Vision screening in the under-5s

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Routine developmental surveillance of the under-5s includes among its aims the early recognition of visual defects. The Stycar series of tests devised by Sheridan¹ and the "hundreds and thousands" test are the principal methods used by clinical medical officers in child health clinics to detect reduced visual acuity. Squint is detected by careful observation, the Hirschberg corneal reflection test, and the cover tests.

In some areas peripatetic orthoptists undertake community vision screening in children.²⁻⁴ They are trained to use a variety of techniques not readily available to clinical medical officers. One of us (AP) is based in a hospital department of ophthalmology and also works as a community orthoptist in the district's child health clinics and day nurseries.

Since the vision screening component of developmental surveillance has never been assessed under field conditions in Britain we carried out initially a prospective analysis of the types of vision defects and the mode of their detection among children attending (a) child health clinics and day nurseries in a defined health district and (b) the ophthalmology outpatient clinic at our hospital. We also examined the contribution of the community orthoptist to the effectiveness of the vision screening programme. Based on the findings of the initial study we measured the sensitivity of the individual Stycar acuity tests.

First study

In our South London teaching district the clinical medical officers undertake routine developmental surveillance in clinics and nurseries and refer suspected visual defects to the community orthoptist for secondary screening; she also undertakes some primary (unselected) screening at some of the clinics and nurseries. She refers any defects which she confirms or detects directly to the children's ophthalmology outpatient clinic at the teaching hospital.

STUDY POPULATION AND DATA COLLECTION

Three groups of children were studied over six months in 1980. For all children having routine developmental examinations in clinics and day nurseries the clinical medical officers were asked to record details of any child who had been referred for further investigation of a suspected visual defect or who had had an unsatisfactory test result and had been asked to return at a later date for review by the clinical medical officer. In addition, all children seen by the community orthoptist either as referrals or during unselected primary screening and those attending the paediatric ophthalmology outpatient clinic were included in the study. The adult accompanying each child was interviewed by one of us (SH) using a structured questionnaire to determine by whom and how the defect had first been detected, what action had been taken, and the length and cause of delay between detection and diagnosis.

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FOLLOW-UP

By the end of the study period some of the children had not yet been seen by the community orthoptist or re-examined by the clinical medical officer. Therefore, nine months later health visitors were asked to ascertain the outcome of referrals to the community orthoptist. Details of children reviewed by the clinical medical officer were obtained from the clinic records.

ESTIMATION OF YIELD OF VISION SCREENING

Yield was defined as the number of newly detected, clinically important cases divided by the total number screened.⁵ To be included the child's defect had to be (a) detected for the first time as a result of vision screening in the study period—that is, not previously suspected by the parents—and (b) confirmed by the ophthalmologist and orthoptist at outpatient clinics and require treatment or observation.

Results

DEVELOPMENTAL ASSESSMENT

Referrals and reviews—One hundred and four children from clinics and 11 from day nurseries were referred by the clinical medical officers to the community orthoptist. Ninety-five per cent of children with suspected squint were referred immediately compared with only 27% of cases of suspected reduced visual acuity. The remainder of this latter group were asked to return for review and, according to the clinical medical officers' recorded comments, this was usually due to difficulty in interpreting the results of the Stycar tests, in obtaining full co-operation, and in testing the two eyes separately.

Secondary screening—Three-quarters of the children seen by the community orthoptist for secondary screening were referred to her because of suspected squint. She confirmed a diagnosis of squint in one-third of these; one-third had a pseudosquint; and one-third had no defect. The remaining quarter had suspected low visual acuity. A defect was confirmed in half of these, all of whom had been referred because of a failed letter-matching test.

Orthoptist's primary screening—No new cases of visual defect were detected among 120 unselected babies at clinics, but five new cases were found in 67 unselected children attending day nurseries.

Follow-up—Nine months later 27% of parents originally referred to the community orthoptist had not kept their appointments. There was no further information on 48 (70%) of the 69 children asked to return for review by clinic doctors. Records were unavailable for 28; 15 had failed to attend; and the eyes had not been retested at the follow-up visit in five.

