

Trends in the long-term impact of childhood visual impairment on health and social outcomes in the UK: a cross-cohort study across three decades of disability-related legislation and policy implementation

Vasiliki Bountziouka ^{1,2,3}, Lisanne Andra Horvat-Gitsels ^{1,4}, Mario Cortina-Borja ¹, Jugnoo Sangeeta Rahi ^{1,4,5,6,7}

1 Population, Policy and Practice Research and Teaching Department, Great Ormond Street Institute of Child Health, University College London, London, UK

2 Computer Simulations, Genomics and Data Analysis Lab, Department of Food Science and Nutrition, University of the Aegean, Lemnos, Greece

3 Department of Cardiovascular Science, Cardiovascular Research Centre, University of Leicester, Leicester, UK

4 Ulverscroft Vision Research Group, Great Ormond Street Institute of Child Health, University College London, London, UK

5 Ophthalmology Department, Great Ormond Street Hospital for Children, NHS Foundation Trust, London, UK

6 Institute of Ophthalmology, University College London, London, UK

7 NIHR Moorfields Biomedical Research Centre London, London, UK

Correspondence: Jugnoo Sangeeta Rahi, Great Ormond Street Institute of Child Health, University College London, 30 Guilford Street, London WC1N 1EH, UK, e-mail: j.rahi@ucl.ac.uk

Vasiliki Bountziouka and Lisanne Andra Horvat-Gitsels contributed equally.

Background: Childhood vision impairment (VI) can adversely impact health and social outcomes and limit life chances. We investigated whether its adverse impacts into adult life changed during a period in which legislation, policy and services to address inequalities relating to disability were implemented. **Methods:** Cross-cohort study comprising 14 247 participants from the 1946, 1958 and 1970 British birth cohorts (BC). Participants dichotomized as VI at age 15/16 (distance visual acuity was 6/12 or worse in the better-seeing eye) or normally sighted. Associations of childhood VI with health, well-being, socioeconomic and social participation outcomes in mid-adult life were investigated using regression models adjusted for participants' early life socioeconomic markers and sex. Change in adjusted odds ratios of >10% in the same direction in successive cohorts, or a > 20% difference between 1970BC and one older cohort were considered meaningful. **Results:** Trends over time in impacts of childhood onset VI into mid-adult life were complex. This included *worsening* of odds of poorer physical health (odds ratio 1.47; 95% confidence interval 1.02–2.14), living in unsatisfactory (1.54; 1.03–2.29) or overcrowded (2.34; 1.26–4.06) households, being unemployed (2.19; 1.19–3.97) and not gaining additional educational qualifications during mid-adult life (1.61; 1.08–2.47). By contrast the odds of *not* participating in some social activities (e.g. seeing friends) *improved* over time. Associations with other outcomes were unchanged. **Conclusions:** Many adverse impacts of childhood VI do not appear ameliorated over time by legislation, policies and provision that would have been expected to reduce inequalities. Moreover, some were increased. Childhood VI continues to cast a life-long shadow.

Introduction

Over the past few decades disability-related public, health, social care and education interventions, policies and legislation have been implemented in UK.^{1–6} Through these acts and legislations UK government aimed to improve and protect the nation's health, through reducing health inequalities,¹ to protect people from discrimination in the workplace and in wider society,² to protect disabled people against any form of discrimination,³ to make provisions about housing conditions, especially in the case of multiple occupancy,⁴ to establish a new framework for the education of children requiring special educational provision,⁵ and to enable direct payments to persons for securing the provision of care services.⁶ Alongside this, the adoption of the World Health Organization's holistic framework for conceptualizing disability⁷ has contributed to changing attitudes to issues affecting those living with disability.^{8–11}

To our knowledge, there has been no published research on whether, how and the extent to which these changes in policy and legislation have improved the lives of those growing up with visual disability. We considered it reasonable to expect that changes in education provision⁵, disability anti-discrimination legislation including in relation to employment opportunities,^{2,3} governmental provision and financial assistance via disability living allowance^{6,12} and benefits of certification as sight impaired or severely sight impaired¹³ should have improved the lives of children with vision impairment (VI) over time. We hypothesized that this would be discernible in the reduced impact of VI on childhood on long-term health, well-being, social outcomes and life chances.^{14–16} Utilizing the 1946, 1958 and 1970 British birth cohorts (BC), we showed previously an increase in prevalence of impaired vision childhood VI over a period when social adversity in early life increased and health inequalities widened.¹⁷ Building on our previous work,¹⁷ we report a cross-cohort investigation

across three key decades of societal change of the association between childhood VI and key outcomes in mid-adult life.

