

## Vision screening referral criteria: an audit

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### Abstract

**Aims:** To investigate whether children with significant refractive errors are going undetected at screening using the referral criterion of visual acuity worse than 0.20 logMAR. To review the refractive status of children referred to community clinics from the reception class screening test with visual acuities of between 0.15 and 0.20 logMAR inclusive.

**Methods:** Primary visual and orthoptic screening was performed in the reception classes of the mainstream primary schools in the south Birmingham area. The children whose visual acuities were found to be between 0.15 and 0.20 logMAR inclusive were recorded. A spreadsheet was created for each academic year. The following were recorded: visual acuities at screening; the visual acuities at first visit to the clinic; the results of refraction; whether glasses were prescribed or not; and whether the child was followed-up.

**Results:** Over a 5-year period, 348 children were recorded who came within the audit criteria. Of these, 275 attended their first appointment, 240 were refracted and 122 of these were prescribed glasses. These 122 represent 35.1% of all the children included in the audit and 50.1% of the children who were refracted. A total of 221 children (80.4%) had follow-up appointments. The reasons for follow-up were analysed.

**Conclusions:** Significant refractive errors are going undetected at reception class screening with the visual acuity referral level set at less than 0.20 logMAR. The age at which the universal screening is carried out needs to be more precisely identified in screening programmes.

**Key words:** National guidelines, Referral criteria, Universal screening

### Introduction

Visual screening provision varies throughout the UK. Primary screening may be undertaken before school (at age 3–4 years) or in reception class (at age 4–5 years) and may be performed by orthoptists or other personnel. In some areas there is no primary visual screening service.

In Birmingham, primary screening is provided for reception class children and is performed by orthoptists. The methods of screening and referral criteria are uniform across the city, but there are local variations in referral pathways in different areas of Birmingham. South Birmingham Community/Primary Care Trust Paediatric Eye Service is a community-based service with four clinic bases and five orthoptists making up 3.2 whole-time equivalents. The service covers 94 mainstream primary schools with a cohort of 4000–4500 children; four clinics with orthoptist and combined optometrist sessions; and a service to children with special educational needs in two child development centres and six special schools. Ophthalmologist cover and support is provided by Birmingham Children's Hospital Eye Department and this is the referral centre for children needing further ophthalmological input.

A reception class eye screening programme has been in place in the South Birmingham Community/Primary Care Trust area for over 25 years. During that time, the make-up of the community trust has been altered six times, the tests used have changed and the referral criteria have also changed. Even during the 5-year life-span of this audit, the catchment that makes up 'the south Birmingham area' has changed, leading to a larger cohort.

Before national screening programmes were introduced in 2003, screening programmes had locally agreed guidelines and referral criteria. The pass criterion for visual acuity used in the South Birmingham area was originally 6/9 Snellens and then 0.10 Sonksen–Silver. When national screening guidelines were introduced, the nationally recognised referral criterion for visual acuity was (and is) less than 0.20 logMAR.<sup>1</sup>

### Methods

In 2005, after 2 years of following the national screening

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guidelines of a referral level of visual acuity less than 0.20 logMAR, the experienced screening orthoptists became concerned that problems that had been identified with the more stringent referral level of less than 0.10 Sonksen–Silver were now going undetected.

To investigate this, a 2-year pilot audit was set up. Those children whose worse visual acuity was recorded between the two referral level criteria, i.e. 0.125–0.20 logMAR inclusive, were recorded at the reception class eye test, for review in Year 1. For various reasons the number of children available for review was very small. Of those rechecked in Year 1, a third were referred to clinics for refraction, half of these were prescribed glasses and three-quarters had follow-up appointments.

This audit also showed that those children achieving 0.125 logMAR as the worse visual acuity did not have significant refractive errors. The referral level was therefore revised to 0.15 logMAR. The results of the pilot study were not included in this analysis as the inclusion criteria had changed.

Following these results a formal prospective audit was started in September 2006 and run for 5 years. All children who had parental consent in the reception class of 94 mainstream primary schools in the south Birmingham area were screened. The screening procedure is as follows: cover test for near and distance, ocular movements, convergence and visual acuity using the Keeler logMAR crowded test. If a child was unable to perform the Keeler logMAR crowded test, either naming the letters or matching them, then the Kay Pictures crowded test was used, with a pass level of 0.10. The referral criteria for the reception class screening are as follows: visual acuity of less than 0.20 logMAR in one or both eyes tested with the Keeler logMAR crowded test, a difference in visual acuity of greater than 0.10 between the two eyes, all heterotropias, significant heterophorias (exophorias over approximately 15<sup>Δ</sup> or with slow recovery that could cause symptoms, any esophoria or vertical phoria), any ocular motility defect, convergence to less than 12 cm or poorly maintained, inability to perform tests, or any obvious ocular pathology.

