

# Strategies to Improve the Accuracy of Vision Measurement by Teachers in Rural Chinese Secondary Schoolchildren

## *Xichang Pediatric Refractive Error Study (X-PRES) Report No. 6*

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**Objective:** To assess and improve the accuracy of lay screeners compared with vision professionals in detecting visual impairment in secondary schoolchildren in rural China.

**Methods:** After brief training, 32 teachers and a team of vision professionals independently measured vision in 1892 children in Xichang. The children also underwent vision measurement by health technicians in a concurrent government screening program.

**Results:** Of 32 teachers, 28 (87.5%) believed that teacher screening was worthwhile. Sensitivity (93.5%) and specificity (91.2%) of teachers detecting uncorrected presenting visual acuity of 20/40 or less were better than for presenting visual acuity (sensitivity, 85.2%; specificity, 84.8%). Failure of teachers to identify children owning

but not wearing glasses and teacher bias toward better vision in children wearing glasses explain the worse results for initial vision. Wearing glasses was the student factor most strongly predictive of inaccurate teacher screening ( $P < .001$ ). The sensitivity and specificity of the government screening program detecting low presenting visual acuity were 86.7% and 28.7%, respectively.

**Conclusions:** Teacher vision screening after brief training can achieve accurate results in this setting, and there is support among teachers for screening. Screening of uncorrected rather than presenting visual acuity is recommended in settings with a high prevalence of corrected and uncorrected refractive error. Low specificity in the government program renders it ineffective.

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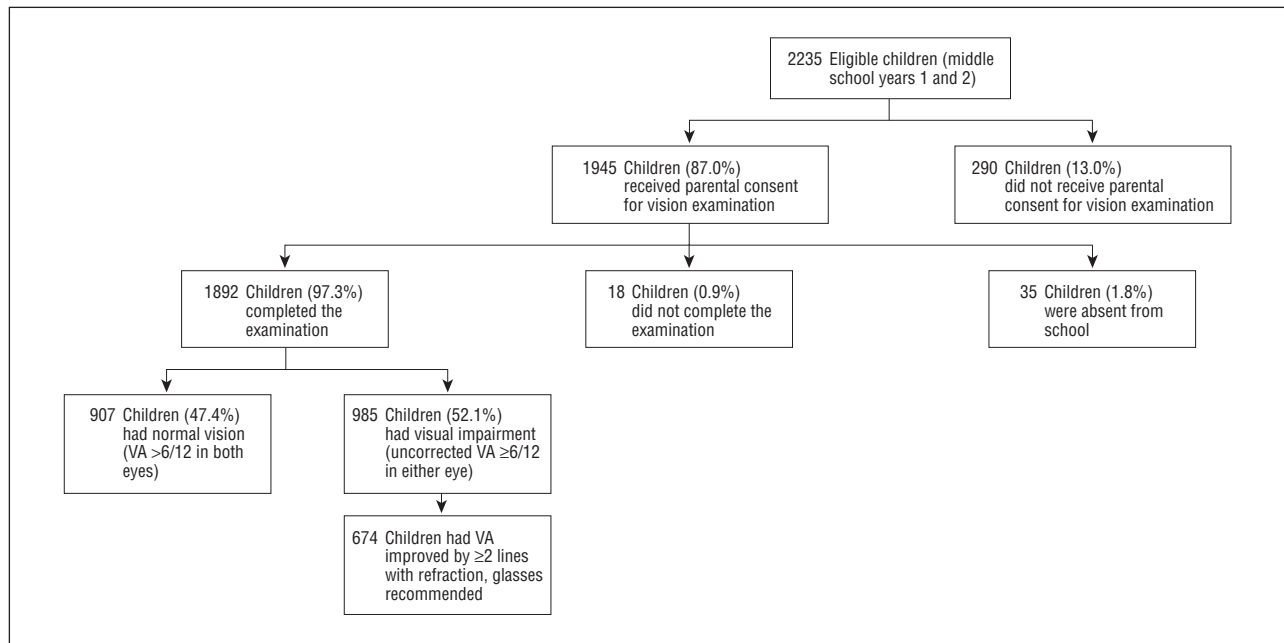
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**T**HE WORLD HEALTH ORGANIZATION estimates that 153 million people in the world in 2004 were bilaterally visually impaired at the level of less than 20/60 owing to uncorrected refractive error.<sup>1</sup> Uncorrected refractive error is the leading cause of visual disability in school-aged children of European,<sup>2,3</sup> South Asian,<sup>4</sup> and East Asian<sup>5-8</sup> descent, with the prevalence of myopia in China being among the highest in the world.<sup>9,10</sup> The aim of screening for refractive error is to identify individuals who would benefit from wearing glasses. In countries such as China with compulsory education or high levels of school attendance, school-based programs may allow access to a large proportion of the population.<sup>9,11,12</sup> Such programs have been used in various settings to improve children's access to vision services and have had variable success in improving glasses uptake.<sup>13,14</sup> Even in settings with lower school attendance, a school-based approach may be reasonable because educa-