Methods

Timeline

Figure 1 details the timeline of the key legislative and policy changes which would be expected to ameliorate the impact of childhood VI in adult life. For example, the landmark Warnock review¹⁸ of special educational needs in 1978 informed the subsequent Education Act 1981,⁵ to enforce appropriate provision for children with special education needs, by which time participants of the 1946BC were on their mid-30s, while participants of the 1970BC were age 10 and therefore transitioned into adolescence through period of implementation of the Education Act. A series of legislations specific to disability^{3,6,12} were introduced in the 1990s, namely the Disability Living Allowance (1992), the Disability Rights Act (1995) and the Community Care Act (1998). Participants of the 1946BC were in their early-40s when these came into force, while the 1970BC were in on their early-20s and were more likely to experience major life events and transitions,¹⁹ such as leaving education, beginning employment and cohabiting, during that time. Provisions relating to housing conditions,⁴ promoting equality of opportunity,² regulating health and adult social care services,¹ and commitment of the local authorities for ongoing improvement of the economic, environmental and social wellbeing⁹ of the local populations areas came in force over a decade in 2000s, by which time the youngest cohort were in their 30s to 40s.

Cohorts

We analyzed data from three UK national studies that sampled all births in a single week in England, Scotland and Wales. These comprise (i) the National Survey of Health and Development of 1946 (1946BC)²⁰ with 5 362 singleton participating babies, (ii) the National Child Development Study of 1958 (1958BC)²¹ with 17 634 participating babies and (iii) the British Cohort Study of 1970 (1970BC)²² with participating 17 287 babies. They are particularly suitable to investigate our hypothesis because each has measures of visual acuity in childhood²³ and rich harmonized data on health and social outcomes throughout life. Members of the 1946BC would have been young adults when they experienced key policy changes

(see figure 1) implemented in the UK, for example, legislation relating to employment, while members of the 1970BC would have experienced the policy changes earlier in their lives, for example, changes in educational provision. Ethics approval for the cohort studies was given by the UK Medical Research Council, the National Health Service and the London Central Ethics Committees, respectively.^{20–22} All participants gave informed consent and could withdraw from the study at any point.

Childhood visual impairment (exposure)

The best-attained distance visual acuity (i.e. with correction if required) was tested using standard Snellen charts at a distance of 20 ft (i.e. 6 m) in each cohort at the ages of 15 or 16 years.²³ By this age, 98% of childhood visual impairment would have presented itself.²⁴ Utilizing harmonized data,²³ cohort members were classified as either having normal vision or VI, which was defined as having an acuity of 6/12 (i.e. logMAR 0.3) or worse in the better-seeing eye, encompassing the full range of VI from mild VI (below the threshold for driving a car in the UK) to blindness^{25,26} and which has been shown to be associated with increased mortality²⁷ (Supplementary table S1).

Outcomes

We investigated outcomes in mid-adult life as new onset VI between childhood and mid-adult life due to new onset eye disorders is uncommon. Therefore, it is reasonable to ascribe and assess the long-term functional impacts of childhood VI and assess any changes over time. We selected those outcomes available at the *same* age (mid-40s) and wherever possible in *each* cohort to cover four domains: (i) physical and mental health, (ii) general well-being/satisfaction with life, (iii) socio-economic position and (iv) social outcomes. Harmonized data by the Cohort and Longitudinal Studies Enhancement Resources (CLOSER) consortium were used to ensure comparability across the three cohorts.²⁸ The selected outcomes, in accordance with the relevant policies and the classification we followed are summarized in table 1.

