

## Prevention of Blindness

### Cost-effective screening of schoolchildren for refractive errors

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*Uncorrected refractive errors are the main cause of severely impaired vision in India. This in itself indicates that there is a shortage of basic eye care services and spectacles, and too little public awareness of the need for them. A simple method for screening schoolchildren for refractive errors is described and the results are analysed. Evaluation of the materials used and the accuracy of the screening shows that this method can be used successfully by teachers.*

Diagnosis and treatment of refractive errors, including aphakia (absence of the lens in the eye, either congenital or due to trauma, or usually after removal for cataract), is one of the easiest ways to reduce impaired vision or even blindness. Yet, in India, refractive errors are the second major cause of blindness (see Table 1)<sup>1</sup> the second cause of low vision, and the most common reason for patients to consult ophthalmologists and ophthalmic assistants (1). Clearly, access to eye care services, public awareness of the need for them, and availability of spectacles have not yet reached adequate levels.

There are three main groups that require spectacles: children with refractive errors, the

Table 1  
**Causes of bilateral blindness (visual acuity of less than 6/60)**

Cause	Percentage of total
Senile cataract	80.10
Refractive errors	7.35
Aphakia	4.69
Glaucoma	1.70
Central corneal opacities	1.52
Trachoma	0.39
Others	4.25

middle age group with presbyopia, and the older age group with aphakia. In this project, refractive errors in schoolchildren were considered a priority. Poor vision in childhood

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<sup>1</sup> In the survey of blindness in India from 1986 to 1989, blindness was defined as visual acuity of less than 6/60 in the better eye, with the usual correction. It is because of this definition that non-availability of corrective spectacles for refractive errors is recognized as a cause of blindness or visual impairment.

affects performance in school and at work and has a negative influence on the future life of the child.

Eye care services in India are provided by approximately 4000 paramedical ophthalmic assistants and 8000 ophthalmologists. The dis-

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tribution of the ophthalmologists, however, is highly unequal: in cities, there is one per 20 000 people, in rural areas one per 220 000 (2). The ophthalmic assistants work at primary health centre level in the rural areas. Ideally, there should be one per 100 000 people, but with approximately 3500 posted in primary health centres, each serves on aver-

age more than 250 000 people. They are supposed to examine all schoolchildren for eye ailments, including refractive errors.

About 13% of the Indian population is in the age group of 10–15 years. With a school enrolment rate of 30% (3), there will be about 4000 students in Middle Schools for every 100 000 people. On average, each paramedical ophthalmic assistant is supposed to screen over 10 000 children a year, which is a Herculean task. By introducing an additional level of screening through schoolteachers, the number of children covered could be increased, the workload for the ophthalmic assistants reduced and their knowledge and skills used more efficiently.

### ***Method and procedures***

In the initial phase, the School Eye Screening programme concentrated on 10–15-year-olds

### ***Successfully screened and taken care of***



in Middle Schools. Refractive errors are most prevalent in this age group, the children are able to understand and cooperate well in the vision screening, and they are able to learn how to test vision themselves and take this knowledge home to their villages.

From each school, one teacher is nominated for a one-day training course. Preference is given to women teachers who wear spectacles, since they are likely to be more interested, and to counteract popular prejudice against girls wearing spectacles. During the training, the teachers are provided with the materials for screening the children in their schools. The teacher's kit contains a six-metre tape measure, a card used by the teacher for the screening, referral cards for children with suspected poor vision, and educational materials. Child-to-child cards, using the same procedure, are given to all children to take home.

The screening is done in the following way. From six metres distance (measured with the tape provided), the child is shown the teacher's card, which is white with four black 'E's of standard size (6/9 of Snellen's Chart). For each eye, the child has to indicate the direction of the open end of the 'E'. By simply rotating the card, the sequence can be changed. The child either indicates the directions correctly (eyesight "good") or incorrectly (eyesight "not good"). If there is any doubt, the teacher should record the eyesight as "not good".<sup>2</sup>

After the training, the teachers go back to their schools and do the screening. Good coordination with the ophthalmic assistants is

crucial at this stage, because they have to do refraction tests and prescribe spectacles. Firm appointments have to be made for the ophthalmic assistant to examine suspected cases

*Time previously spent on travelling and examining children with good eyesight can now be used exclusively for examining children with vision problems.*

from a certain school. If further examination by an ophthalmologist is needed, the child is referred. If not, the child goes to the local optician's shop for spectacles.