For the audit, visual acuities that fell between 0.15 logMAR and 0.20 logMAR inclusive were recorded. All other referral criteria remained the same, so children were not included in the audit if one of the above reasons for referral was found. A spreadsheet was created for each academic year. The visual acuities at screening were recorded after the screening session. The visual acuities at first visit to the clinic, the results of refraction, whether glasses were prescribed or not, and whether the child was followed-up were recorded after the first clinic visit. The results were analysed each year when the data were complete and the combined data from the 5 years are presented in the results.

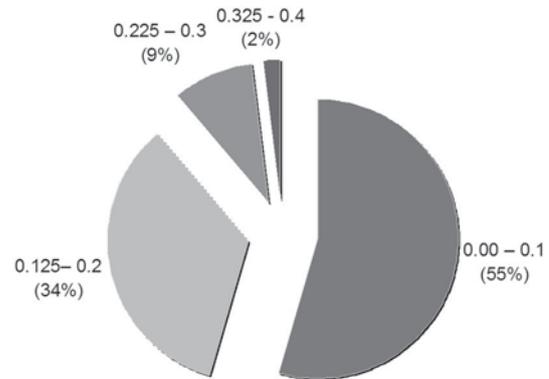
**Results**

Over the 5 years, a total of 18 790 (92.85% of total cohort) children were screened; a total of 3336 (17.75%) were referred, including those included in this audit.

Three hundred and forty-eight children were recorded who fell within the audit criteria. Eight children were

**Table 1.** Levels of visual acuity (logMAR) recorded at the first clinic appointment

	0.00–0.1	0.125–0.20	0.225–0.30	0.325–0.40	Total
Right eye	145	92	25	5	267
Left eye	142	93	28	4	267
Total	287	185	53	9	534



**Fig. 1.** Proportions of all visual acuities at the first clinic visit (logMAR).

discounted from the audit for the following reasons: 3 had moved away; 3 went elsewhere; 2 refused the appointment as parents felt there was no problem; and 65 (18.8%) did not attend their first appointment. The results from the remaining 275 attenders were used for analysis.

On attendance at the clinic for their first appointment, 4 of the 275 children refused to do a visual acuity test, 3 children had unreliable results and 1 child was assessed with a Kay Pictures crowded test. These 8 children were discounted from this part of the analysis. Two hundred and sixty-seven remained who had recordable acuities; taking the two eyes separately gives a total of 534 acuities. All these children were in the audit because their reception class visual acuities were between 0.15 logMAR and 0.20 logMAR (inclusive) at screening. Table 1 shows the levels of visual acuity recorded at the first community orthoptic/optometric clinic appointment.

These data are also represented visually in Fig. 1, highlighting the proportions of all visual acuities at the first clinic visit.

One hundred and twenty-two (55.2%) of the children refracted had glasses prescribed; 30 had +2.00DS or more in one or both eyes, 27 had –1.00DS or more in one or both eyes, 37 had IDC or more in one or both eyes with less than +2.00DS or –1.00 DS. Fig. 2 shows the proportions of different strengths of glasses prescribed.

The high proportion of astigmatism may be attributed to the cultural demographic of the south Birmingham area. The highest individual corrected retinoscopy results found were +5.00DS; –2.25DS and +2.25DC. Fifty-four children were discharged after their first appointment. One of these was emigrating and thus unavailable for further appointments; another was referred to Birmingham Children’s Hospital at the parents’ request. The other 52 (18.9%) can therefore

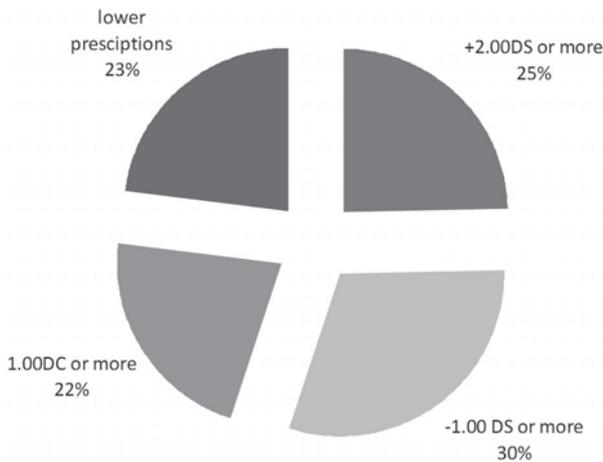


Fig. 2. Proportions of the different strengths of glasses prescribed.

