acuity test was/were searched for and the outcome of using the distance visual acuity test as the sole screening tool was assessed as well.

Although 87 out of 384; that is a satisfying 22.6%; were referred initially, which satisfied the criteria mentioned by Limburg *et al*.,[4] 42 students were detected as false negative (that is considering them as not requiring referral in previously done screening). This followed the trend observed by Sudhan *et al*. where 6.1% false-negative value was detected among 543 students by re-screening.[11] But, in that series, only refraction was done.

In this study, among all the tests incorporated to detect refractive anomalies, retinoscopy showed a higher sensitivity value of 78.6% and a negative predictive value of 96.6%. This indicates retinoscopy has the potential to effectively reduce the chances of false negative as well as false-positive values.

Table 4: Amount of refractive error in solely detected by retinoscopy

	Hyperopia (D)		With the rule astigmatism				Against the rule astigmatism			
	Right eye	Left eye	Right eye		Left eye		Right eye		Left eye	
			Sph. (D)	Cyl. (D)	Sph. (D)	Cyl. (D)	Sph. (D)	Cyl. (D)	Sph. (D)	Cyl. (D)
Total	5.25	5.5	−0.5	−4.25	−0.5	−5.5	0	−1	0.25	−1.5
Average	0.75	0.7857	−0.12	−1.06	−0.1	−1.1	0	−0.5	0.083	−0.5
SD±	0.322749	0.40052	0.75	0.657489	0.720243	0.518411	0	0	0.144338	0

D: Dioptre, Sph.: Spherical, Cyl: Cylindrical, SD: Standard deviation

Retinoscopy detected hyperopia and astigmatism, even when visual acuity was normal. The response of students varied with their socioeconomic and educational level, when distance visual acuity chart was used, as was the result from a study in Delhi.[10] This variation was not found when objective tests like retinoscopy is done.

The findings strongly indicated that only distance visual acuity testing (sensitivity 40.5%) was not sufficient enough for screening and making quality referrals. Students (17 out of 42 including one case of monocular amblyopia) who failed in distance visual acuity testing (gross range of monocular vision is from 6/9.6 to 6/24) were supposed to be detected in previously conducted screening itself, of which four of them were using spectacles already. This outcome indeed met an agreement with the study done in Israel regarding discrepancies in two screening results of the same population.[16]

As per recommended by few authors, shifting the cutoff acuity from 6/9 to 6/12 size "E" Snellen's acuity would reduce the rate of false positives.[4,10]

In this study, the refractive status of the students who were detected solely by retinoscopy (15 out of 42) was hyperopic and astigmatic. If the current cutoff acuity (6/9 Snellen's acuity) can miss on an average + 0.78 dioptre hyperopia,-(minus) 1.10 diopter with the rule astigmatism and-(minus) 0.5 dioptre against the rule astigmatism [the higher value between right and left eye is taken here from Table 4] then shifting up the acuity cut off will provide a wider window to the students to escape from being detected with abnormality and hence will increase false negatives.

As initially referred, 87 students were not assessed during further screening there was no scope to calculate false positive value and positive predictive values. The result reflects that if distance visual acuity test was considered only, 17 students (true positive is 17 and false negative is 25), instead of 42, would be detected, whereas 33 (true positive is 33 and false negative 9) students would be detected if only retinoscopy was done. However, still only distance visual acuity is unfortunately the most widely used screening test, even though it is proven that screening solely for the reduced distance visual acuity may miss up to 40% of children with potential vision problems, including hyperopia, binocular disorders, or other ocular health problems. There is also a correlation existing between uncorrected hyperopia and poor reading skill,[1,9,17] which in turn is related to quality of life. Hence, retinoscopy along with distance visual acuity for each and every child will increase the accuracy of the screening procedure and help to give better quality of life to the students.

Dandona *et al*. indicated childhood blindness in India to be 1.7 per 1000 (visual acuity <6/60 in the better eye), 33.3% amongst being refractive errors. The study also suggests that refractive error correction would result in benefit to more than 70% of the children who had bilateral vision impairment in India.[18] The best way to reach those children with refractive error is school eye screening.[19] Performing retinoscopy was proven feasible in school screening on a large scale as documented by Padhye *et al*.[20] She performed retinoscopy while screening but that requires professional skills. She performed retinoscopy while screening but that requires professional skills. In the Vision 2020 plan, NPCB has recognized "school eye screening" as second priority. The output of an eye screening program can be much more accurate for the pediatric population, if a minimum level of false-negative rate can be achieved. In school eye screening, where making quality referral is the primary concern, rather than conducting comprehensive eye examinations, it is enough to incorporate retinoscopy. While scoping one has to analyze the refractive status by observing the quality and nature of the glow, which cannot be possible with an autorefractor. In fact final spectacle prescription can be made in the school itself if someone with sound retinoscopy skill is available. The only thing is having an individual (optometrist) who shall be proficient in this clinical skill. Although sample size was little less in this study, this can be conclude the introduction of retinoscopy as screening tool definitely increase the efficiency and efficacy of the screening programs .

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Conflicts of interest

There are no conflicts of interest.

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