Teachers' cooperation in this work has been excellent, without any monetary incentive. They usually feel this screening adds to their own efforts to improve the performance of their students. The programme also enhanced their status. Some teachers have trained one of their colleagues to assist them in the implementation of this programme.

An agreement is made with one or more of the local opticians for the supply of good spectacles (acetate frames and white English glass) to all children referred to them under this programme for the reasonable price of 60 rupees (US\$ 1.80). Payment is made directly by the programme against the referral card. For the opticians this is an attractive scheme, because the programme brings them business, which in its turn may lead to competition in prices and quality, and hence better service.

It must be emphasized that a school eye screening programme should only be started when adequate services can be provided. If there is no trained staff to do refraction or no supply system for spectacles, it is better not to start a screening programme at all, as it would only lead to frustration.

<sup>2</sup> A training manual, instruction video and slide set on this procedure are available through: DANPCB, A1/148, Safdarjung Enclave, New Delhi 110 029, India. Phone: 011-6887339, fax: 011-6881099.

## Results

In 1991, 46 672 students of the 50 168 registered (93%) in the sixth to the eighth standards in ten blocks of four districts were examined. Out of 277 schools, 268 (97%)

**For these 46 000 children, the cost of screening was less than 1 rupee (US\$ 0.03) per child.**

were covered and 292 teachers were trained. Of the children screened by teachers, 4.6% were suspected of having poor eyesight (see Table 2). This means that the teachers actually reduced the workload of the ophthalmic assistants to about a twentieth of its original size. Only new cases were reported; children already using spectacles were not included in the screening.

In the end, only 65% of the suspected cases were actually examined by ophthalmic assistants, as in some cases the referral system was not well organized, and in others parents preferred to take their child directly to a private ophthalmologist.

Of the cases identified by the teachers and subsequently examined by ophthalmic assis-

tants, 43% were confirmed as refractive errors. The percentage of children referred by each ophthalmic assistant to an ophthalmologist varied from 7% to 30%. This may reflect the confidence of the ophthalmic assistant, and could be improved through in-service training. Of the children with a prescription, 95% collected their glasses and wore them at school, which indicates good compliance.

Looking at the power of the glasses prescribed (see Table 3), it is obvious that hyperopics are far less numerous than myopics. It must be mentioned that teachers screen only on distant vision. For the myopics, over 60% of the corrections are of less than -1 dioptré. For such light corrections, it is up to the ophthalmic assistant or the ophthalmologist to decide whether the child actually needs spectacles.

Considering these results, one might suggest a higher cut-off point for screening. It is now 6/9, and could be raised to 6/12. This would mean fewer cases of poor eyesight detected by teachers and referred to ophthalmic assistants, fewer false positives, and, probably, fewer prescriptions for glasses of less than 1 dioptré strength. Conversely, the cut-off point could be lowered to 6/6, which would mean more cases detected and referred by teachers, more work for the ophthalmic assistants, more false positives, and more prescriptions for glasses of less than one dioptré strength. In our experience 6/9 was the most appropriate cut-off point for screening.

*Table 2*  
**Results of screening 46 672 children in 268 schools**

	Number	%
Cases of poor eyesight identified by teacher	2125	4.6
Of these, number examined by paramedical ophthalmic assistant	1385	65
Number referred to ophthalmologist	229	17
Number prescribed with spectacles	593	43
Of these, number of glasses provided by optician	562	95
Students wearing spectacles in school	540	96

*Table 3*  
**Number of pairs of glasses prescribed, by power of spherical corrections**

<+1	+1 to +2	+2 to +3	+3 to +4	+4 to +5	>+5
14	1	0	0	0	1
<-1	-1 to -2	-2 to -3	-3 to -4	-4 to -5	>-5
334	116	22	22	7	23

### Costs

The teachers are not paid for this service, but they receive one day of training. Most of the costs are for the cards, the tape measure and the bag they are packed in, and the provision of spectacles. For these 46 000 children, the cost of screening was less than 1 rupee (US\$ 0.03) per child. The cost per child found to have a refractive error and provided with spectacles worked out at 85 rupees (US\$ 2.55).

