Aims: To investigate whether there is an association between congenital colour vision defects (CVD) and occupational choice and employment history, in order to inform the debate about the value of universal childhood screening for these disorders.

Methods: Participants were 6422 males and 6112 females from the 1958 British birth cohort, followed from birth to 33 years, whose colour vision was assessed (Ishihara test) at 11 years.

Results: A total of 431 males (6.7%) had CVD. Men with CVD had pursued some careers for which normal colour vision is currently regarded as essential; for example, eight men (3.1%) with CVD were in the police, armed forces, or fire-fighting service at 33 years compared to 141 men (3.8%) with normal colour vision. They were, however, under-represented compared to those with normal colour vision, in other occupations; for example, no men with CVD were employed in electrical and electronic engineering at 33 years compared to 15 men (0.4%) with normal colour vision.

Conclusions: The findings of this study suggest there is little to be gained by continuing with existing school screening programmes for CVD, whose primary purpose is to advise affected children against certain careers. Other ways of informing young people about potential occupational difficulties and pathways for referral for specialist assessment are likely to be more useful.
Differences in occupation and employment by 33 years were compared by colour vision status. Sex is the only sociodemographic factor previously reported to be associated with occupational outcomes which is also related to CVD, and therefore these analyses were carried out separately for men and women.

This study is part of a broader programme of work approved by the Ethics Committee of the Institute of Child Health.

RESULTS
Of 12 534 children tested for congenital colour vision defects, 6422 (51%) were male and 6112 (49%) were female. CVD affected 431 boys (6.7%, 95% CI 6.1% to 7.3%) and 68 girls (6.4%, 95% CI 5.7% to 7.1%). Distribution of distance visual acuity did not vary by colour vision status (χ² trend, p = 0.12). Birth weight, social class at birth, family size, and parental education were not associated with CVD.

Table 2 Comparison of men who in 1991, aged 33 years, worked in “target” occupations, according to colour vision status

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Normal colour vision</th>
<th>Colour vision defect</th>
<th>Difference in proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 3665</td>
<td>n = 267</td>
<td>% normal – % CVD</td>
</tr>
<tr>
<td>Armed forces*</td>
<td>23  0.6</td>
<td>2  0.8</td>
<td>-0.1</td>
</tr>
<tr>
<td>Transport operation*</td>
<td>6  0.2</td>
<td>0  0.0</td>
<td>0.2</td>
</tr>
<tr>
<td>Aircraft and ships’ officers*</td>
<td>11  0.3</td>
<td>0  0.0</td>
<td>0.3</td>
</tr>
<tr>
<td>Police, fire-fighting, and protective services*</td>
<td>118  3.2</td>
<td>6  2.3</td>
<td>1.0</td>
</tr>
<tr>
<td>Electrical and electronic engineering*</td>
<td>15  0.4</td>
<td>0  0.0</td>
<td>0.4</td>
</tr>
<tr>
<td>Electrical fitting and wiring*</td>
<td>11  0.3</td>
<td>0  0.0</td>
<td>0.4</td>
</tr>
<tr>
<td>Electrical installation and maintenance*</td>
<td>74  2.0</td>
<td>4  1.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Medicine, pharmacy, health diagnosing, and treatment†</td>
<td>25  0.7</td>
<td>4  1.5</td>
<td>-0.8</td>
</tr>
<tr>
<td>Laboratory and engineering technology†</td>
<td>47  1.3</td>
<td>4  1.5</td>
<td>0.2</td>
</tr>
<tr>
<td>Painting and related coating†</td>
<td>39  1.1</td>
<td>3  1.1</td>
<td>-0.6</td>
</tr>
<tr>
<td>Fibre and textile processing†</td>
<td>18  0.5</td>
<td>0  0.0</td>
<td>0.5</td>
</tr>
<tr>
<td>Wood processing and paper making†</td>
<td>1  0.03</td>
<td>0  0.0</td>
<td>0.03</td>
</tr>
<tr>
<td>Horticulture†</td>
<td>23  0.6</td>
<td>2  0.8</td>
<td>-0.1</td>
</tr>
<tr>
<td>Biological, chemical, and geological sciences‡</td>
<td>18  0.5</td>
<td>2  0.8</td>
<td>-0.3</td>
</tr>
<tr>
<td>Printing, paper, and photographic processing‡</td>
<td>15  0.4</td>
<td>1  0.4</td>
<td>0.03</td>
</tr>
<tr>
<td>Art, sculpture, photography, and industrial design‡</td>
<td>21  0.6</td>
<td>0  0.0</td>
<td>0.6</td>
</tr>
<tr>
<td>Total in “target” occupations</td>
<td>465 12.7</td>
<td>29  10.9</td>
<td>1.8</td>
</tr>
</tbody>
</table>

