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EDITORIAL

Vision Screening in Children: Why and How?

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Children with bilateral poor vision will largely present symptomatically to eye services, or be detected as part of the targeted surveillance of vulnerable groups (such as those with other neurological disorders) or within a wider health screening program, for example the Newborn and Infant Physical Examination schedule.[1] By contrast, children with unilateral reduced vision, in particular where this is of early onset, e.g. amblyopia, are unlikely to be aware of the failure to develop normal vision in the affected eye. Thus the primary aim of childhood vision screening is the detection of reduced vision due to amblyopia, enabling diagnosis at an age which allows timely intervention. Since 2006, following the recommendation of the Hall Report ''Health for all children'' and supported by the Royal College of Ophthalmologists (RCO) and the UK National Screening Committee (NSC),[2–4] childhood vision screening has been part of the Department of Health's Healthy Child Programme, previously the Childhood Health Promotion Programme. The NSC has now revised its policy on childhood vision screening based on a recent systematic review and recommends orthoptist-led testing of visual acuity undertaken on children aged 4–5 years with referral of children with visual acuity worse than 0.2 logarithm of the minimum angle of resolution (logMAR).[3,5] In the article published in this issue,[6] Toufeeq and Alam investigate the practice and outcomes of orthoptist undertaken screening using tests additional to, and a more inclusive acuity referral threshold than that used in NSC guidelines. The study provides valuable data on the performance of a screening program for children aged 4–5 years, and highlights the issues surrounding the rationale and practice of childhood vision screening.

The principles of population-based health screening are that it should only be undertaken for important disorders for which acceptable, appropriate and reliable tests and effective treatments are available. The overall benefits of screening and intervention should outweigh the potential harms, including the societal harm of the failure to provide a cost-effective practice.[3] Individuals with amblyopia, a common disorder affecting the bulk of the pediatric ophthalmic out-patient population, are largely affected unilaterally and are thus not formally defined as visually impaired. Due to the paucity of research on the real-life impact of the disorder, the burden of amblyopia on the individual is unclear, although amblyopia is known to confer a higher risk of later life blindness for affected individuals due to vision loss in the unaffected eye.[7,8] Other significant current gaps in the evidence base on childhood vision screening concern the best diagnostic pathway for children who fail screening, the management and monitoring of the necessary infrastructure and staffing, the cost-effectiveness of the program and its acceptability to the public.

Vision screening is a component of childhood health programs in other high- and middle-income countries, reflecting the perceived importance of reducing the burden of amblyopia to the health of a state. Where states differ, however, is in the method of screening: that is, should screening aim to identify children with amblyopia, or all children with

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"amblyogenic" risk factors? Following a major policy review in December 2013, NSC/RCO guidance is that acuity measurement is undertaken in each eye separately using crowded logMAR charts. This apparently parsimonious approach is advocated because there is at present *no evidence to justify the inclusion of assessments of visual function beyond acuity*, such as tests for strabismus, refractive error or stereopsis in a screening program. By definition, screening consists of a test to simply distinguish between those who should and those who should not be referred for formal assessment with a view to diagnosis. The failure to adopt the existing national guidance on program content is a major obstacle to optimizing the service. As shown by Toufeeq and Alam, additional tests add significantly to the costs of vision screening[6] as they require expert examiners and a more detailed examination, without the added benefit of detecting individuals with reduced vision, thus reducing the cost-effectiveness of screening, and threatening its inclusion within a formal whole population program.

A significant determinant of the cost-effectiveness of vision screening is the benefit to the individual of the detection and treatment of amblyopia in childhood. The value of this benefit, a reflection of the disutility conferred by amblyopia, requires a quantification of the impact of the disorder on the individual's satisfaction with their health state. A 2008 UK Health Technology Assessment Programme report estimated that a theoretical disutility of 0.98 in comparison to a score of 1 for perfect health (a 2% reduction in utility due to amblyopia) resulted in the cost per quality-adjusted life-years (QALY) gained through screening falling from £134,963 to £17,000, well within the £20,000–30,000 per QALY considered by the National Institute for Health and Care Excellence to be a cost-effective use of resources.[9] The current study suggests that this modeling may have underestimated the true costs. In any case, the true disutility value of amblyopia remains unclear.

As visual function testing is unlikely to be associated with physical harm, it is also unlikely that families would object to the testing of their children, and the acceptability of the screening process can to some degree be inferred by the high participation rates within the study, with consent given by 97% of parents/carers of identified children, although only 80% actually attended hospital eye services following referral.[6] This acceptability to the population is a key aspect of the success of a screening program. Any test, however, can lead to potential harms through false positive or false negative results. The acuity test used within the study, the Sonsken crowded logMAR, is designed to fail 10% of normal children when an acuity threshold $\leq$0.2 logMAR or interocular difference $\geq$0.1 is used, rather than the NSC recommended threshold (worse than 0.2 logMAR). This helps to explain the false referral rate of 14%,[6] relatively high considering the expert nature of the screeners.

Vision screening undertaken at an earlier age can be expected to result in a higher false referral rate. A proportion of children diagnosed as amblyopic at age 3 years and left untreated are later found to have developed improved vision by age 5 years.[10–12] Although there may have been some resolution of amblyopia in these children, the normal physiological maturation of the visual system in early childhood, and associated developments in cognitive and motor skills, contribute to the improved acuity and improved accuracy of acuity assessment by the preschool (age 4–5 years) milestone. It is, however, key that screening takes place at or soon after this milestone, as although there is emerging evidence that neuroplasticity extends into adulthood,[13,14] allowing some benefit from later life amblyopic therapy, for most children the best chance of attaining full visual potential is timely intervention before the age of 6–7 years.[15,16]

In 1997, a major systematic review concluded that there was no robust evidence of the effectiveness of amblyopia treatment, let alone the importance of timely intervention. This challenge to the ophthalmic community was met by several investigators, and we now have high level evidence that timely amblyopia therapy is effective in helping return affected children to a more normal trajectory of visual development.[10,12,15–17] The greatest benefit of timely treatment (intervention before the age of 6 years) is seen in children with more severe amblyopia (worse initial acuity),[10,12,18] and it is these individuals who are at particular risk of bilateral visual impairment in later life should they lose vision in the non-amblyopic eye.

All screening programs should be part of a regular audit cycle, with a framework which includes assessment of the screening population, screening practitioners, method of screening, and outcomes.[19] It is also important to identify the number of children who are pronounced normal at screening but later present to a hospital eye service with an eye problem that should have been detectable. In this regard, Tufeeq and Alam demonstrate the utility and feasibility of such an audit, which is necessary for the commissioning and provision of screening services by clinical commissioning groups and local authorities. Without this information, we will be unable to meet the societal challenge of evaluating the true effectiveness of childhood vision screening in the UK.

In summary, Toufeeq and Alam have demonstrated the value of screening children aged 4–5 years for amblyopia in order to allow reliable and timely detection of amblyopia, whilst also demonstrating the existing variation in the national practice of screening despite the current national guidelines.

Questions regarding the administration and cost-effectiveness of the NSC-recommended screening process remain unanswered. Nevertheless, the authors have highlighted the value of universal screening of a ''captive'' population at school entry, at an age where accurate testing is feasible, and timely intervention is possible. Further guidance on the choice of crowded logMAR acuity testing for screening and the governance of the screening program is needed to achieve standardization of national practice and allow systematic examination of the program. This is key to quality assurance and optimal outcomes, essential in ensuring that the screening program is ''fit for purpose''.

DECLARATION OF INTEREST

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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