Barriers to vision correction for children in a disadvantaged school community

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Abstract

Objectives
The objectives of this study were to explore the barriers to correction of vision problems in a disadvantaged school community and inform delivery of public health programmes directed at children most in need of community support.

Methods
A primary school in suburban Melbourne, Australia (School A) was identified with demographic indicators of social disadvantage, including recent refugee arrivals, low-income profile and families from non-English-speaking backgrounds. Optometrists performed eye examinations on 414 students (School A) and on a clinical control group of 71 students from a demographically contrasting primary school (School B). Parents completed pre-examination questionnaires and case history was also taken from the students themselves. The clinical findings were analysed. Key informant interviews, focus groups and questionnaires were used to elucidate issues of eye care service utilisation, knowledge, attitudes and practice.

Results
Vision problems were common, with over 23% of all children having some disorder. Children at School B were 2.8 times more likely than children at School A to have had a previous eye test. The cost of glasses and medicines was perceived as a significant barrier to receiving vision correction by both parents and teachers at School A. Additionally parents perceived the normal cost of an eye examination as being a barrier even before any treatment costs, but teachers did not share this perception. Teachers lacked confidence in identifying students with vision problems.

Conclusion
Significant barriers to children receiving vision correction were identified in this disadvantaged school community (School A). There is a need to improve awareness of vision problems in children and ways to improve access to existing publicly funded services for children in disadvantaged school communities. Further research is needed on whether existing service models are adequate, if increased awareness can improve equity, or whether sustainable outreach services need to be developed to overcome the barriers faced by the most disadvantaged children.
relating to optical dispensing, clinical examinations related to employment eligibility, educational vision screening or work carried out in public hospitals. As is the case with the GOS, the relevant government department (Health) provides a schedule of fees and charges and specific guidance on patient eligibility, the conditions necessary for repeat testing, referral processes, domiciliary conditions and a series of codes for specific items of service. Interestingly, separate supplementary codes are provided for low-vision consultations, child vision assessments and contact lens consultations. At the time of going to press the two main bulk billed consultation rates for an initial comprehensive consultation and a subsequent review were $60.35 and $35.35 respectively, equivalent to approximately £30 and £17.50. Other items of service for which a supplementary or alternative fee can be claimed include: a contact lens-fitting fee for individuals with irregular astigmatism and a best corrected visual acuity of worse than 0.3logMAR ($189, £95); a supplementary low vision or children's vision assessment ($30.25, £15); and a fully automated threshold perimetry assessment ($76.70, £29).

The provision of optical appliances following a Medicare-funded examination is deemed to be the responsibility of the state and as such the funding mechanism and eligibility criteria differ from state to state. In the case of Victoria, individuals who hold a pension concession card or a healthcare card, plus their dependants, can access subsidised optical appliances (spectacles, low-vision aids and contact lenses) at ACO metropolitan and outreach sites across the state or through a network of affiliated optometry and ophthalmology practices. The Australian system differs from the UK GOS in that it is not voucher-based and appliances are available free of charge to only a very limited number of individuals who are extremely disadvantaged. The latter service is funded from charitable sources. Specific arrangements have also been put in place to ensure that Australia's Indigenous community (Aboriginal peoples) can obtain spectacles for an assured flat rate of $10 (£5).

Initially, the ACO's eye care service programmes for disadvantaged people in the community, referred to above, were provided at a central inner urban location, and thereafter extended throughout metropolitan Melbourne via co-location of optometry services in community health centres, and across Victoria through collaboration with a network of private optometry practices in rural and regional areas.

More recently, with recognition that there are many other barriers to healthcare beyond geographic accessibility, and that many disadvantaged groups in need of public health support were not receiving care via the available options, the ACO implemented VES-supported outreach programmes to provide optometry services to homeless people, Indigenous communities and housebound people in aged care facilities, among others. As part of the ongoing development of these outreach optometry services, the ACO was approached about the needs of disadvantaged children in specifically identified communities. Philanthropic funding was obtained and this was the genesis of this project to explore barriers to the identification and correction of vision problems amongst a disadvantaged school community, and explore the need for, and development of, specific paediatric outreach optometry services.


