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Vision screening in children

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**Vision Screening in Children – A Retrospective Study of
Social and Demographic Factors with Regard to Visual
Outcomes**

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3 **Vision Screening in Children – A Retrospective Study of Social and Demographic Factors**
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5 **with Regard to Visual Outcomes**
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11 Sub-title: A retrospective review of pre-school vision screening outcomes found that
12 socioeconomic deprivation and poor home and family environment are associated with
13 higher failure rates of pre-school vision screening.
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43 Keywords – vision screening, socioeconomic factors, amblyopia, psychosocial deprivation,
44 strabismus
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49 Word count: 2,458 words
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ABSTRACT**Background**

Amblyopia and its risk factors have been demonstrated to be more common amongst children from low socioeconomic backgrounds. We sought to investigate this association in a region with orthoptic-delivered screening and whole population coverage, and to also examine the association of the Health Plan Indicator (HPI) with screening outcome.

Methods

Screening examination outcomes, postcodes and HPIs were extracted from the community child health database for every child who underwent pre-school vision screening between March 2010 and February 2011. We obtained the Scottish Index of Multiple Deprivation (SIMD) score for every child as a measure of area-based deprivation. We assessed the vulnerability/needs of the individual family through the HPI – ‘Core’ (children and families receiving universal health visiting service), ‘Additional’ (receiving additional health/social support) and ‘Intensive’ (receiving high levels of support). The outcomes from follow up examinations for those who failed screening were extracted from the orthoptic department database.

Results

4365 children were screened during the year 2010-11 of whom 523 (11.9%) failed. The odds of children from the least deprived socio-economic group passing the visual screening test was 1.4 times higher than those from the most deprived socio-economic group (OR 1.4, 95%CI 1.07-1.89, $p=0.01$). The odds of a child from a family assigned as ‘Intensive’ failing the pre-school visual screening test was 3 times greater than the odds of a child from a family assigned as ‘Core’ (OR 3.59, 95%CI 1.6-7.8, $p=0.001$).

Conclusion

We found that children from the most deprived backgrounds and those from unstable homes were more likely to fail pre-school vision screening.

INTRODUCTION

The National Screening Committee and the Hall (Four) Report recommend orthoptic-led vision screening for children in their fourth year.^{1,2} Testing children at this age by trained practitioners has been identified as the most effective and cost-efficient way to capture children at risk of amblyopia and associated visual problems.²

Amblyopia is a preventable cause of visual disability and may have an impact on a child's education and behaviour;³ cosmetically poor strabismus is independently acknowledged to be unacceptable in most societies due to its social and psychological impact.⁴ Amblyopia and strabismus may have an impact on the future eye health and social opportunities of those affected.^{3,5}

A number of studies have described an association between lower socio-economic status and the incidence of paediatric eye conditions including refractive error, strabismus and amblyopia. These studies have used self-reported and objective measures of socioeconomic status.^{6,7,8} Conclusions have also been drawn about inequity of access to health care with children from more deprived backgrounds being less likely to access an eye health professional.^{6,9,10}

In the UK, all new-born infants have a post-natal screening examination of red reflex and for major eye abnormalities; the next examination is provided at six to eight weeks of age, usually undertaken by the GP who examines the baby for normal visual behaviour, the presence of a red reflex and eye abnormalities. The next and final vision screening examination for children is recommended to take place at the age of four.

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3 The aim of this study is to report the outcomes of a cohort of children screened by the
4
5 Tayside Preschool Vision Screening (PSVS) programme and to compare their socioeconomic
6
7 and home backgrounds with the outcomes of vision screening.
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10 11 **METHODS**

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14 The details of every child living in our region are stored from birth on the community child
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16 health database; the database includes their demographic details, Health Plan Indicator
17
18 (HPI), address/postcode and the result of their PSVS test. The child health database also
19
20 includes information on each child's public health record. In Tayside, a region in the east of
21
22 Scotland, there is a long established orthoptic-delivered vision screening programme for
23
24 four year old children - the Pre-school Vision Screening (PSVS) programme.
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28 29 **Definitions**

30 31 32 **Socioeconomic Deprivation**

33 34 35 ***a) Scottish Index of Multiple Deprivation***

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38 We used the Scottish Index of Multiple Deprivation (SIMD) 2012 score as a measure of area-
39
40 based deprivation. The SIMD score is a combination of multiple indicators of deprivation:
41
42 crime, geographic access, income, employment, health, housing, education, skills and
43
44 training. We used the residential postcodes to assign every child an individual SIMD 2012
45
46 score. The higher the SIMD score, the more deprived the area of residence. The SIMD score
47
48 is used to group the data into quintiles: 0-20% most deprived, 20-40%, 40-60%, 60-80%, 80-
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50 100% least deprived. To examine the link between extreme deprivation and vision screening
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52 results, we subdivided the SIMD groups into 0-20% most deprived areas and 20-100% least
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54 deprived areas.
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b) Health Plan Indicator