*Preclusion on basis of safety.
†Preclusion on basis of quality of product.
‡Total less than sum by occupation as an individual may have been in more than one “target” occupation.

At 33 years, 91% of men and 68% of women were in work or seeking work. Employment status did not differ by colour vision status (p = 0.911 and p = 0.075 for women and men respectively), and there were no significant differences in employment history, such as a period of unemployment (p = 0.862 and p = 0.553 respectively).

We found the overall occupational groups at 33 years varied significantly according to sex and by social class at birth, as reported previously. However, there were no differences according to colour vision status in major occupational groups. Nor did we find any evidence of an association between social class and colour vision status consistent with individuals choosing an occupation as a result of their colour vision defect—that is, choices other than that expected on the basis of educational background and social class. Analysis of “target” occupations, for which normal colour vision is conventionally considered necessary,
was restricted to men, as too few women were in these jobs. Analysis of current job at 33 years found that men with CVD were under-represented, compared to those with normal colour vision, in only some of these “target” occupations (table 2). For example, no men with CVD were employed in electrical and electronic engineering at 33 years compared to those with normal colour vision, in only some of these “target” occupations. We found that some men had been in “having worked in target occupations” (table 3). It should be noted that the number of individuals involved is small: for example, as only 106 per 10 000 men with normal colour vision ever worked as electrical and electronic engineers by the age of 33 years, then only 7 in every 10 000 individuals in the population might have been precluded from this occupation on the basis of their colour vision.

DISCUSSION
While the measurement of CVD by a single screening test and self-reporting of employment and occupation are potential sources of error in this study, these are outweighed by the benefits conferred by the size and representativeness of the population studied and the longitudinal study design, with colour vision status being measured before the outcomes.

Colour vision is integral to an individual’s understanding of their visual world, and those with CVD can experience difficulties in everyday life. But, adaptive strategies and behaviours help to deal with any potential difficulties they face in both their professional and personal lives. Thus, the rationale for screening must remain the population-level impact of these conditions, particularly on occupational choice.

There are a number of occupations from which individuals with CVD are barred, on the basis of potential hazard to safety and/or in the interest of quality assurance in the workplace, even though the functional impact of a given congenital colour vision defect is known to depend on both its nature and severity as well as the specific visual tasks to be undertaken. The evidence base for these long standing occupational preclusions is not well defined. Our findings show that men with CVD were employed in many of these “target” occupations. We found that some men had been in the same “target” occupation for several years, but our study was not able to address how successful their careers were or the nature of any problems encountered at work. National guidance emphasises the need for specific, individual occupational risk assessments based on detailed diagnostic (rather than screening) tests to identify severe CVD combined with a consideration of the precise colour dependent tasks that a given job requires. These findings strengthen the growing challenge to established population screening for these non-progressive and untreatable disorders. There is already evidence of deficiencies in the implementation of school screening for CVD, together with concerns that despite being identified, affected children remain ill informed about the occupational significance of their condition. Based on our findings, as well as the absence of robust work identifying the true risk of important adverse outcomes in key occupations, we suggest there is now a good case for existing screening programmes, whose primary purpose is to advise affected children against certain careers, to be discontinued. Other ways of informing young people about potential occupational difficulties and pathways for referral for specialist assessment are likely to be more useful.

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