Whereas the epidemiology of childhood visual impairment in the UK is broadly similar to that in Australia, the policies around detection and vision screening are very different (Hall and Elliman 2003; Rahi et al. 2010). In Australia there are no national policies or plans, and state programmes lack the cohesion, uniformity, coverage and evaluation necessary for success. In the UK vision-screening policies are generally formulated in accordance with the Hall report IV (Hall and Elliman 2003). The fourth edition of the report Health for All Children (published in 2003, and revised in 2006) and national screening committee recommendations have changed the ethos of vision screening from a highly medical model to one with a greater emphasis on health promotion, primary prevention and active intervention for children at risk. It advocates for the introduction of preschool vision screening awareness training by, and for, health professionals and teachers and dedicated multidisciplinary vision screening, coordinated by orthoptists, for those most at risk, including children with disability or a family history of vision problems in childhood. It also advocates for vision screening of all children as part of the school nurse health programme at the point at which children commence formal education (age 4–5 years).

It is known that demographics and geopolitical situation affect parental awareness of, and access to, eye care (Brotherhood of St Laurence 2004; Kiely et al. 2007; Morcos and Wright 2009; Odedra et al. 2008; Refractive Error Program Committee 2008; Saliba 2008; Schneider et al. 2010; Senthilkumar et al. 2013; Yasmin and Minto 2007). The current study aims to understand better the teacher, parent and child reports of vision issues, barriers to receiving eye care and the ophthalmic clinical profiles of children in a disadvantaged school community.
Methods

The ACO Human Research Ethics Committee approved the study (approval H10-003) and the investigation was conducted in accordance with the Declaration of Helsinki of 1975. Informed consent was obtained from the parents of all participants as well as from participating children when developmentally able, and the adult focus group attendees. Presence of symptoms potentially related to eye and vision problems, together with relevant medical and previous eye examination information were collected via a pre-examination questionnaire completed by parents. Eye examinations (School A and School B), key informant interviews (School A and School B), focus groups (School A only) and surveys (School A only) were completed.

School A (where 459 students were enrolled and were invited to participate) is situated in the western suburbs of Melbourne, with a student population consisting of approximately 70% refugee background, around 30% recently arrived in Australia, and over 90% holding healthcare or pensioner concession cards (indicating limited financial resources). School B (where 82 students were enrolled and were invited to participate) is situated to the north of Melbourne and is a private school requiring fee payment where the majority of students were born in Australia and speak English as their first language.

Eye examinations were conducted by a group of seven optometrists on location at the schools. All participants were examined with a standard protocol that included case history, unaided vision and best corrected visual acuity (logMAR Lea or letter charts), pupil reactions, ocular motility, cover tests (distance and near), stereopsis (Randot test – both random dot stereo shapes and contour circles), colour vision screening (Ishihara – selected plates), distance retinoscopy without cycloplegia, subjective refraction, monocular estimate method (MEM) near retinoscopy, near point of accommodation, accommodation facility, heterophoria measurements (using the Howell phoria card), near point of convergence (NPC), vergence reserves, accommodative convergence to accommodation (AC/A) ratio and examination of eye health using a portable slit-lamp biomicroscope and direct ophthalmoscope. Measurements of vergence and accommodation were performed with participants’ habitual optical correction when present. Participants who required further ocular assessment (eg cycloplegic refraction or pathology management) were referred to an appropriate ophthalmic practice.

Diagnostic thresholds defining significant refractive error were adapted from the International Agency for the Prevention of Blindness’ classification of hyperopia ≥ 1.50D, myopia ≥ 0.75D, astigmatism ≥1.00D and anisometropia ≥1.00D (Refractive Error Program Committee 2008). Diagnosis of significant binocular vision problems was based on objective analysis of both symptoms and signs, using the normative data shown in Table 1.

Perceptions about access to eye care and eye care knowledge, attitudes and practice in the school communities were initially investigated via key informant interviews with principals and other senior staff. Given the low eye care access rates found at School A, the interviews were followed by semistructured focus groups conducted at School A (open forum with some specific questions), with adults representing five different subcommunities within the school: Chin (spoken by those native to Burma, East India and Bangladesh); Arabic speakers from the Horn of Africa; Vietnamese; English-speaking (and classified as low-income); and English-speaking (not low-income). The focus groups aimed to develop a locally appropriate questionnaire covering knowledge, attitudes and practice with regard to eye care. The questionnaires consisted of three demographic items (participant country of birth; number of years in Australia; languages spoken at home), then a range of items formulated from focus group records. The questionnaire was professionally translated (by a contracted registered interpreting service) from English into three other key languages in the School A community.