The Health Plan Indicator (HPI) is based on a comprehensive assessment of the needs of the child and family's circumstances and situations. It is a code applied to every child in the UK before or around the time of birth by their assigned health visitor (HV). Specifically, it is calculated based on an assessment of the stability and safety of the child's home and family; the function of the indicator is to ensure the provision of the appropriate level of support that will be necessary for the child. There are three HPI codes: core (C), additional (A) and intensive (I). A child from a normal, stable home about which there are no concerns would be assigned 'Core' and would receive routine health visitor and GP input; a child from a less stable home, for example a single young mother with poor family support, could be assigned 'Additional' – she and her child would receive additional input from the HV, social worker and GP; a child from an unstable, chaotic home, for example with substance abuse problems, could be assigned 'Intensive' – these children and families receive high levels of contact and input from health and social services. The possible impact of the stability and security of a child's home environment has not previously been reported, and the HPI is the only formally applied measure of this factor which is widely used and recognised.

Demographics, postcode and health plan indicator (HPI) data were extracted from the community child health database for every child who underwent pre-school vision screening between March 2010 and February 2011. Each child's SIMD was calculated using a tool provided on the Scottish government website using their home postcode. (www.scotland.gov.uk/Topics/Statistics/SIMD accessed January - March 2012) The outcomes of the screening examination and referral visit were extracted from the orthoptic

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3 PSVS database and long term follow up visual and refractive data were extracted from the
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5 clinical notes.
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9 The HPI and SIMD may change if a family's situation changes or if they move house, and
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11 while the database is maintained 'live' and up to date, we used the codes/scores on the
12
13 database at the time of the child's birth.
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15
16 Pre-school vision screening in Tayside is a single programme which covers the whole
17
18 population; children are screened in their fourth year of life. It is orthoptist-delivered -
19
20 achieved in the majority of cases by orthoptists visiting childcare nurseries/pre-school
21
22 classes. If a child does not attend nursery/pre-school they are invited to attend a clinic at
23
24 one of the community health centres or in the hospital, whichever is more local to them. If a
25
26 child fails screening, they are referred to a clinic either at the community health centre or
27
28 the hospital. At the referral clinic visit their visual acuity and orthoptic examination is re-
29
30 checked, they undergo cycloplegic refraction and ocular examination by a hospital
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32 optometrist or ophthalmologist. Follow up is arranged in the same community/hospital
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34 clinics if required.
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41 The vision standard to pass screening is vision of greater than 0.2 LogMAR (Keeler test), or
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43 greater than 0.1LogMAR with crowded Kay pictures if 'letter' testing is not achieved. A cover
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45 test, ocular motility, convergence, prism reflex test and stereotest are also carried out.
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47 These tests give additional information to the orthoptist about binocular function and they
48
49 allow detection of ocular motility disorders and other abnormalities such as anisocoria. If a
50
51 child has already been referred to the hospital eye service prior to their PSVS, they are
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53 recorded as 'under review' which counts as a fail for epidemiological purposes if the reason
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55 they are under review relates to any visual/refractive/strabismic diagnosis.
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3 We examined the details of every child who failed the PSVS in the screening year 2010 –
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5 2011 (children born 2006-2007) (n=523) and, as a control group, examined the details of
6
7 647 randomly chosen children who passed their PSVS the same year.
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9

10 11 **Statistical analysis**

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14 We analysed the data using the SPSS statistical package (IBM SPSS Statistics for Windows,
15
16 Version 19.0. Armonk, NY: IBM Corp.). We used the chi-squared test to calculate the odds
17
18 ratio of association between visual screening outcome and socio-economic background
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20 based on SIMD index and HPI index respectively. We used one-way ANOVA analysis to
21
22 assess the association between the mean LogMar visual acuities and socio-economic
23
24 background based on the SIMD index and HPI index respectively.
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28 29 **RESULTS**

30 31 32 ***Tayside Preschool Vision Screening Programme***

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34
35 4365 children were screened during the year 2010-11; 523 (11.9%) failed and were referred
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37 for repeat orthoptic examination, cycloplegic refraction and ocular examination. The results
38
39 of the screening examination – visual acuities and orthoptic examination – were complete
40
41 for 493/523 (94.3%) children.
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45 46 1. The reasons for failing screening.