Yield—The Stycar graded balls, the miniature toys test, and the "hundreds and thousands" test did not yield any confirmed case with reduced visual acuity; the letter-matching test was the only Stycar test to yield any new cases (table I). Although many children with squint were referred, few of these met the criteria for yield.⁵ The follow-up study added only one further case to the overall yield.

OUTPATIENT INTERVIEWS

Of the 135 interviews, 78 (60%) of the children lived in the study district. The reasons for referral were suspected squint in 97 (72%), low visual acuity in 27 (20%), and other defects in 11 (8%). Only two children out of 95 under the age of 3 had been referred because of reduced visual acuity; in both the defects had first been recognised by the parents, and examination showed pronounced refractive errors. None of the 135 children had been referred because of failure in the graded balls, matching toys, or "hundreds and thousands" test.

Children whose defects had first been suspected by parents outnumbered those detected by professionals by 3 to 1. Of the 25 (18.5%) children referred as a direct result of vision screening, 11 had been

examined initially in the study district clinics but only three met the criteria for yield (table I).

TABLE I—Yield of vision screening

Results of vision screening	No (%)	No of assessments
Clinic assessments (CMO):		2455
Suspected defects	176 (7.2)	
Confirmed defects	11 (0.4)*	
Yield (%) [†]	3 (0.1)†	
Using graded balls test	0	
Using miniature toys test	0	
Using five-letter test	1	
Nursery assessments (CMO):		188
Suspected defects	26 (13.8)	
Yield (%)	3 (1.6)‡	
Primary screening (CO):		
In clinics		120
Yield (%) of defects	0 (0)	
In nurseries		67
Yield (%) of defects	5 (7.5)§	

CMO = Clinic medical officer; CO = Community orthoptist.

*Six had a squint, three low visual acuity, and two other defects.

†Two had a squint and one low visual acuity (astigmatism).

‡All had low visual acuity (myopia).

§Three had a squint and two low visual acuity (myopia).

Long delays between first suspicion of a defect and the start of treatment were common, the responsibility for the delay being divided equally between parents and professionals. For example, although 42% of the 63 children with confirmed squint were first recognised as abnormal by parents before the child's first birthday, only 12% of them attended the eye clinic under 1 year of age.

HYPOTHESIS

One possible explanation for the negligible yield of visual acuity testing was that the tests used were not sufficiently sensitive to detect the common visual defects. We explored this hypothesis by testing co-operative subjects with known Snellen visual acuities.

Second study

SUBJECTS AND METHODS

Subjects over 6 years of age were invited to participate. Their Snellen visual acuity was 6/12 or worse in at least one eye. Details were obtained of diagnosis, refraction, visual acuity (corrected and uncorrected) for near and distance vision, using the standard Snellen type. The tester was blind to this information.

Four Stycar tests are widely used in clinics: graded balls (mounted and rolled), miniature toys, and letter-matching tests. The "hundreds and thousands" test, although not part of the Stycar series, was also included. All tests were conducted exactly in the manner described in the manual and always in the same order. Each eye was tested without spectacles. Illumination was constant throughout the study.

Graded balls—In the fixed ball test each size of ball was presented three times in randomised positions. The result recorded was the smallest size which the subject located correctly on all three presentations. Failure was defined as inability to localise the smallest ball in the series (3 mm, 1/8 inch). In the rolling ball test one trial of each ball was given. The smallest ball which could be seen and visually tracked without difficulty was recorded. Failure was defined as for the fixed ball test.

Miniature toys—The subjects were asked to identify verbally each of the three items of cutlery (knife, fork, and spoon). The smaller size

TABLE II—Sensitivity and specificity of Stycar tests of visual acuity

Test	Sensitivity for detection of (%):		Specificity
	Moderate defects	Severe defects	
Fixed balls	5	68	100
Rolling balls	12	70	100
Miniature toys	58	95	91
Matching letters	98	100	64

of each item was presented three times in random order. They were told to indicate difficulty rather than guess; even a single error was therefore regarded as noteworthy. If any of the nine presentations was incorrectly identified the result was scored as a failure.