### Table 1. Classifications of normal limits of binocular vision used in this study, with evidence referenced

<table>
<thead>
<tr>
<th>Accommodation</th>
<th>Vergence</th>
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<tbody>
<tr>
<td>MEM retinoscopy +0.50DS ± 0.25&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Near phoria 3pd exo ± 4&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>NPA ≥15D – 0.25 (age)&lt;sup&gt;4&lt;/sup&gt;</td>
<td>Distance phoria 1pd exo ± 1&lt;sup&gt;3&lt;/sup&gt;</td>
</tr>
<tr>
<td>Relative accommodation:</td>
<td>NPC</td>
</tr>
<tr>
<td>≥2.00D (+) at near</td>
<td>Break &lt;8cm</td>
</tr>
<tr>
<td>≥2.00D (−) at distance&lt;sup&gt;4&lt;/sup&gt;</td>
<td>Recovery &lt;10cm&lt;sup&gt;5&lt;/sup&gt;</td>
</tr>
<tr>
<td>Interaction: AC/A ratio 2.2pd/D ± 0.8&lt;sup&gt;7&lt;/sup&gt;</td>
<td>Reserves (blur/break/recovery)</td>
</tr>
<tr>
<td></td>
<td>Near: B1 ≥10/16/10, BO ≥12/18/11</td>
</tr>
<tr>
<td></td>
<td>Far: B1 ≥7/4, BO ≥14/7&lt;sup&gt;6&lt;/sup&gt;</td>
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</tbody>
</table>

<sup>1</sup>Rouse et al. (1982), <sup>2</sup>Wong et al. (2002), <sup>3</sup>Dwyer (1991), <sup>4</sup>Hofstetter (1944), <sup>5</sup>Scheiman et al. (2003), <sup>6</sup>Wesson and Amos (1985), <sup>7</sup>Jimenez et al. (2004).

MEM, monocular estimate method; NPA, near point of accommodation; NPC, near point of convergence; B1, base in; BO, base out; AC/A, accommodation convergence to accommodation.
(Chin, Arabic and Vietnamese) and disseminated in the appropriate language to all parents and teachers to gather quantitative information.

Teachers at School A were also asked to identify students in their class who they believed might have a vision problem. Students found by optometrists to have vision problems were compared with the students identified by teachers.

Data were entered and validated by three different optometrists. Descriptive statistics and graphs were produced using Microsoft Excel version 2007. Other statistical analysis was performed with SPSS version 20. Chi-square test was used to analyse if issues reported by children and/or parents were related to treatment outcome.

Results

Statistical analysis of pre-examination questionnaires and examination results included 414 participants from School A and 71 participants from School B. Some participants from School A (45) and School B (11) were excluded from the study due to absences or incomplete data.

Participants in the eye examination component were aged between 5 and 15 years. At School A, the average age was 9.9 (±2.4) years; 39% were born somewhere other than Australia or New Zealand (mostly in South-East Asia or Africa). Only 12% had had a previous eye examination by an optometrist or ophthalmologist. At School B, the average age of participants was 10.5 (±2.6) years, 34% of whom had had a previous eye examination.

Parents at both schools showed similar concerns regarding potential eye problems in the pre-examination parent questionnaire – 30% and 35% of parents at School A and B respectively thought their child might have one or more eye problems. Allergy was the most common concern reported, although it is worth noting that the majority of data was collected in springtime, the most commonly allergenic season in Melbourne. Results are summarised in Figure 1.

Children were more likely to report concerns than their parents did in the pre-examination questionnaire – 50% at School A and 46% at School B. The breakdown of issues reported by participating children at both schools is shown in Figure 2.

A similar spread and pattern of clinical diagnoses were found at each school. There were no significant differences between School A and School B at each category of treatment/review period (P > 0.20, Mann–Whitney U-test). Overall, 373 participants (77%), across both schools, did not need active ophthalmic management, meaning that 112 (23%) did require active management. Diagnoses requiring active management included significant refractive errors, symptomatic binocular vision problems, ocular diseases, amblyopia, strabismus and colour vision defects. Only 5 students out of 414 examined at School A had previously been diagnosed with a vision problem.