### Evaluation of the materials used

To find out if the Teacher's Card was adequate for identifying children with refractive errors, it was compared with the standard Snellen's Chart and trial lens set. To reduce bias, both methods were used by well trained paramedical ophthalmic assistants. They examined 1158 children from five schools separately, without knowing each other's findings. The prevalence of refractive errors in this sample was found to be 7%. The results are indicated in the figure.

The sensitivity to detect a refractive error with the Teacher's Card, as compared to the Snellen's Card, was 86%, the specificity 98%. The predictive value of a positive test was 77%, with a kappa value of 0.78. This indicates good validity and good reliability for the screening material used.

### Evaluation of the examiners

To find out if teachers can adequately identify children with refractive errors, we compared their results with those of an ophthalmic assistant. Both were using the Teacher's Card for screening. The 1158 children from five schools, already examined by an ophthalmic assistant with the Teacher's Card, were also examined by the trained teacher of each of

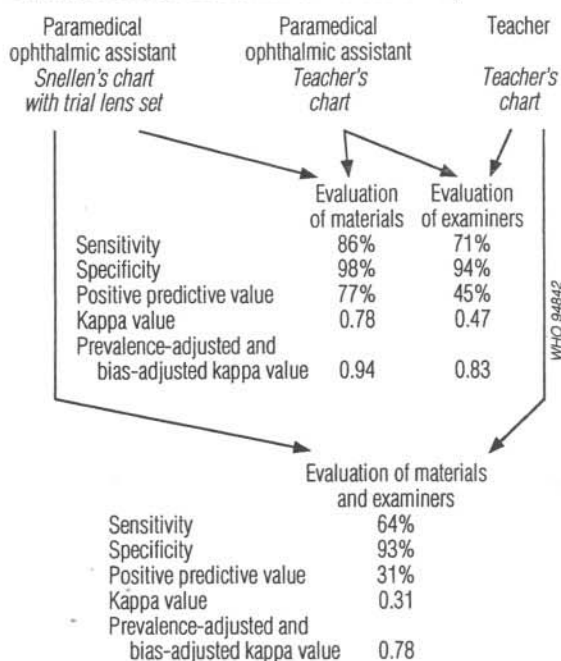
these schools, with the same card. Taking the ophthalmic assistant's results as the standard, the sensitivity was 71% and the specificity 94%. The predictive value of the positive test

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was 45% and the kappa value 0.47, suggesting lower inter-observer agreement. However, it should be borne in mind that the kappa value is also influenced by bias between observers and the prevalence of poor eyesight (4). The prevalence-adjusted and bias-adjusted kappa value shows a much better inter-observer agreement, 0.83 (see figure).

### Evaluation of school eye screening programme

Examination of 1158 students from 5 middle schools by:





The sensitivity and positive predictive value of the screening procedure, which are also influenced by prevalence, were lower for the teachers. This indicates that some children with refractive errors were not detected in the screening by teachers (false negatives), but this is not a serious problem. It may be caused by children peeping through their fingers or squeezing their eyes, and ophthalmic assistants may be more alert to correct this. Specificity and negative predictive value remain high (96–99%), indicating that teachers identify children with normal vision correctly and do not overload ophthalmic assistants with false positives.

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Teachers are being used successfully to screen children for refractive errors, and the materials and methodology at their disposal are adequate for this task. The accuracy with which teachers confirm the absence of refractive errors is comparable with that achieved by trained staff such as paramedical ophthalmic assistants. The variation in proficiency between different teachers suggests that a yearly one-day refresher training course may be useful. Using teachers for screening saves an enormous amount of time for ophthalmic assistants. Time previously spent on travelling and examining children with good eyesight can now be used exclusively for examining children with vision problems. The number

of children provided with spectacles has increased dramatically. In addition, many more children now know what refractive errors are and where to seek corrective services.

This screening programme has been taken up in many more districts in India. In the first four districts, the programme now covers nearly the entire district and over 500 000 schoolchildren have been screened. The biggest challenge, however, will be to make this vision screening an annual routine activity in all the schools. ■

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