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48 The most common reason for a child to fail PSVS was reduced visual acuity 399/493
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50 (80.9%); 65/493 (13.2%) failed due to both reduced VA and strabismus; 29/493
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52 (5.8%) had strabismus alone (with normal/pass level VA). The mean level of vision in
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54 the better eye of those with bilaterally reduced vision was 0.36LogMAR and the
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3 mean level of vision of those with unocular reduced vision was 0.44LogMAR in the
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5 failing eye. Figure 1.

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8 a. In children who failed screening due to reduced vision only, there was a weak
9
10 correlation between poor vision and socioeconomic deprivation according to
11
12 SIMD rank. The correlation between vision in the better eye and SIMD score
13
14 was $r=-0.005$, p-value of 0.91. The correlation between vision in the worse
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16 eye and SIMD score was $r=0.079$, p-value 0.097.

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21 2. The odds of passing PSVS test according to SIMD.

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23 The odds of children from the 20-100% least deprived socio-economic group
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25 passing the visual screening test was 1.4 times higher than those from the 0-
26
27 20% most deprived socio-economic group ((OR 1.4, 95% CI 1.07 – 1.89, p =
28
29 0.017). This result was independent of the child's HPI. Figure 2.

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34 3. The odds of passing PSVS test according to HPI

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36 The odds of a child from a family assigned as 'Intensive' failing the pre-school
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38 visual screening test was 3 times greater than the odds of a child from a
39
40 family assigned as 'Core'. (OR 3.59, 95% CI 1.6 – 7.8, p = 0.001). This result
41
42 was independent of the child's SIMD. Figure 3.

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47 ***Secondary hospital eye service follow-up visit***

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50 4. Failure to attend

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53 a. The results of the secondary hospital referral (repeat orthoptic examination,
54
55 refraction and examination) were unavailable on 93/523 (17.7%) children
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3 either because they did not attend their follow up appointment or no data
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5 were available from that visit. This left 430 children on whom there were
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7 both screening and follow up information.
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10 b. Amongst children who never attended their referral appointment after failing
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12 PSVS there was a trend towards a higher proportion with HPIs of 'Intensive'.
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14 This was not statistically significant due to the small number of cases.
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18 5. Outcome of the secondary hospital eye service follow up visit
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21 254 (59.1%) of children were prescribed glasses at their referral visit The
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23 remaining 176 (40.9%) were not prescribed glasses, of whom 57 were
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25 discharged because their repeat vision test was within 'pass' standards. 119
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27 children were kept under review.
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35 **DISCUSSION**
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38 Previous studies on the impact of socioeconomic factors on vision and visual defects have
39
40 repeatedly found an association between lower socioeconomic background and poor
41
42 vision.⁶⁻⁹ These studies used various indices of deprivation, eg *the Noble*, and parent-
43
44 reported data on occupational class. In Scotland the HPI is a universally applied index which
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46 is objectively applied by a health visitor (HV) who is familiar with the family. To our
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48 knowledge, this is the first time that a personalised indicator of social background such as
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50 the HPI has been used to illustrate the differences in pass rates of childrens' vision
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52 screening.
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3 Our data demonstrates a significant disparity between the most deprived 20% of children
4 and the least deprived 80%, with children from the most deprived geographic areas
5 significantly more likely to fail screening. We also found that independent of postcode, a
6 child's home situation was correlated with failure – with 'intensive' support children
7 significantly more likely to fail their vision screening than 'core' support children.
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15 The pre-school screening programme is designed to pick up amblyopia and its risk factors,
16 such as strabismus and refractive error, at a stage where both detection and treatment
17 rates are effective. It has been recognised that children from deprived backgrounds have
18 higher rates of refractive error and amblyopia⁶. Our study supports this claim. In addition we
19 have investigated the aspect of home stability as indicated by the HPI. This is the first time
20 this measure of family circumstances has been examined as an associated factor with vision.
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30 Although there is not enough biological evidence to explain why children from the
31 'Intensive' group were more likely to fail the vision screening test, several pieces of evidence
32 from epidemiological studies suggest that inadequate pre/antenatal care, more commonly
33 in socioeconomically deprived families, may contribute to poorer visual outcomes in
34 children.^{9,10} Firstly, maternal smoking during pregnancy, which is more prevalent amongst
35 the lower social class, single mothers and those on benefits¹¹, has been associated with
36 strabismus.^{12,13} Secondly, the increased incidence of vision problems amongst children of
37 women who consume drugs and alcohol during pregnancy may be relevant^{14,15} as there is
38 an increased antenatal drug and alcohol usage in deprived areas¹⁶, and these children would
39 be assigned 'Intensive' HPIs.
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55 Our findings have implications for future planning of resource allocation and the provision
56 of healthcare. We previously reported unequal distribution of optometry practices within
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3 our region – there were fewer practices located in more deprived areas with poor
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5 geographic access compared with affluent areas with good geographic access.¹⁷ Taken in
6
7 context of the trend towards a higher rate of non-attendance at referral appointments
8
9 amongst children from deprived backgrounds, these children are at an increased
10
11 disadvantage - with poor local access to primary eye healthcare tied on with parental failure
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13 to bring them to appointments. In Scotland optometrists work under an enhanced GOS
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15 contract whereby they provide primary eye healthcare services; it is therefore desirable that
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17 optometry premises are accessible to all population groups, in the same way that GP
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19 practices are.¹⁷
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25 The strengths of our study are that our PSVS is orthoptist-delivered, and has whole
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27 population coverage. We have a high rate of complete data both from the screening test
28
29 and the follow up visit. Additionally we report both the area-based deprivation status and
30
31 the HPI correlations with failing the PSVS, independent of each other, which we believe
32
33 make our data more robust. The false positive and non-attendance rates are acceptable for
34
35 a screening programme. All patients were seen under the auspices of the NHS optometry
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37 service and only clinically significant refractive errors were prescribed glasses. All children
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39 underwent cycloplegic testing. The population of Tayside is homogeneous, white/Scottish
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41 population so we do not believe that there is an effect from geographic concentration of
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43 ethnic groups. As the number of live births in NHS Tayside between 1 April 2006 and 31
44
45 March 2007 were 3665¹⁸, we are confident that we achieved high population coverage of
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47 pre-school vision screening. In addition, all eligible children are screened within a 12-month
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49 period, and they are within 12 months of age of each other. If the child fails to attend
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51 screening, they are recalled later in the year. We are therefore confident that the results of
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our study are not just a mere effect of the delayed screening in socio-economically deprived populations. One limitation of the study is the retrospective nature of the data collection.