Relationships between teacher-, parent- and child-reported vision issues and eye examination outcome

The ability of symptom reports from parents or children to predict treatment outcome of eye examinations was investigated via sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV). (Sensitivity is the proportion of all diseased patients for whom there is a positive test, determined as: [true positives / (true positives + false negatives)]. Specificity is the proportion of non-diseased patients for whom there is a negative test, expressed as: [true negatives / (true negatives + false positives)]. Positive predictive value is the proportion of persons with a positive test who truly have the disease, determined as: [true positives / (true positives + false positives)]. Negative predictive value is the proportion of persons with a negative test who truly do not have the disease, determined as: [true negatives / (true negatives + false negatives)] (NIH US National Library of Medicine 2004).) The results are shown in Table 2. Specificity of children and parents was reasonable at both schools, but sensitivity was poorer, particularly at School B.
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The highly consistent feedback from key informants and individual teachers was that teachers do not feel equipped with the knowledge or skills to identify vision issues in their students. One key informant noted that identification of potential vision problems is no longer part of teacher education in Victoria. Teachers identified fewer than 5 students as having potential vision problems, so meaningful quantitative analysis was not possible. One author’s clinical experience (AJJ) is that UK teachers are equally uncomfortable about being put in a position to identify children who have a visual problem.

Binocular vision profile
Analysis of contour stereoaucy, distance and near heterophoria, NPC, AC/A ratio and MEM retinoscopy showed approximately normal distributions for each measure. Results were classified as normal (≤1 standard deviation from the mean), or abnormal (>1 standard deviation from the mean). No account was made in this analysis for presence or absence of symptoms; some results classified as ‘abnormal’ may be subclinical (asymptomatic) problems. Children with two or more abnormal binocular vision test results were classified as ‘fail’; otherwise children were classified as ‘pass’. There were no significant differences between the two schools in the pass and fail categories. Strabismus was also consistent between schools (2% at each school).

Eye care service utilisation, knowledge, attitudes and practice at School A
Despite similar symptom, assessment, diagnosis and recommended management profiles between schools, participants at School B were 2.8 times more likely to have had a previous eye examination than participants at School A. This access difference is consistent with published evidence on the effect of demographics and geopolitical situation on awareness of, and access to, eye care (Brotherhood of St Laurence 2004; Kiley et al. 2007; Morcos and Wright 2009; Schneider et al. 2010; Yasmin and Minto 2007). Consequently, additional qualitative and quantitative aspects of eye care service utilisation, knowledge, attitudes and practice in the School A community were explored.

Key informant interviews with principals and other senior staff provided an understanding of the community issues and diversity at School A. The focus groups improved our understanding of community perceptions, comprehension, language, access to eye care and eye care knowledge, attitudes and practice. Some vast differences in healthcare systems between country of origin and Australia were apparent, with the level of orientation and adult education provided on arrival in Australia unable to uncover details such as options for eye health provision, Medicare and other eye care subsidisation systems. Racial and religious differences, language, cost, distance and lack of any doctors (let alone eye doctors) were commonly cited as issues in countries of origin. The Chin group noted that there were two doctors they felt comfortable with in Burma (there are one million Chins in Burma), and it would take 3 days of walking to attend. Basic eye checks in transit countries or on arrival in Australia consist of presenting distance vision checks only.

The questionnaire derived from this qualitative information was subsequently sent to teachers and parents (with translations into Arabic, Chin and Vietnamese as appropriate), with 34 teachers and 40 parent responses. Analysis revealed that parents and teachers had mostly similar responses (Wilcoxon signed ranks test, \( P > 0.20 \) on all questions). The results are shown in Figure 3. There is general agreement that children should have regular eye tests every 2 years, or any time a child reports an eye problem. Some individual differences in belief were recorded however. An example was a child at School A whose teacher had identified a suspected vision problem, but whose mother had not allowed the child to have his eyes examined due to a belief that boys should not wear glasses. He was significantly myopic; his vision improved markedly with correction.