Physical and mental health

Participants (i) self-reported their general health status (poor vs. good), (ii) whether experiencing a long-standing illness (yes vs. no)

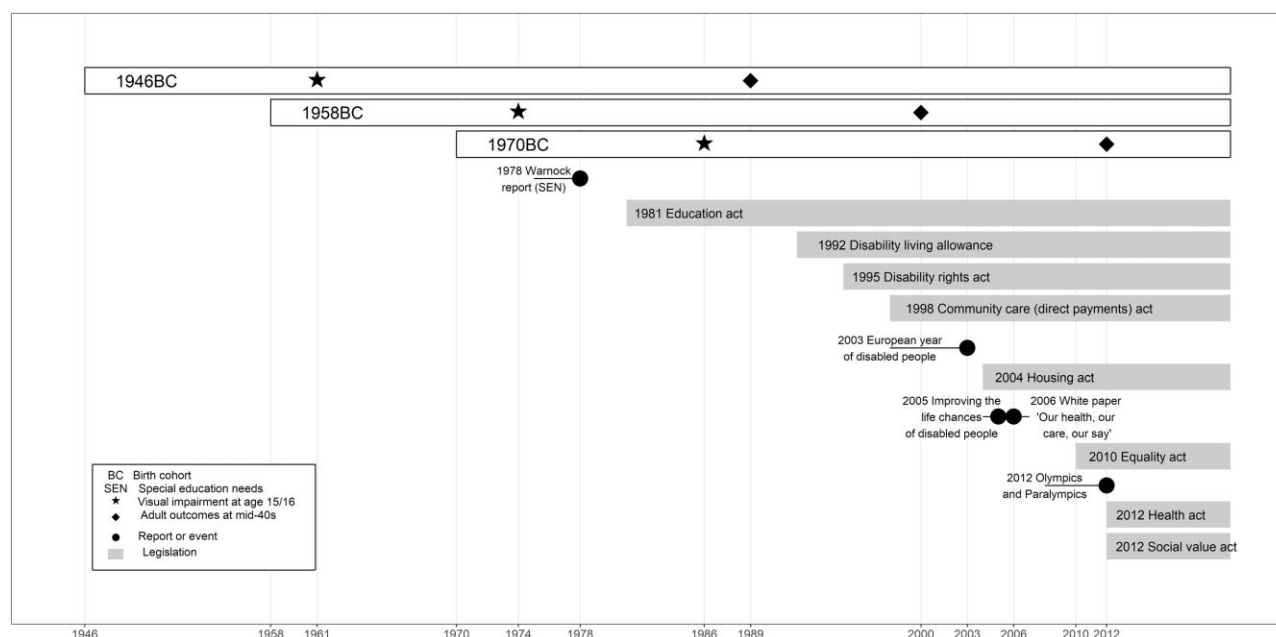


Figure 1 Timeline of cohort sweeps and societal changes

Table 1 Coding of outcomes and hypotheses of cohort effect linked to new legislations and societal changes

Outcome at mid-40s	Description	Coding	Linked legislation or major societal events
Self-reported health status Long-standing illness	General state of participant's health Whether the participant suffers from any long-term health problem, long-standing illness, infirmity or disability of any kind lasting or expected to last 12 months or more	Poor vs. good Yes vs. no	2012 Health and Social Care Act Improved health care
Anxiety/depression	Whether the participant has seen a specialist, been to a hospital, or seen a doctor in the past ten years for feeling low, depressed, sad, or generally anxious or jittery and still has this problem	Yes vs. no	Gaining wider acceptance of mental health issues; increased mental health problems
Job satisfaction	Satisfaction with current job	Poor vs. good	1995 Disability Discrimination Act; 2010 Equality Act
Accommodation satisfaction	Satisfaction with current accommodation	Poor vs. good	2004 Housing Act
General life satisfaction	Satisfaction with the way life has turned out so far	Poor vs. good	2005 Improving the life chances of disabled people; 2010 Equality Act
Educational qualification	Highest NVQ level from an academic or vocational qualification	None/statutory/extended schooling vs. higher/further education	1981 Education Act
Gained additional higher qualification between 23 and 45 years	Increase in NVQ level from an academic or vocational qualification between ages 23/26 and 42/43 years	No vs. yes	1981 Education Act
Unemployed	Current economic activity is unemployed and seeking work	Yes vs. no	1981 Education Act; 1995 Disability Discrimination Act; 2010 Equality Act
Occupational class given current/previous employment	Social class of current or last job based on Registrar-General's Social Classes (RGSC)	Unskilled/partially skilled (class IV or V) vs. Skilled (class IIINM or IIIM) or professional (class I or II)	1981 Education Act; 1995 Disability Discrimination Act; 2010 Equality Act
Worsened occupational class compared with childhood	Decrease in RGSC class from childhood to adulthood. Childhood's social class is derived from father's current or last job when cohort member was 10/11 years old, based on RGSC	Yes vs. no	1981 Education Act; 1995 Disability Discrimination Act; 2010 Equality Act
Disability allowance	Receiving disability-related allowances (including employment and support allowance (ESA))	No vs. yes	1992 Disability Living Allowance; 1996 Community Care (Direct Payments) Act
Home ownership	Ownership of home	No vs. yes	2004 Housing act; Improvement of occupational and economic opportunities
Overcrowded household	More people in household than rooms at home	Yes vs. no	2004 Housing Act
Married/partner	Current marital status	No vs. yes	Increase in acceptance of disability (from medical to social model)
Seeing friends at least weekly	How often the participant meets up with friends or relatives socially	No vs. yes	Increase in acceptance of disability (from medical to social model)
Doing sports at least weekly	Frequency of regular exercise, that is at least once a month for most of the year	No vs. yes	2012 Olympics & Paralympics in UK
Going to pubs, clubs, social activities at least weekly	Frequency of taking part in organizations, attending meetings or events, and/or going for a drink at a pub or club	No vs. yes	1995 Disability Discrimination Act; 2005 Improving the life chances of disabled people; 2010 Equality Act