CONCLUSION

We report the outcomes of a large cohort from an orthoptic-delivered pre-school vision screening service encompassing all children in our region. We found a significant disparity in passing vision screening between the most deprived 20% of children and the least deprived 80%, with the most deprived more likely to fail.

We also found that children from more chaotic home backgrounds, conferring a HPI rating of 'Intensive' on the child, are more likely to fail screening.

These results are important for planning resource management in public health and screening support.

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39 Contributorship: data were collected by UOC, CG and LL. Statistical analysis was performed
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41 by LL. UOC produced an initial draft and all authors contributed to revisions and preparation
42
43 of the final draft.
44

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46 Funding: none
47

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49 Competing interests: none
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53 Ethics approval: Ninewells hospital orthoptic and ophthalmology departments have ongoing
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55 Caldicott guardianship approval for analysis and review of pre-school vision screening
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57 outcomes.
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3 Provenance and peer review: not commissioned, externally peer reviewed.
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9 **LEGENDS**

10
11
12 Figure 1. This graph shows the reasons for failing preschool vision screening according to the
13 HPI categories.
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16
17
18 Figure 2. This graph shows the percentage of children passing or failing the vision screening
19 test divided by SIMD group. Y-axis represents the percentage of children, while the X-axis
20 represents the SIMD groups from 0-20% most deprived to 20-100% least deprived
21 socioeconomic groups.
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28 Figure 3. This graph shows the percentage of children passing or failing the vision screening
29 test divided by HPI group.
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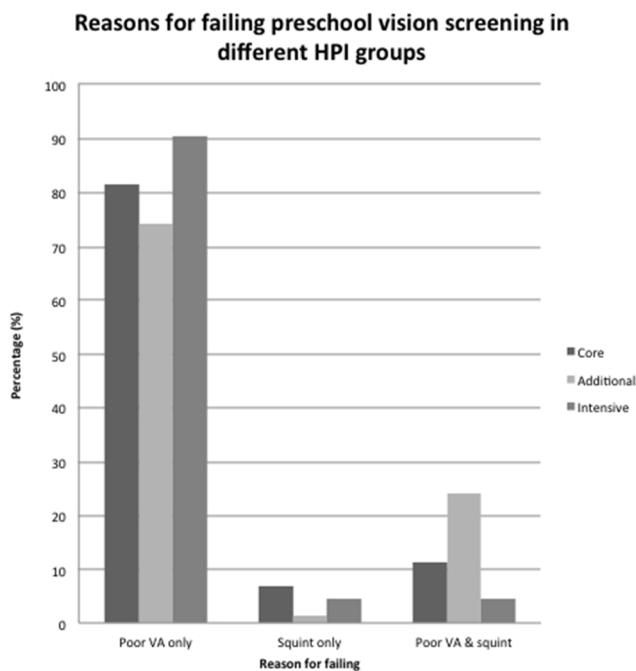