tional attainment seems to increase the risk of myopic refractive error.<sup>15,16</sup>

For such programs to be successful, they must detect visual disability at a high level of sensitivity and specificity while minimizing expense. A major hurdle to sustainable and reliable screening programs is the cost of personnel to perform the screening. Refractive programs in the past have relied on parents and other volunteers,<sup>14,17</sup> health technicians,<sup>18,19</sup> school nurses,<sup>20-22</sup> teachers,<sup>13,14,23-27</sup> and even computer programs<sup>28,29</sup> to perform vision screening. The high prevalence of myopic refractive error in China has been well documented.<sup>9-11,30</sup> However, little published evidence exists to suggest whether available personnel other than vision professionals can perform accurate vision screening in school settings in China, although some such assessments have been attempted in other regions.<sup>21,22,27,31-33</sup> There is a general paucity of information on screening strategies and student and screener characteristics associated with more accurate vision evaluation.



**Figure.** Flowchart detailing the recruitment and examination of children for the Xichang Pediatric Refractive Error Study. VA indicates visual acuity.

Teachers seem to be ideal candidates to perform basic vision screening in school-based programs because they are readily available and are experienced in interacting with children. We, thus, sought to determine the accuracy of teacher screening for visual impairment and refractive error in a school setting in rural China. In addition, we assessed the accuracy of an annual government-run vision screening performed at 1 school at the same time as the present study.

The Xichang Pediatric Refractive Error Study (X-PRES) is a school-based evaluation of refractive error prevalence, patterns of eyeglass wear, and uptake of refractive services in 1900 children in junior middle school years 1 and 2 (ages 13-17 years) in rural Guangdong Province. The present article describes (1) the accuracy of teacher screening after brief training and of a government-run vision screening performed by health technicians in detecting visual impairment and refractive error in rural secondary schoolchildren compared with evaluation by experienced vision professionals and (2) student factors and screening strategies associated with more accurate teacher screening.

## METHODS

Xichang is a town with a population of 109 673 in 2002,<sup>34</sup> located within 2 hours of Shantou in eastern Guangdong Province. Eye services are provided through a facility run cooperatively by the local government medical clinic and the Caring Is Hip eye care program, supported by the Li Kai Shing Foundation. Basic refractive services and glasses are available at the eye clinic and at a few privately run optical shops in Xichang and surrounding areas.

A school-based survey was conducted between April 1 and June 30, 2007, on a cluster-based random sample of children in junior middle school years 1 and 2 at all 3 middle schools in Xichang. The sample is likely to be representative of the population in this age range because of compulsory education in

China through age 16 years. The purpose of the survey was to determine the prevalence and predictors of visual disability, refractive error, and eyeglass wear in Chinese rural-dwelling children while also assessing the effectiveness of a multipart educational intervention to encourage the purchase of eyeglasses in children found to need them. The protocol was approved by the ethics committee at the Joint Shantou International Eye Center, parent hospital of the Xichang Eye Clinic. Informed consent was obtained from the parents of all participating children, and the Declaration of Helsinki was followed throughout.

## PARTICIPANTS

Cluster-based random sampling was used to select 2235 children in middle school years 1 and 2 from all 3 middle schools in Xichang. Thirty-two classes were selected at random from 55 eligible classes at the 3 schools, with a class size of approximately 60 to 70 children. The parents of all the children in the selected classes were sent invitation letters explaining the purpose and methods of the study. Parents were asked to return forms indicating whether they were willing to have their children participate in the study. Of 2235 children in the sample, 2197 returned the forms (98.3%); permission was granted for 1945 children (88.5% of returned forms and 87.0% of the sample), and 1892 of these (97.3% of consenting children and 84.7% of the sample) were examined (**Figure**).