and (iii) having seen a doctor/specialist (GP) for being anxious or depressed in the past and still feeling that way now (yes vs. no).

General well-being/satisfaction with life

Participants reported their overall satisfaction (poor vs. good) with their (i) job, (ii) accommodation and (iii) the way their life had turned out so far.

Socioeconomic position

Participants reported their (i) highest educational qualification (none/statutory/extended schooling vs. higher/further education),

(ii) current unemployment (yes vs. no), (iii) receiving disability allowance (no vs. yes), (iv) home ownership (no vs. yes) and (v) overcrowded household (yes vs. no). Based on the highest educational qualifications obtained by age 23/26 vs. 42/43 years, we derived whether (vi) participants gained *additional* higher qualifications later in life (no vs. yes). Participants also reported their occupation in current or previous employment, from which (vii) social class (unskilled/partially skilled vs. skilled/professional) was derived using the Registrar-General's Social Classes classification.²⁹ Based on paternal social class when aged 10/11 years and own social class when aged 42/43 years, we derived whether (viii) participants had a downward social mobility (yes vs. no) since childhood.

Social outcomes

Participants reported (i) marital status (married/partnership vs. other) and frequency (less than weekly vs. weekly or more) of (ii) friend visits, (iii) doing sports and (iv) going to pubs, clubs or engaging with other social activities.

Confounders/covariates

Based on prior work by us^{17,30,31} and others^{14–16} we included as important confounders key early life markers of social position: maternal education at birth (none/statutory schooling vs. extended/further/higher education) and paternal social class at age 10/11 years (classified as unskilled/semiskilled vs. skilled/professional), and cohort member's sex ([Supplementary table S1](#)).

Statistical analysis

Chi-squared tests assessed differences in baseline characteristics (sex, maternal education at birth and paternal social class at age 10/11 years) by childhood VI and birth cohort. A logistic regression model for each outcome was fitted to assess its association with VI stratified by cohort and adjusted for sex, childhood socioeconomic position (maternal education and paternal social class). Outcomes 'marital status' and 'long-standing illness' were also treated as potential confounders and were included in the regression models. Results are shown as adjusted odds ratios (aORs) alongside their 95% confidence intervals (95% CIs). We considered a >10% difference in same direction (i.e. reduction or increase) in the aOR point estimate in successive cohorts, or a >20% difference when comparing 1970BC with only one older cohort to represent a meaningful cohort effect. In the absence of any published work in this area that could have provided effects sizes for understanding the impact of policy or changes in societal attitudes, we pragmatically chose these thresholds as appropriate for providing results robust enough to be meaningful for assessing changes in policy or provision.