Letter-matching test—The seven-letter version was used. Inability to identify letters marked 4 and upwards was recorded as a failure.

"Hundreds and thousands" test—About 20 small coloured sweets ("hundreds and thousands," 1 mm in diameter) were placed on a matt black plate and the child asked to pick up one individual sweet. The result was recorded as: pass, pass with difficulty, fail.

SENSITIVITY AND SPECIFICITY

The sensitivity and specificity of each test in detecting (a) moderate defects (Snellen visual acuity 6/12–6/36) and (b) severe defects (Snellen visual acuity ≤ 6/60) were calculated according to the standard epidemiological method of evaluating a screening test.⁶ The Snellen visual acuity was the reference test in each case.

Results

The 53 subjects tested consisted of 11 patients with severe eye disease, 16 with amblyopia, and 26 with simple refractive errors.

The sensitivity and specificity of the individual Stycar tests are shown in table II. Of 18 subjects with the Snellen near-visual acuity of ≤ 6/60 or worse, only one failed the "hundreds and thousands" test; six of the 18 passed with difficulty. All subjects with a near visual acuity of 6/12 to 6/36 performed the test easily.

Discussion

Ideally, a screening procedure should be validated against a standard diagnostic test, but there is no such test of visual acuity for children who are too young to recognise letters on a Snellen chart. In the first study, therefore, we assessed the yield of abnormalities produced by the Stycar tests under field conditions. Our reference tests were the orthoptic examination and, in out-patient cases, the refraction data and the ophthalmologist's decision on management. If the tests of visual acuity are to be useful, they should result in an appreciable number of referrals to the eye clinic; also, the defects should be previously undetected and of sufficient clinical importance to require some form of active management. We were not surprised that screening detected no new cases of severe disorders of the globe or optic pathways or of high myopia. These defects are rare⁷ and are usually either noted at a neonatal examination or are subsequently obvious to the parents.

On the other hand, squints and refractive errors are among the commonest visual defects in infancy. In a study of a large number of infants and young children by retinoscopy,^{8,9} Ingram found that severe myopia was rare, but anisometropia, hypermetropia, and astigmatism were very common in this age group; furthermore, these minor refractive errors could predispose to squint and amblyopia.¹⁰ The negligible yield of new cases in our study, therefore, suggested that either the delivery of the service was inadequate or that the tests themselves were unsuitable for vision screening. The performance of a visual acuity test in young children depends both on their developmental level of attention and on the optical resolution demanded by the test itself. The first is difficult to estimate but the second is unaffected by age and can be either calculated or measured experimentally by comparison with the accepted reference test, the Snellen test card. Sheridan calculated equivalents for the Stycar tests,¹ but no experimental validation has been published.

In the second study, by using as subjects only older children and adults who could co-operate with Snellen testing, we eliminated developmental variations and were able to examine the purely optical aspects of the Stycar tests. Inability to see the smallest Stycar ball or a "hundred and thousand" indicated a severe reduction in visual acuity. The frequent test failures recorded by clinical medical officers in apparently normal babies

were therefore probably due to developmental rather than optical factors. The greater sensitivity of the toy test in our co-operative subjects could only be duplicated in young children by giving enough trials to eliminate guessing, which is seldom possible before the child's attention is lost. The seven-letter test was very sensitive, although it did underestimate the severity of amblyopia, as others have shown.¹¹

In the first study, in contrast to the low yield from the visual acuity tests, children with suspected squint provided the bulk of referrals both to the community orthoptist and to outpatient clinics. Parents and other non-professionals were by far the most likely to notice a squint first and, where a professional did notice it first, it was usually by careful observation rather than by use of the Cover test or observation of corneal reflections. The orthoptist undoubtedly reduced the ophthalmology outpatient load and probably encouraged earlier referral by clinic medical officers.

There are still unacceptable delays between detection and diagnosis variously due to ignorance, prejudice, or carelessness. Further public and professional education is clearly needed, and further revisions of standard baby books should emphasise that persistent unilateral squint is never normal.