## TEACHER TRAINING

To assess the accuracy of vision screening of children in this age range after brief training, teachers observed vision measurement and then performed measurement with monitoring by study ophthalmologists for 10 children of the same age range as those participating in the study. The importance of asking all the children about glasses ownership was emphasized, and the teachers were told to measure uncorrected and corrected vision in children who had glasses. The teachers then performed vision screening for all the children in their class (approximately 60 children), unobserved by study personnel. All the teachers gave written informed consent and answered a brief questionnaire regarding their

age, sex, teaching history, eyeglass wearing, and beliefs about the importance and effect of eyeglass wear on children's school performance. All teachers participating in the study taught in classes whose children had been selected for participation in the study (see the "Participants" subsection). There were no refusals among teachers selected for inclusion. Teachers were compensated ¥100 (US\$13) for their participation.

## ASSESSMENT OF VISION

Uncorrected visual acuity (VA) and VA wearing habitual refraction, if available, were measured in well-lighted areas during daylight hours at a distance of 6 m separately for each eye of each child by his or her teacher. Children who did not have their eyeglasses at school were asked to bring them for vision assessment by teachers and staff on a separate day. Identical illuminated Snellen Tumbling E vision charts (Shantou City Medical Equipment Ltd, Shantou, China) were used for all testing. The nontested eye was covered by the student using a hand-held occluder, with proper occlusion and neutral head position monitored by the examiner. The right eye was tested first. A single optotype of each size was shown first, starting at 20/100. If a letter was misread, testing began 2 lines above, with the child being asked to read all optotypes on the line sequentially. A participant had to identify correctly more than half of the letters on a given line (eg, 3 of 5 or 4 of 6) to pass successfully to the next line. To prevent covert memorization of the optotypes in advance of testing, children were instructed to line up outside of the area where testing was performed, and they entered only when instructed to do so by the examiner.

After vision measurements were completed and recorded by teachers, children proceeded to a separate room where vision measurements were recorded by study ophthalmologists or optometrists masked to the teachers' results and using the identical protocol and vision charts.

The Guangdong government conducts yearly health surveys of all schools. Approximately 5000 students in grades 1, 2, and 3 of the 3 middle schools in Xichang were screened on May 16 to 18, 2007 (during the period of the present study), by trained general health technicians. The students underwent a 15-minute whole-body examination conducted in a large hall with 20 stations staffed by 2 physicians and 20 nonmedical health technicians. The examination consisted of height, weight, and abdominal girth measurements, hearing and vision testing, a brief neurologic examination, chest auscultation, and abdominal palpation. All VA testing and body measurements were obtained by the technicians. Nonilluminated Snellen Tumbling E charts were used at a distance of 6 m, and presenting VA only was recorded separately in each eye for all the participants. All information was recorded on a paper form, and after government review, school health statistics and the original data forms were returned to the schools.

After obtaining written consent from the parents, records of VA as measured during the government screening were sought for a random sample of 300 children who had undergone vision testing in the present study at 1 of the participating schools. Original records were successfully reviewed at the school for 242 children in the sample (80.7%).

## BASIC QUESTIONNAIRE

All 1892 study participants were given a self-administered basic questionnaire by study personnel before being told the results of their vision assessment. The basic questionnaire included questions on age, sex, parental education, history of eyeglass wear, and reasons for eyeglass nonwear. The basic questionnaire also included a Chinese translation of an instrument

developed originally by Fletcher et al<sup>35</sup> to assess self-reported visual function in rural Asia. The instrument was scored from 0 (worst) to 100 (best) and is described in detail elsewhere.<sup>35</sup>

## REFRACTION

All the students with an uncorrected VA of 20/40 or worse in either eye (n=985) and a 25% random sample with a VA greater than 20/40 in both eyes (n=248) underwent refraction. Cycloplegia was accomplished by using cyclopentolate (Cyclogel, 1%;) and tropicamide (Mydracil, 1%), 1 drop of each every 5 minutes for a total of 3 drops of each medication, followed by autorefraction (Canon RK-F1 Refractometer/Keratometer; Canon Inc, Tochigi, Japan) with refinement in each eye by an ophthalmologist.