Attrition and missingness were investigated by fitting logistic regression models with them as responses to understand the potential selection bias in carrying out a complete case analysis. Outcomes with more than 10% missing data were excluded from the analysis. All tests were two-sided and the significance level was set at 5%. All analyses were performed in R version 4.1.0.³²

Results

Study population

Altogether 14 247 cohort members (2 296 of 1946BC, 7 752 of 1958BC and 4 199 of 1970BC) had complete visual acuity data at age 15/16 years, childhood social position data and outcomes of interest ([figure 2](#)).

Some outcomes were only collected in the 1958BC and 1970BC. Baseline characteristics and distribution of outcomes by VI for each cohort are shown in [Supplementary tables S3 and S4](#) respectively. Attrition was higher in men and those with lower childhood social position ([Supplementary table S2](#)), who were underrepresented in the complete case analysis. Although missing data for the baseline characteristics and outcomes were in general minimal, 65% of data on social activities were missing in 1958BC, precluding analysis.

Impact of childhood VI on outcomes in adulthood over time

The adjusted associations (aOR) of childhood VI with the adverse health, well-being, socioeconomic position and social outcomes over time in mid-adult life are shown in [table 2](#). While only some of the associations with adverse outcomes and cohort effects observed were significant at the 5% significance level, broad trends were discernible.

There was evidence of increasing odds over time of the following adverse outcomes for those with childhood VI: worse general

physical health, more likely to see a doctor for anxiety or depression, being dissatisfied with accommodation, living in overcrowded accommodation, unemployment and not gaining any educational qualifications in adult life increasing over time. For example, the odds of VI participants of the 1946BC being unemployed were 0.95 (95% CI 0.36–2.07), rising to 1.88 (1.13–3.10) for the 1958BC and further increasing to 2.19 (1.19–3.97) for the 1970BC.

By contrast, as shown in [table 2](#), those in the youngest cohort had lower odds than older cohorts of having a long-standing illness, being unsatisfied with their job (where employed), experiencing downward social mobility, seeing friends less than weekly and having social activities less than weekly. They were also less likely to *not* receive (i.e. more likely to receive) Governmental financial support (disability living allowance) to which they were entitled for their disability [0.65 (0.35–0.98) for the 1970BC vs. 0.92 (0.54–1.69) for the 1958BC].

Using our thresholds for changes over time in effect sizes, there were no changes in associations between having childhood onset VI and the following: general dissatisfaction with life, not gaining any further/higher educational qualifications after statutory schooling, being unskilled/partially skilled, not owning a home, not being married/having a partner and doing sports less than weekly ([table 2](#)).

Discussion

This cross-cohort investigation spans key decades of legislative, policy and societal changes intended to improve outcomes for people living with disabilities. The findings show a complex picture of trends in adverse impacts of childhood onset VI into mid-adult life on health, socioeconomic participation outcomes. Many adverse impacts do not appear to have been ameliorated by policies and provisions intended to address them. Moreover, some adverse impacts increased over time such as the likelihood of being unemployed, having worse physical health, experiencing anxiety or depression, living in overcrowded accommodation and not pursuing education into mid-adult life.

To our knowledge there are no equivalent studies with which we can compare our findings directly. We analyzed harmonized rich data collected longitudinally from three directly comparable UK birth cohorts, assessing outcomes at comparable ages to minimize confounding alongside multivariable analysis that included *a priori* potential confounders. Nevertheless, the possibility of residual confounding exists, as in any observational study. VI in childhood is uncommon,^{24,33} which limited the power of the multivariable analysis and thus true associations may have been missed as they either did not reach 'statistical significance' or resulted in overlapping corresponding 95% CIs. Therefore, we focused on the magnitude of effect sizes to be indicative of the change that policymakers would consider important. The small selection bias in our study with respect to male sex and lower socioeconomic class, suggests that the point estimates would be larger in their absence. We did not implement multiple imputation procedures as suggested in the CLS' Guidelines³⁴ because, as shown in [figure 2](#), most missing data occurred in the exposure and the outcome variables. Also, [Supplementary table S2](#) shows that missing data in the covariates are not completely random. So instead, we followed the literature^{35,36} that shows a complete case analysis is valid if, as in our study, data are not missing completely at random and covariates related to missingness are included in the model.