Thus our findings suggested that vision testing as presently performed makes little contribution to the detection of visual defects in preschool children. Child health clinics and the orthoptist together play an important part in facilitating the rapid referral of definite and suspected squint. The negligible yield of visual acuity testing seemed to be due to the intrinsic unsuitability of the Stycar tests for detecting minor or moderate visual acuity defects rather than to inadequate conduct of the test or delivery of the service. If they are to be retained in routine child health practice their limitations must be appreciated and incorporated into training. We suggest, however, that in children who are too young to co-operate with letter tests, screening for vision defects should be confined to a history, inspection of the eyes, a properly performed cover test, and recognition of abnormal visual behaviour.

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Correspondence to DMBH.

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Doctors in my area have recently been advised that if one of our patients dies from cirrhosis of the liver and we believe this to have been associated with a heavy intake of alcohol we should report it to the coroner. Should not the same principle be applied to deaths from bronchitis or carcinoma of the bronchus if the patient's doctor thinks that these were related to smoking?

The wording of a medical certificate of the cause of death is entirely at the discretion of the certifying doctor, and he may therefore write anything he wishes so long as it is in good faith and "to the best of his knowledge and belief." Naturally, he should take notice of the instructions offered by the Registrar General printed in the death certificate booklet to avoid vague and undesirable terminology, but apart from this he has the sole prerogative as to the expression of the cause of death. Therefore there is nothing to stop a doctor offering the opinion that bronchitis or carcinoma of the bronchus was a consequence of smoking, if he so believes. Similarly, the decision to report a death to the coroner is entirely at the discretion of the doctor, but it is equally within the powers of the coroner to decide that he does not wish to take official notice of any notification if he considers the case does not warrant admitting into his jurisdiction. Alternatively, he could accept the notification from the doctor but then issue his "Form A," which directs the doctor to certify the death without the coroner ordering a necropsy.

There is a special verdict available to the coroner in respect of chronic alcoholism but no such special verdict to cover the association of smoking with diseases. Therefore it would be a matter for an individual coroner to decide what he would do about notifications such as these. As stated, he could either decline to accept the case, he could direct the doctor to issue a certificate, or he could hold an inquest, in which case the opinion of the pathologist who would invariably carry out a necropsy would presumably be added to the evidence. The other complication of this matter would be that the registrar of births and deaths who received the death certificate would almost certainly decline to register it without reference to the

coroner if the doctor had certified the death in the usual way and issued a certificate to the relatives for transmission to the registrar. This matter is not new: some years ago at least one such case was reported in the medical press. It would depend on the attitude of individual coroners as to how they dealt with the matter, but there is certainly no legal barrier to a doctor giving this cause of death if he genuinely believes it to be the correct reason.—BERNARD KNIGHT, professor of forensic pathology, Cardiff.

A 2-year-old girl has Poland's anomaly—absent sternal head of the pectoralis major. To what extent can exercise increase the cosmetic acceptability of the eventual adult appearance?

Poland's syndrome^{1,2} includes not only congenital absence of the sternal head of pectoralis major but hypoplasia of the hand and syndactyly on the same side. There may be other thoracic anomalies, other muscles or the breast and nipple may be hypoplastic or absent, or there may be anomalies of the ribs, scapula, or spine. The middle phalanges of the fingers are small or absent, and a disproportionately small thumb is common. Only one in seven patients with the pectoralis major defect, however, have the full Poland's syndrome: in the others there is little loss of function and even the appearance is often overlooked. The missing muscle may be represented by a fibrous band that causes limitation of abduction of the shoulder. Surgical correction might well then be indicated. Reconstruction of the breast has occasionally been tried in women.³ Unfortunately since the pectoral muscle is not hypoplastic but absent, little can be expected from treatment with exercises.—A J HARROLD, consultant orthopaedic surgeon, London.

¹ Poland A. Deficiency of the pectoralis muscles. *Guy's Hospital Reports* 1841;6:191.

² Ireland DCR, Takayama N, Flatt AE. Poland's syndrome. A review of forty-three cases. *J Bone Joint Surg* 1976;58A:52-8.

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