Figure 1. This graph shows the reasons for failing preschool vision screening test according to HPI groups.
254x190mm (72 x 72 DPI)

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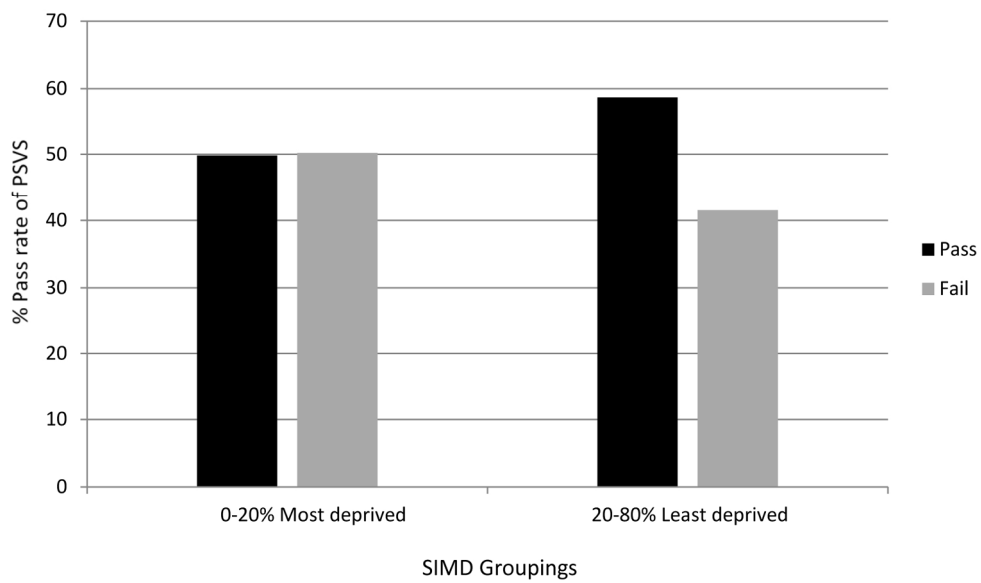


Figure 2. This graph shows the percentage of children passing or failing the vision screening test divided by SIMD group. Y-axis represents the percentage of children, while the X-axis represents the SIMD groups from 0-20% most deprived to 20-100% least deprived socioeconomic groups.
164x98mm (300 x 300 DPI)

For Review Only

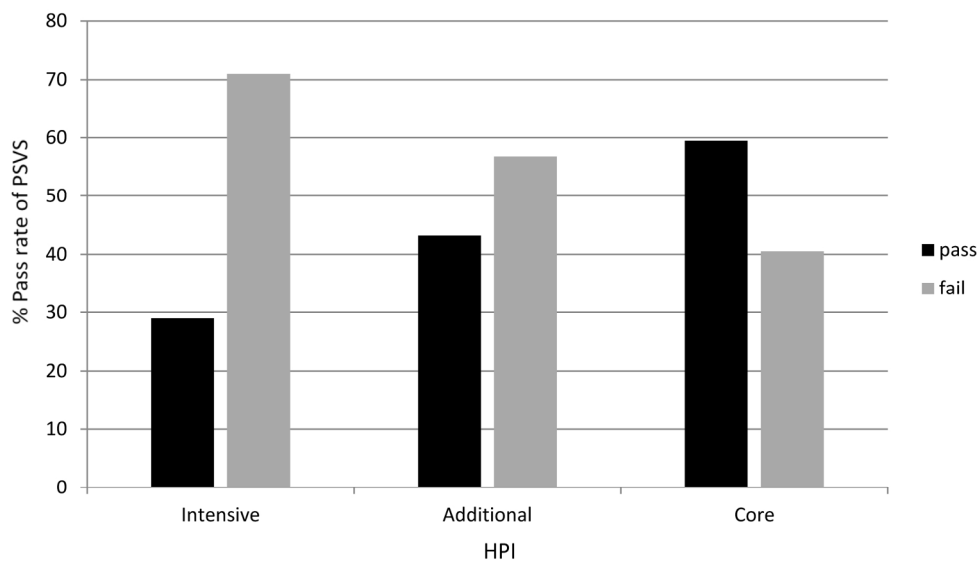


Figure 3. This graph shows the percentage of children passing or failing the vision screening test divided by HPI group.
164x96mm (300 x 300 DPI)