<table>
<thead>
<tr>
<th>School A</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parent-reported issues</td>
<td>0.53</td>
<td>0.77</td>
<td>0.42</td>
<td>0.84</td>
</tr>
<tr>
<td>Child-reported issues</td>
<td>0.61</td>
<td>0.63</td>
<td>0.39</td>
<td>0.89</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>School B</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parent-reported issues</td>
<td>0.15</td>
<td>0.70</td>
<td>0.32</td>
<td>0.87</td>
</tr>
<tr>
<td>Child-reported issues</td>
<td>0.23</td>
<td>0.67</td>
<td>0.42</td>
<td>1.00</td>
</tr>
</tbody>
</table>

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The majority (77%) of School A teachers and parents felt that optometrists, ophthalmologists and general medical practitioners provide the best management of eye problems. Overall 3% (all parents) were not sure who to go to for eye care. Most teachers and parents believed that glasses and eye medicines were expensive, with 23% and 16% of parents considering glasses and eye medicines respectively too expensive to afford. Of those responding, 53% of parents believed that eye tests were expensive, including 13% who considered them too expensive to afford.

Discussion
This study provides valuable information to guide effective promotion of existing public health optometry services in Australia and the development of a sustainable paediatric outreach optometry resource for the community. Many of the lessons learned are equally applicable in the UK. The study shows that:

- Eye problems in children are common.
- Parents are not consistently good at identifying whether their child has an eye or vision problem and a minority report prejudice against eye examinations.
- Children attending schools in socioeconomically disadvantaged areas are much less likely to have had any previous eye examination.
- There is a lack of awareness of existing publicly funded eye care services.
- Teachers report a lack of confidence in identifying children with potential vision problems.

In all, 112 (23%) of the children in this study were found to have a significant vision problem, with no significant difference between the two contrasting schools. Evidence varies widely regarding the prevalence of significant vision problems in children, with perhaps the definition of ‘significant’ being the most important variable. We have tried to be as practical as possible, relating evidence-based thresholds to clinical decision making. We have included diagnoses such as allergic conjunctivitis, which does not affect vision or need hospital-level management, but does affect a child’s quality of life and benefits from professional clinical management. We have also included diagnoses of accommodation vergence disorders, which have been disparaged in similar studies (Robaei et al. 2005, 2006), but which have been shown to have real effects on children’s lives through professional clinical management (Bade et al. 2013; Borrsting et al. 2003; Convergence Insufficiency Treatment Trial Study G 2008, 2009; Scheiman et al. 2005a, b, 2009, 2010, 2011).

The poor sensitivity of parent identification (0.53 at School A and 0.15 at School B), and of child identification (0.61 at School A and 0.23 at School B) of vision problems means that many potentially significant vision conditions would be missed in a system that relies on parents or children to identify potential problems. Parents had better specificity (0.77 at School A and 0.70 at School B), as did children (0.63 at School A and 0.67 at School B), but even at these rates many children who do not actually need care will attend ophthalmic practices based on perceived potential for an eye problem.

In terms of predictive value of parent or child reports of vision problems, the children’s ability to identify the absence of vision problems appeared best (NPV of 0.89 at School A and 1.00 at School B). However, poor PPVs (<0.45 across parents and children at both schools) reinforce the implication that parents and children are unreliable identifiers of potential vision problems.

It is worth noting explicitly that the key informant interviews, focus groups and knowledge, attitude, practice questionnaires were performed after the eye examinations – ie exposure of the school community to the outreach eye examinations may have influenced results. Regardless, the data revealed that perceived cost of glasses and medicines was a major barrier to getting children’s eyes tested for both parents and teachers at School A. Additionally, parents...
thought eye examinations themselves were expensive. These perceptions of cost do not match the reality of available publicly funded services, and even optometry consultations in private clinics are 85–100% rebatable by Medicare throughout Australia. The ACO specifically provides low-cost eye care for people in the Victorian community who are financially or otherwise disadvantaged. ACO services include comprehensive eye examinations, diagnosis and management of ocular disease, children’s vision services, contact lens services, visual fields clinics, disability services, low-vision services and outreach programmes. Residents of Victoria who hold a pensioner concession card or a healthcare card, and who have a clinical need, are eligible for visual aids subsidised through the VES, which is funded by the Victorian state government (Australian College of Optometry 2010).