Table 2. Percentages of false referrals at different levels of visual acuity (logMAR)

Referral VA	0.15 (all)	0.175	0.20
No glasses	55.6%	53.57%	54.98%
No follow-up	18.9%	19.44%	29.35%

be assumed to be false referrals. Table 2 shows the percentages of false referrals at different levels of visual acuity according to whether a false referral is taken as the child not being prescribed glasses or not needing follow-up. The percentages of children having follow-up appointments are high because a child was rechecked if there was a difference between visual acuity at screening and visual acuity at the first clinic visit.

Two hundred and twenty-one (80.4%) children had follow-up appointments. Of these, 122 (55.2%) had been prescribed glasses; 15 (6.8%) were borderline myopes; and 84 (38.0%) were recalled for visual acuity checks. The reasons for follow-up visual acuity checks were: the referral and first visit acuities were not compatible, with more than 0.10 logMAR difference in one or both eyes (47); the visual acuity did not meet discharge criteria despite there being no significant refractive error (21); or there was a significant refractive error, that is of +2.00DS or 1.00DC, but vision was not affected at the first clinic visit so glasses had not been prescribed (5 children). Five children were rechecked at their parents' request, usually because of a family history of eye problems. Four children were recalled for visual acuity testing as the parents had refused refraction, but the acuities did not meet discharge criteria. Two children refused to do the visual acuity test in clinic and so were recalled.

The Paediatric Eye Service personnel had expressed the opinion that they often prescribed small plus corrections that may not have been prescribed if the child was seen elsewhere. The corrected retinoscopies that were recorded at less than +1.25DS with +0.25DC or +0.50DC, including planos with or without cylinders, were analysed. There were 72 retinoscopies recorded in

this range: 7 children had their corrections prescribed, 5 were attaining 0.20 logMAR or less in one or both eyes, and 1 had been noted to be struggling to see his close work at home and had mild learning difficulties. His mother was keen to try the glasses to see if they helped him. The other child had the glasses prescribed as a difference in visual acuities had been found at screening and this correlated with the retinoscopy.

## Discussion

There has been much debate about the efficacy of primary visual screening in many countries across Europe,<sup>2-5</sup> the USA and Canada,<sup>6-8</sup> Australia,<sup>8,9</sup> Asia<sup>10-14</sup> and the Middle East.<sup>15-18</sup>

Many aspects of visual screening in the UK have been examined including: age at testing,<sup>19,20</sup> tests used,<sup>21-23</sup> personnel undertaking the screening,<sup>24-26</sup> referral criteria,<sup>21,27</sup> and cost-effectiveness.<sup>28</sup> For a primary visual screening programme to be viable it has to have excellent coverage of the target group<sup>29,30</sup> and show the highest possible levels of sensitivity and specificity.<sup>28,30,31</sup>

The results of this audit of screening visual acuities falling between 0.15 logMAR and 0.20 logMAR inclusive showed a false referral rate of 18.9% if the false referral is taken as the child not needing any follow-up. If a false referral is taken as the child not being prescribed glasses then it showed a false referral rate of 55.6%. When the outcomes were analysed separately for the different visual acuity levels (0.15, 0.175 and 0.20) the relative consistency of outcomes is probably due to the audit criteria being applied to all the levels and the criteria of discharge or follow-up being applied consistently across the whole audit cohort.

Looking at the true positives, over half of the children included in the audit had glasses prescribed. These are children who would have passed the test and not been referred if the visual acuity referral level had been set at less than 0.20 logMAR. Ainscough *et al.*<sup>21</sup> found a 0.100 logMAR referral level to be too stringent as it resulted in a false positive rate of 17.95%. They also found a false negative rate of 19.34% when the referral level was set at 0.200 logMAR. While those children who were not discharged at their first visit (221) represent the false negatives within this audit, the overall false negative rate could not be calculated as it was not known how many children in the overall cohort were false negatives.

Both Stewart<sup>22</sup> and Ainscough<sup>21</sup> have recommended that the referral criterion be set at 0.175 logMAR. The numbers in both these studies was smaller than the numbers in the current audit, but the analyses are likely to be more robust as both were able to identify false negative (these not identified as having a problem who do actually have it).

One of the difficulties in accurate referral levels has been generated by the change from the Snellen to logMAR test. The Snellen referral level of 6/9 was widely accepted as accurate in this age group. 6/9 does not translate directly into logMAR, but an on-line converter<sup>32</sup> gives the conversion as 0.176. This lends weight to the argument that the referral level should be revised to 0.175. The difference between 0.20 and 0.175

may seem minimal, but the referral level at the moment is 'less than 0.20'. The recommendation is that the referral level be 0.175, that is a child is referred if they attain less than 0.15 logMAR. This may still seem a very small difference, but it has been shown to greatly improve the accuracy of the screening.<sup>21</sup>

The term 'pre-school screening' has come into usage for the primary visual screening. This is not an accurate term as there are other screening programmes apart from this one in south Birmingham that are run in reception class rather than being done before the children start school. It also causes difficulty when comparing programmes with other countries as children start school at different ages; this argument can be levied against the term 'reception class screening' too.