## REFERRAL FOR EYEGLASSES

Recommendation was made for new eyeglasses for the following children: (1) those with presenting VA of 20/40 or less in either eye (with or without spectacles) and whose VA could be improved by 2 or more lines in either eye with refraction and (2) children with eyeglasses improving VA to greater than 20/40 but whose VA could be improved by at least 2 lines with refraction. All such children (n=674) (Figure) received a card with a map depicting the location of the Xichang Eye Clinic, their refraction, and a message indicating that eyeglasses were recommended.

## STATISTICAL METHODS

Raw data are given as mean (SD), median (interquartile range), or frequency (percentage), as appropriate. Sensitivity, specificity, and positive and negative predictive values and associated 95% confidence intervals were calculated for teacher and government screeners in detecting low uncorrected and presenting VA ( $\geq 1$  eye with VA of  $\leq 20/40$ ), taking VA measured by professional staff as the gold standard. These 95% confidence intervals were estimated using the Clopper-Pearson method,<sup>36</sup> as implemented in MATLAB 6.5 (The MathWorks Inc, Natick, Massachusetts). Logistic regression was used to assess student factors potentially associated with more accurate teacher screening. Age, sex, and all variables with  $P < .25$  in univariate analyses were included in the final model. All the statistical analyses, except the previously mentioned confidence interval calculations, were performed using SPSS version 14.0 (SPSS Inc, Chicago, Illinois). All the statistical tests were 2-sided, and  $P < .05$  was considered statistically significant.

## RESULTS

Thirty-two teachers from the 3 Xichang schools screened 1892 students from their own classes and subsequently completed the teacher questionnaire. The mean age of the participating teachers was 28.9 (5.3) years, 24 were women (75.0%), and 19 wore eyeglasses themselves (59.4%) (Table 1). Less than one-third of the teachers indicated that they had completed undergraduate training (10 [31.3%]), and the median time that they had been teaching was 5.5 years (interquartile range, 2.0-11.0 years). Most of the teachers were satisfied or very satisfied with their jobs (17 [53.1%]). The mean number of students in their classes was 65.6 (5.4) (Table 1).

The teachers generally believed that eyeglasses improved academic performance (23 [71.9%]) but did not necessarily improve behavior (11 [34.4%]). More than

half of the teachers believed that a yearly vision program would be useful (18 [56.3%]), with most supporting teacher screening of students (28 [87.5%]).

The mean age of the 1892 examined children was 14.7 (0.8) years (range, 11.4-17.1 years), 969 (51.2%) were female, and 26.4% were wearing eyeglasses at the time of examination. Of 1892 children participating in the study, 674 (35.6%) were advised by project staff to purchase new eyeglasses (Figure).

According to vision screening by study optometrists and ophthalmologists, 985 children (52.1%) had visual impairment when measured without refractive correction (uncorrected VA  $\leq$ 20/40 in 1 or both eyes). The sensitivity and specificity of teachers in detecting these children were 93.5% and 91.2%, respectively (**Table 2**). For 627 students (33.1%) identified by study personnel as presenting with visual impairment (presenting VA  $\leq$ 20/40 in either eye), teachers had a sensitivity of 85.2% and a specificity of 84.8%. Teacher specificity in detecting presenting visual impairment decreased to 2.2% in 25 children where staff performed testing with eyeglasses but the teacher did not do so. Sensitivity in detecting low presenting VA by teachers was only 70.6% in 109 children wearing eyeglasses in whom vision was tested by teacher and staff (Table 2).

The government screening program assessed only presenting VA, and the sensitivity and specificity in identifying children with low presenting VA compared with study personnel were 86.7% and 28.7%, respectively. Positive and negative predictive values were 54.5% and 68.6%, respectively (**Table 3**). Although specificity was 69.6% in children who did not wear eyeglasses, it was only 4.0% in those wearing eyeglasses.

Of the student factors, wearing eyeglasses (according to the assessment of study personnel), female sex, worse refractive error, and worse visual function scores were associated with worse odds of accurate teacher screening assessment in univariate analyses, although of these, only eyeglasses wear persisted as significant in the multivariate model (**Table 4**).