The mismatch between perceptions of cost and the reality of what is available revealed by the questionnaire, plus focus group comments regarding the vast contrast in health systems between some countries of origin and Australia suggest there are gaps in parents’ knowledge regarding low-cost eye care in Victoria. Greater penetration of information is required in specific communities. It is possible that specific teacher training to develop competency in awareness of vision problems may also improve outcomes in vision correction in disadvantaged school communities. Alternatively, a working model for outreach services to children in disadvantaged communities may be required. The UK author (AJJ) advocates that a similar approach to teacher education should be taken when developing teacher education programmes in the UK.

There are over 480,000 children in over 1500 Victorian primary schools (Victorian State Government Department of Education and Early Childhood Development 2013). A high number of eye and vision problems in schoolchildren are undetected, and this research suggests that the rate of detection is affected by socioeconomic and demographic factors. There is a need to improve awareness of access to existing publicly funded services for children in disadvantaged school communities. Further research is needed on whether existing services are adequate, if improved awareness can occur, or whether targeted outreach services need to be developed to overcome barriers to eye care for the most disadvantaged children.

**Summary**

This paper seeks to highlight some of the issues surrounding the delivery of primary care eye care, and vision screening, services to children most in need of community support. The authors draw from experiences gained from delivering services to a cohort of schoolchildren attending two very different schools in Melbourne, Australia. In one of the schools children from disadvantaged backgrounds, including recent refugee arrivals, those from families with a low-income profile and families from non-English-speaking backgrounds, predominated. This was not the case in the comparator school. Across both schools vision problems were common, with over 23% of all children having some disorder. Children attending the school whose students tended to come from disadvantaged backgrounds were 2.8 times less likely to have had a previous eye test than their counterparts in the other school. The anticipated cost of eye examinations and the possible cost of glasses and medicines were perceived by both parents and teachers to be a significant barrier to receiving vision correction. Teachers from both schools were also noted to lack confidence in identifying students with vision problems. We conclude that there is a need to improve awareness of vision problems in children and that ways need to be found to improve access to publicly funded services for children in disadvantaged school communities. We believe that these issues are not specific to Australia and that lessons learned translate to disadvantaged communities in the UK, and indeed other highly developed nations.

**Acknowledgements**

This research was supported by the school communities of Sunshine Harvester Primary (including Sylvia Farnfield) and Candlebark. ACO staff (particularly Lesley Dacion, Rose Haikal, Lisa Lombardi, Anna Marinaro, Vicki McSweeney, Tessa Mihailou, Genevieve Napper and Janelle Scully) contributed to service delivery and data collection. We also acknowledge the Victorian Government Department of Health (Ageing and Aged Care Branch) for ongoing funding of the Victorian Eyecare Service, enabling the ACO in its public service mission of clinical care to tens of thousands of Victorians each year. We also acknowledge Prof. David Edgar and Ms Jane Hanley for invaluable advice on the UK perspective.

This research was supported by a grant from Perpetual Philanthropic Services.

**Disclosure of potential conflicts of interest**

No authors have any known conflict of interest.
References


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1. How many participants across both schools required active management?
   - 23%
   - 46%
   - 50%
   - 77%

2. Which of the following did the study show?
   - Parents are good at identifying whether their child has an eye or vision problems
   - Teachers are confident in identifying eye or vision problems
   - Eye problems in children are uncommon
   - There is a lack of awareness of existing publicly funded eye care services

3. How many times more likely were participants at school B to have had a previous eye examination?
   - 2.0
   - 2.6
   - 2.8
   - 3.0

4. What was the positive predicted value of ‘child-reported issues’ from school A?
   - 0.32
   - 0.39
   - 0.42
   - 0.89

References:

- Schneider J, Leeder SR, Gopinath B et al. (2010) Frequency, course, and impact of correctable visual impairment (uncorrected refractive error). *Surv Ophthalmol* 55, 539–60
5. How did parents’ concerns regarding potential eye problems vary between school A and school B?
- Greater at school A
- Greater at school B
- Similar level of concerns
- Exactly the same level of concerns

6. According to this paper, uncorrected refractive error results in which of the following?
- Increase in quality of life
- Decrease in general health
- Lost education and employment opportunities
- Decrease in ocular health

**CPD Exercise**
After reading this article can you identify areas in which your knowledge of barriers to vision correction for children in a disadvantaged school community has been enhanced?

How do you feel you can use this knowledge to offer better patient advice?

Are there any areas you still feel you need to study and how might you do this?

Which areas outlined in this article would you benefit from reading in more depth, and why?