While key legislation and policy changes were implemented during the period covered by our study, we are not able to assess the direct experiences of individual cohort members of the changes in the provision or access resulting from these policies. For example, we are unable to disentangle whether the increase in odds over the decades covered by our study of seeing a doctor for anxiety or depression represents increasing risk of adverse mental health, improved societal acceptability of seeking help for mental health

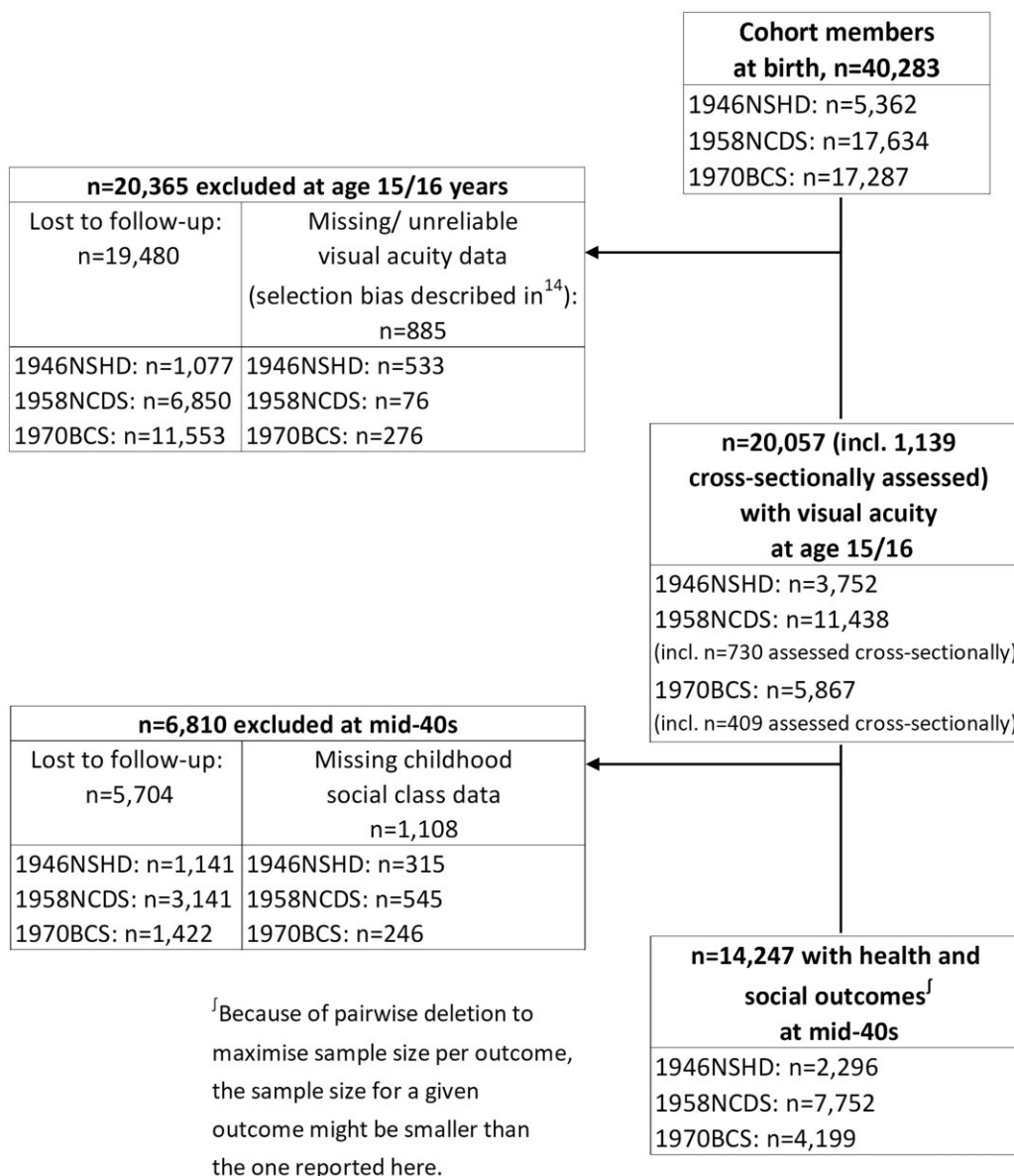


Figure 2 Flow of participants in the study

problems, increased access to mental health provision, or a combination of all three. Despite this, some coherent cohort effects are discernible.