## COMMENT

Teachers in this school setting in rural China achieved good accuracy (>90% sensitivity, specificity, and positive and negative predictive values) in the detection of uncorrected visual impairment after brief training. Vision screening in secondary school students in China poses a particular challenge owing to the high prevalence of corrected and uncorrected refractive error: that of identifying which children already own eyeglasses and accurately assessing the presenting VA with habitual correction in these individuals. In fact, wearing eyeglasses was the single most important risk factor for inaccurate teacher vision assessment in the present study, and teacher sensitivity and specificity in the assessment of presenting VA seem to have been adversely affected as a result. These data indicate that teachers often (25 of 134 [18.7%]) did not test presenting VA with eyeglasses in children wearing eyeglasses, resulting in a significant loss of specificity. Furthermore, teacher sensitivity in detecting visual impairment in children wear-

**Table 1. Demographic and Professional Characteristics of and Perceptions About Eyeglasses Among 32 Teachers Participating in a Vision Screening Program for Secondary Schoolchildren in Rural China**

Characteristic	Value
<b>Demographic and Professional Variables</b>	
Age, mean (SD), y	28.9 (5.3)
Female sex, No. (%)	24 (75.0)
Wearing eyeglasses, No. (%)	19 (59.4)
Education, No. (%)	
$\leq$ Junior college	22 (68.7)
Undergraduate	10 (31.3)
Teaching experience, median (IQR), y	5.5 (2.0-11.0)
Job satisfaction, No. (%)	
Very satisfied	4 (12.5)
Satisfied	13 (40.6)
No strong feeling	12 (37.5)
Unsatisfied	3 (9.4)
No. of students in class, mean (SD)	65.6 (5.4)
<b>Perceptions of Eyeglasses and Screening</b>	
Eyeglasses improve academic performance, No. (%)	23 (71.9)
Eyeglasses improve behavior, No. (%)	11 (34.4)
Yearly vision program useful, No. (%)	18 (56.3)
Teacher screening useful, No. (%)	28 (87.5)

Abbreviation: IQR, interquartile range.

ing eyeglasses was low (70.6% vs 87.6% in children not wearing eyeglasses), suggesting a possible bias toward good vision in teacher measurements in these children.

Although the government screening program displayed good sensitivity in screening for low presenting VA, specificity was very poor (<30%). As a result, only slightly more than half of the students who would have been referred by the government program had poor vision according to trained vision professionals (positive predictive value of 54.5%). Although the poor specificity was most pronounced in children wearing eyeglasses (4.0%), suggesting that their presenting VA was frequently assessed without correction, even in children not wearing eyeglasses, the specificity of the government program was still less than 70%. Screening programs with this low level of specificity, and particularly with a poor positive predictive value, are inefficient and unlikely to be of practical benefit to the screened population.

Although a variety of potential student factors associated with poor teacher screening accuracy were suggested by univariate analyses, the multivariate model indicates that female sex, higher refractive error, and worse visual function likely mediated their effect on screening accuracy principally through wearing eyeglasses, which was more common in all these groups. Wearing eyeglasses was the only student factor that predicted worse teacher screening in the univariate and multivariate models.

A principal aim of the X-PRES is to guide programs designed to improve refractive service delivery in rural Chinese students. The present study seems to have important program implications in that the data suggest that teacher screening accuracy may be maximized by focusing on the assessment of uncorrected vision, thus avoiding 2 potential problems: failure to accurately identify and appropriately test children who already wear eye-

**Table 2. Accuracy in Detecting Uncorrected and Presenting Visual Impairment ( $\geq 1$  Eye With Visual Acuity  $\leq 20/40$ ) in 32 Teachers Screening Students in Rural China Compared With Experienced Optometrists and Ophthalmologists**

Characteristic	Affected According to Criterion Standard, No. (%)	Sensitivity, % (95% CI)	Specificity, % (95% CI)	Positive Predictive Value, % (95% CI)	Negative Predictive Value, % (95% CI)
In all students (n=1892)					
Uncorrected VA	985 (52.1)	93.5 (91.8-95.0)	91.2 (89.1-92.9)	92.0 (90.2-93.6)	92.8 (90.9-94.4)
Presenting VA	627 (33.1)	85.2 (82.1-87.9)	84.8 (82.7-86.8)	73.6 (70.2-76.7)	92.0 (90.3-93.5)
In students with presenting VA $\leq 20/40$ in either eye (n=627)					
Those not wearing eyeglasses when examined by staff and teacher	493 (78.6)	87.6 (84.4-90.4)	91.5 (89.5-93.3)	85.0 (81.6-88.0)	93.1 (91.2-94.7)
Those wearing eyeglasses when examined by staff but not teacher	25 (4.0)	100.0 (86.3-100.0)	2.2 (0.3-7.8)	22.1 (14.9-30.9)	100.0 (15.8-100.0)
Those wearing eyeglasses when examined by staff and teacher	109 (17.4)	70.6 (61.2-79.0)	89.9 (85.7-93.2)	73.3 (63.8-81.5)	88.6 (84.3-92.1)