When the National Screening Committee guidelines were published in the Hall Report in 2003<sup>1</sup> the recommendation for visual screening was that: 'Screening of the vision of all children should be undertaken by an orthoptist with the aim of achieving this by the age of 5 years'.

This age is optimum for obtaining good results from the screening tests and for the child still being well within the critical period for treatment to be effective. It has been shown that there is little difference in final outcomes between children screened and treated at age 4 years and those screened and treated at age 5 years.<sup>33</sup> However, the target of children being screened by the age of 5 years does not relate to the usual social and educational activities of under-5s. In the UK, the most widespread practice is that children start school in the September of the academic year in which they have their fifth birthday. The previous academic year is considered to be their 'nursery year'. However, there is no legal requirement for a child to have any pre-school or nursery input. There are many nursery and child care providers, making it difficult to ensure adequate coverage of this age group.

In the 1980s vision screening in the south Birmingham area was done at age 3–3½ years. Children were sent appointments at their local health clinic. The uptake of this was between 50% and 55% (author's unpublished figures). The screening was then moved to nursery, with those children not attending nursery called to their local clinic as previously. These children were 3 or 4 years old when tested. The coverage with this programme was between 60% and 65% (author's unpublished figures). This is similar to other clinic-based programmes.<sup>33,34</sup> At this time there was a reception class screening programme running alongside the pre-school screening programme. These two programmes were rationalised into one universal screening programme in 1999.

When the age recommendations were published<sup>1</sup> it was decided in the south Birmingham area to keep the screening in the school reception class. This means that the children seen are all over 4 years old. As it takes the whole academic year for the cohort of approximately 4500 (and rising) to be covered, a good percentage of those tested towards the end of the academic year have already had their fifth birthday. The reception class age was chosen because the coverage in reception class in school in the south Birmingham area is 92–93%. Ainscough *et al.*<sup>21</sup> had an uptake rate in school of

94.9%. In the current academic year (from September 2012), an opt-out\* consent system is being introduced in south Birmingham and that is expected to give coverage of 95–98%. This is based on numbers from the academic year from September 2010 when an opt-out consent system was used. The system ran into administrative problems and the programme reverted to an opt-in† system for the academic year starting September 2011.

The Healthy Child Programme 2009 update from the National Screening Committee contains this statement: 'all children should be screened for visual impairment between 4 and 5 years of age by an orthoptist-led service'.<sup>35</sup>

This age guidance could be seen as more flexible than 'by the age of 5 years' in the Hall report<sup>1</sup> and tallies with the reception class age group.

### Variability

As there are five orthoptists covering 94 schools and four clinic bases, sometimes the orthoptist doing the screening is the same orthoptist as at the clinic and sometimes it is not.

During the course of the audit there has also been a change of personnel, so six different orthoptists have recorded these results.

There is likely to be inter-examiner variation. There can also be variation in performance from test to test, especially with this age of child. However, there is also the possibility of true variable visual acuity because of uncorrected refractive errors affecting the visual acuity and varying depending on the child's ability to compensate for it. This varies with concentration, time of day and general tiredness, and what the uncorrected refractive error is.

The correlation between the visual acuity at screening and at the first clinic visit could be analysed to investigate inter-examiner and inter-visit variability.

The orthoptists queried whether the time of year of testing made a difference. The month when the test was done in school was not recorded for this audit. The information would be obtainable, but not easily.

As we do not cherry-pick the children by age, some of them are only just 4 years old when we first start the screening programme. Whether results are affected by a child's age, or by their general competency being improved by being in school, could be subject to further investigation.

### Conclusions

Significant refractive errors are going undetected at reception class screening as a result of the visual acuity referral level being set at less than 0.20 logMAR. The most effective coverage of the target group is achieved in school rather than before school. The main problems

\*The opt-out, negative or assumed consent system used provides two opportunities for the child's carer to sign and return the consent, followed by a letter saying that unless they definitely state they do not want the screening done, then consent is assumed 'in the best interests of the child'. This system has been passed through the Trust's legal systems and approved.

†An opt-in or positive consent system is where there is a consent form signed by the child's carer.

identified in this audit were small refractive errors affecting visual acuity, or larger refractive errors the child has partially managed to compensate for but which still cause some reduction in visual acuity and which could also affect their long-term visual development. This provides further evidence that the referral criteria for universal screening need to be reviewed.

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The authors declare that they have no competing interests.

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