Our findings of improved odds of some social participation activities are consistent with some improvement in societal acceptance and engagement with disability. It is encouraging to see findings that suggest effective implementation and uptake of some specific measures such as Governmental financial assistance (Disability Living Allowance) for those living with disability.

Our findings relating to no change in educational attainment during childhood and worsening odds of gaining *additional* educational qualifications into mid-adult life for those with childhood VI are notable in light of the significant changes that have taken place in education policy in the UK. Although special educational provision for children and young people with disabilities dates from the late 1800s, it was the Warnock Committee Report¹⁸ in 1978 which recognized the needs of children and young people with ‘disabilities of body or mind’ which was the foundation for the Education Act 1981 setting out the statutory requirement to provide an appropriate education for children with special educational needs. Thus, while the schooling of members of the 1946BC and 1958BC would not have been affected, more appropriate secondary schooling for the 1970BC

should have been available. In the decades since participants in our study were children, statutory provision via the formal process of agreeing on an Education and Healthcare Plan plan has been implemented and understanding of the specific needs of children and young people with VI has improved.^{37,38} Despite these changes via the 2014 Education Act, by 2019, compared with those without a disability, a much lower proportion of adults living with VI in the UK had a university degree (38% vs. 15%, respectively) and a much higher proportion had no educational qualifications (6% vs. 11%).³⁹ We recently showed that the education attainment gap for children and young people living with VI was not explained by differences in their ambitions or intentions for further education after school.⁴⁰ The recent UK Government review of Special Educational Needs and Disabilities (SEND) has resulted in its SEND and Alternative Provision Improvement Plan,⁴¹ which is ambitious but has been criticized by the UK Children’s Commissioner for ‘not going far enough swiftly enough’.

While education in childhood is intricately linked to subsequent employment opportunities, our finding of a striking worsening of odds of being unemployed over time—such that members of the 1970BC who had childhood VI were more than twice as likely as those without to be unemployed in their mid-40s—cannot be solely

Table 2 Associations of childhood visual impairment with adverse health and social outcomes at early-40s over the three birth cohorts

Domain	1946BC aOR (95% CI)	1958BC aOR (95% CI)	1970BC aOR (95% CI)	Association in the youngest cohort vs. either/both older cohorts (i.e. cohort effect)
Adverse physical/mental health				
Poor self-reported health status		1.10 (0.75–1.59)	1.47 (1.02–2.14)	Increased adverse impact
Long-standing illness		1.37 (1.20–1.56)	0.83 (0.57–1.21)	Reduced adverse impact
Seeing a doctor for anxiety/depression	0.74 (0.33–1.49)	0.67 (0.39–1.09)	1.18 (0.79–1.77)	Increased adverse impact
Adverse general well-being				
Not satisfied with job	1.48 (0.99–2.20)	1.05 (0.70–1.52)	0.78 (0.46–1.27)	Reduced adverse impact
Not satisfied with accommodation		1.06 (0.58–1.78)	1.54 (1.03–2.29)	Increased adverse impact
Not satisfied with life in general		1.03 (0.67–1.53)	0.90 (0.55–1.42)	No change
Adverse socioeconomic position				
Completing statutory (compulsory) education only vs. university/college higher/further education	1.06 (0.50–2.50)	0.82 (0.60–1.12)	1.00 (0.70–1.44)	No change
No educational qualifications vs. additional qualifications between mid-20s and mid-40s	0.86 (0.42–1.99)	0.70 (0.48–1.03)	1.61 (1.08–2.41)	Increased adverse impact
Unemployed	0.95 (0.36–2.07)	1.88 (1.13–3.10)	2.19 (1.19–3.97)	Increased adverse impact
Unskilled/partially skilled occupational class using current/previous employment	0.80 (0.42–1.52)	1.24 (0.81–1.86)	0.81 (0.42–1.45)	No change
Downgrade social class since childhood	1.25 (0.66–2.38)	1.21 (0.89–1.67)	1.01 (0.68–1.49)	Reduced adverse impact
No disability allowance		0.92 (0.54–1.69)	0.65 (0.35–0.98)	Reduced adverse impact
No home ownership	0.80 (0.32–1.76)	1.13 (0.74–1.70)	0.99 (0.62–1.55)	No change
Living in overcrowded households		0.89 (0.56–1.33)	2.34 (1.26–4.06)	Increased adverse impact
Adverse social participation				
Not married/no partner	1.07 (0.53–1.99)	0.94 (0.63–1.36)	1.03 (0.70–1.48)	No change
Seeing friends less than weekly	1.98 (1.09–3.47)		1.08 (0.75–1.55)	Reduced adverse impact
Doing sports less than weekly	1.19 (0.68–2.13)	1.18 (0.87–1.60)	1.29 (0.87–1.88)	No change
Going to pubs, clubs, social activities less than weekly	1.53 (1.02–2.82)		0.78 (0.50–1.25)	Reduced adverse impact