Abbreviations: CI, confidence interval; VA, visual acuity.

**Table 3. Accuracy in Detecting Initial Visual Impairment ( $\geq 1$  Eye With Visual Acuity  $\leq 20/40$ ) for a Government Screening Program in Rural China Compared With Experienced Optometrists and Ophthalmologists**

Accuracy in Detecting Presenting Visual Impairment	Affected According to Gold Standard, No./Total No. (%)	Sensitivity, % (95% CI)	Specificity, % (95% CI)	Positive Predictive Value, % (95% CI)	Negative Predictive Value, % (95% CI)
In all students	120/242 (49.6)	86.7 (79.3-92.2)	28.7 (20.9-37.6)	54.5 (47.1-61.7)	68.6 (54.1-80.9)
In those not wearing eyeglasses	94/140 (67.1)	83.0 (73.8-90.0)	69.6 (54.3-82.3)	84.8 (75.8-91.4)	66.7 (51.6-79.6)
In those wearing eyeglasses	26/102 (25.5)	100.0 (86.8-100.0)	4.0 (0.8-11.1)	26.3 (17.9-36.1)	100.0 (29.2-100.0)

Abbreviation: CI, confidence interval.

**Table 4. Student Factors Potentially Associated With More Accurate Teacher Screening**

	Accurately Screened		OR (95% CI)		P Value
	No (n=324)	Yes (n=1568)	Univariate Model	Multivariate Model	
Age, mean (SD), y <sup>a</sup>	14.7 (0.8)	14.7 (0.8)	0.93 (0.80-1.08)	0.85 (0.71-1.00)	.06
Sex, No. (%)					
Male	133 (41.0)	790 (50.4)	1 [Reference]	1 [Reference]	
Female	191 (59.0)	778 (49.6)	0.69 (0.54-0.87) <sup>b</sup>	0.98 (0.74-1.30)	.89
Wearing eyeglasses, No. (%)					
No	153 (47.2)	1239 (79.0)	1 [Reference]	1 [Reference]	
Yes	171 (52.8)	329 (21.0)	0.24 (0.19 to 0.31) <sup>b</sup>	0.28 (0.20-0.40)	<.001
Parents' highest educational level, No. (%)					
Primary or below	62 (19.1)	351 (22.4)	1 [Reference]	1 [Reference]	
Junior school	156 (48.1)	724 (46.2)	0.82 (0.60-1.13)	0.64 (0.44-0.93)	.02
High school	103 (31.8)	473 (30.2)	0.81 (0.58-1.14)	0.70 (0.47-1.04)	.08
College or above	3 (0.9)	20 (1.3)	1.18 (0.34-4.08)	0.85 (0.22-3.23)	.81
Average refractive error, diopters <sup>a</sup>	-2.71 (2.14)	-2.32 (1.84)	1.11 (1.03-1.18) <sup>b</sup>	0.94 (0.86-1.03)	.18
Visual function score <sup>a,c</sup>	69.4 (16.3)	77.1 (16.0)	1.03 (1.02-1.04) <sup>b</sup>	1.00 (0.99-1.01)	.90

Abbreviations: CI, confidence interval; OR, odds ratio.

<sup>a</sup>Odds ratio per 1-unit increase.

<sup>b</sup> $P < .05$ .

<sup>c</sup>Visual function scores ranged from 0 (worst) to 100 (best).

glasses and upward bias in measuring the VA of children who wear eyeglasses.

