Impact of congenital colour vision deficiency on education and unintentional injuries: findings from the 1958 British birth cohort

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Congenital colour vision defects (CVD) are common, inherited (most commonly X linked), non-progressive, and untreatable disorders. Screenining children for these disorders is established practice in the United Kingdom, primarily so that those affected can be advised about occupational preclusions. Population based work on the broader impact of colour vision defects is, however, limited.

Participants, methods, and results

We investigated the association between CVD and education and accidents in the 1958 British birth cohort. Despite attrition, people remaining were representative of the original sample, including with respect to colour vision status, the latter assessed in 12 534 children aged 11 years using the Ishihara test, with CVD being the inability to identify all 24 plates. Corrected distance acuity was measured with Snellen charts. We analysed educational, perceptual, and motor skills tests done at 7, 11, and 16 years together with highest educational qualification by 33 (none, below O level or equivalent, O level or equivalent, A level or equivalent, or higher). We converted education test scores to z scores and assessed the effect of CVD with multivariate linear regression. We analysed unintentional injuries requiring hospital care by CVD status and sex.

Overall, 431 of 6422 boys (6.7%; 95% confidence interval 6.1% to 7.3%) and 68 of 6112 girls (1.1%; 0.8% to 1.4%) had CVD. The distribution of corrected visual acuity did not vary by colour vision status ($\chi^2$ trend, $P = 0.12$). Birthweight, social class at birth, family size, and parental education, all associated with education were accounted for in the present analysis, although not associated with CVD.

At 7 years, CVD and mathematics and reading scores were not significantly associated, after adjustment for age at testing and factors described above (table). At 16, after additional adjustment for prior test scores, children with CVD scored higher than those without; but the small differences, although statistically significant, were functionally unimportant (0.08 standard deviations; 0.002 to 0.16; $P = 0.05$ for mathematics and 0.07; 0.002 to 0.14; $P = 0.04$ for reading). There were no significant differences, by colour vision status, for boys or girls, in scores for "copy a design" or "draw a man" at 7 years. Highest educational qualification and colour vision status were not associated for either men or women ($\chi^2$ trend, $P = 0.07$ and $P = 0.61$).

Risk of unintentional injury did not differ significantly (table). Overall, 8.9% (8.2% to 9.6%) of females and 19.2% (18.2% to 20.2%) of males had road injuries as a driver by 33 years: people with CVD reported fewer accidents ($P = 0.08$ and $P = 0.05$). At 33 years, 30% (28.9% to 31.2%) of men reported accidents in the workplace, without any increased risk in those with colour vision defects ($P = 0.293$).

Comment

Increasing use of colour in education has raised concerns for children with CVD, but robust evidence is lacking. Our findings indicate that affected children do as well as their peers educationally, during school and subsequently. Although the use of colour has increased since the early schooling of the subjects...
of this study, only a minority with severely impaired colour vision would be potentially disadvantaged and any limitation would depend on the specific environment as well as the individual's abilities.

That unintentional injuries were no more common among those with CVD supports current standards for driving in the United Kingdom (in which CVD is not a preclusion) and also indicates that normal colour vision is not a prerequisite for safe working in many occupations or environments.

Most people with colour vision defects develop effective adaptive strategies and behaviours, and use other clues, such as a colour's saturation, to deal with any potential limitations in their professional and personal lives. At a population level, congenital CVD confer no functional disadvantage in relation to educational attainment and unintentional injury. This challenges the rationale for and the value of population screening for these disorders.

JR has a joint appointment within the Division of Epidemiology, Institute of Ophthalmology, London EC1V 9EL. We thank the Centre for Longitudinal Studies (Institute of Education), National Birthday Trust Fund, National Children's Bureau, City University Social Statistics Research Unit and the Data archive distributor, SN:3138, Colchester, for archived data. We thank Angie Wade for comments on a previous draft.

Contributors: JSR designed the study; PC did the analysis; and PC, JSR, and CSP interpreted the findings and wrote the paper. JSR is guarantor.

Funding: Project grant from the BUPA Foundation.

Competing interests: None declared.

Ethical approval: Institute of Child Health's Research Ethics Committee.

What is already known on this topic

Congenital colour vision defects are common, non-progressive, and untreatable disorders, for which screening is done so that affected children can be informed about occupations which require normal colour vision.

Little population based work exists on the broader functional impact of these disorders.

What this study adds

At a population level, colour vision defects confer no functional disadvantages in relation to educational attainment or unintentional injury—challenging the rationale for and value of screening.