One undesirable outcome of such an approach is the unnecessary referral of children whose vision is already accurately corrected with their current eyeglasses, a potential problem in vision screening by nonprofessionals that has been discussed elsewhere.<sup>19,37</sup> Taking as the cri-

terion standard children who were identified by the present program after subjective refraction by an ophthalmologist as needing eyeglasses (including those with and without eyeglasses at baseline), the sensitivity, specificity, and positive predictive value of teacher screening using uncorrected vision and presenting VA were 91.0%, 68.1%, and 61.2% and 79.8%, 84.8%, and 74.1%, respectively.

The approach of measuring uncorrected vision maximizes sensitivity (presumably by eliminating the phenomenon whereby teachers seemed to overestimate the vision of children tested while wearing their eyeglasses), whereas measuring presenting VA maximizes specificity. Failure of teachers to correctly identify some children who already had eyeglasses somewhat limited the potential gains in specificity from the approach of measuring presenting VA.

The decision of which strategy to follow will ultimately depend on program resources. Differences between the 2 strategies will be reduced in areas with a low prevalence of refractive error or very low access to eyeglasses. An alternative strategy is to test presenting VA and to emphasize strongly to teachers the importance of carefully asking about the wearing of eyeglasses and the potential for bias in vision measurement of glasses-wearing children. These results call into question the efficacy of emphasizing the need to ask about glasses wear during training; we did not mention the problem of overestimating vision in glasses-wearing children during teacher instruction.

Another finding with direct program implications is that government vision screening by health technicians in the setting of a variety of other health investigations does not seem to yield sufficient diagnostic accuracy to warrant use of this approach, at least in this setting.

Screening in schools is an appealing method of detecting childhood visual dysfunction because, in appropriate settings, it may provide rapid and inexpensive access to children of various socioeconomic backgrounds, with the added benefit of ready follow-up.<sup>12,38</sup> School-based teacher vision screening has been used by refractive programs in reports from many settings, including Mexico,<sup>13</sup> North America,<sup>14</sup> and South Africa.<sup>17</sup> A variety of approaches may be taken. For example, teachers may be instructed simply to report children thought to have visual difficulties, thus reducing screening time.<sup>14,27,37</sup> Alternatively, formal school vision screening may be implemented by teachers or others not trained as vision professionals.

The results of such programs have varied widely between studies, although most of these have focused on the detection of vision abnormalities in children considerably younger than those participating in the present study. Nurses<sup>21,22,39,40</sup> and lay screeners<sup>40</sup> have achieved reported sensitivities of 37% to 71% at specificities of 70% to 90% in detecting visual impairment in preschool-aged children. Sensitivity and specificity of 55% and 99%, respectively, have been reported for Oman's national school vision screening program in the detection of low presenting VA in elementary school students by school nurses.<sup>22</sup> Vision screening seems to be more accurate,<sup>22</sup> and the prevalence of refractive error is higher in older children. In view of these differences, the variety of studies in the literature directly comparable with the present study is limited. The Oman program<sup>22</sup> reported specificity of 72.5% and sensitivity of 99% in children aged 12 to 17 years, 6.6% of whom required referral for visual impairment. This represents a lower sensitivity and referral rate but higher specificity than observed for similar-aged children in this cohort.

Although teacher vision screening after brief training seems to be capable of yielding good accuracy in this setting, important questions remain about its widespread acceptability to schools and teachers in regions such as China with a high prevalence of uncorrected refractive error. The fact that most teachers (87.5%) interviewed in this study indicated that they believed that the approach was useful is encouraging.

The results of this study must be understood in the context of its limitations. Broader applicability of the finding that teacher screening can be performed accurately, and of suggested strategies to enhance this accuracy, may be limited by the small number of teachers included. Failure to obtain parental consent from 13% of the children raises the possibility that these findings are not fully representative of the population examined, secondary schoolchildren in Xichang. Finally, only a modest sample of children from a single school examined under the government program underwent medical record review, and it is at least possible that screening accuracy in other settings was better.

Despite its limitations, this study highlights, for the first time, some of the practical problems in implementing accurate teacher vision screening in secondary schoolchildren in a rural Chinese setting, where uncorrected and corrected refractive error are prevalent. An awareness of these potential sources of inaccuracy may allow future planners to improve the quality and effect of their school-based refractive programs. We are currently conducting a large randomized trial of interventions to promote the purchase and wear of eyeglasses in this population. Vision screening in this program is being performed by teachers on the basis of uncorrected VA to avoid some of the potential pitfalls of attempting to measure vision with currently worn correction.

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