aOR for sex, childhood socioeconomic position (maternal education and paternal social class), marital status, and illness. We considered a >10% difference in same direction (i.e. reduction or increase) in the aOR point estimate in successive cohorts or, a >20% difference when comparing 1970BC with only one older cohort to represent a meaningful cohort effect. Empty cells indicate that the outcome was not measured in the relevant cohort.

attributed to lower educational attainment. This disparity persists today, with 57% of adults living with VI being in paid employment vs. 81% of those without a disability.⁴² Interestingly, the odds of downward 'social mobility' between childhood and adulthood (based on parental and own occupational social class) improved over time. These positive trends may partly reflect the benefits experienced by the 1970BC from the implementation of legislation and provisions that should have addressed some inequities arising from disability including the Disability Rights Act (1995), Community Care Act (1998), Disability Living Allowance (1992), Housing Act (2004) and Equality Act (2010). Nevertheless, the stark trend of worsening odds over time for those with childhood VI of finding themselves unemployed and living in overcrowded accommodation in their mid-40s demonstrates how far the UK is from realizing the ambition of the 'Improving the Life Chances of Disabled People' UK Government strategy (2005) that 'disabled people should have full opportunities and choices to improve their quality of life'.

The improved odds of some social participation activities over time in our study may reflect some improvement in societal attitudes, acceptance and engagement with disability,⁷ (including the reframing through adoption of the World Health Organization's International Classification of Functioning Disability and Health in 2001⁷) alongside the implementation of legislation to prevent discrimination and improve equitable provision. The 1995 World Summit for Social Development,⁴³ saw an international commitment to 'society for all' followed by initiatives to promote inclusivity and opportunity that may have benefited the 1970BC. The evidence from our study of worse physical and mental health in mid-adult life demonstrates the long shadow that those with childhood onset VI casts over the lives of affected people, despite the reduction in odds of other long-standing illnesses which will likely be due to improved healthcare during this timespan. It also demonstrates that these adverse outcomes are not new, although rightly receiving greater attention,^{44,45} especially to escalation due to the COVID-19 pandemic.⁴⁶

Our study shows that much remains to be done to tackle the inequities in health, social position, life chances and participation that can result from childhood onset VI. However, childhood VI tends to be overshadowed by the more prevalent adult-onset VI in initiatives relating to eye health or blindness⁴⁷ and is rarely considered specifically within those relating to child health.⁴⁸ We suggest that for progress to be made, an explicit focus is needed on the adverse impacts of childhood vision across the life course within initiatives to address inequities relating to disability.

Supplementary data

Supplementary data are available at *EURPUB* online.

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Conflicts of interest: None declared.

Author contributions

VB contributed to the design of the study, data analysis and interpretation, prepared the initial draft of the manuscript, and gave final manuscript approval. LAH-G contributed to the design of the study, performed the data analysis, contributed to the interpretation of the findings and the preparation of the manuscript and gave final manuscript approval. MC-B contributed to the data analysis, interpretation and critical revision of the manuscript, and gave final manuscript approval. JSR was accountable for the design of the study, data interpretation and critical revision of the manuscript, gave final manuscript approval and was the guarantor.

Data availability

The dataset used in this research uses harmonized data from three British national birth cohort studies. The original and the harmonized 1946 birth cohort data are made available to researchers who submit data requests at <https://skylark.ucl.ac.uk/NSHD/>. The original data for the 1958 and 1970 birth cohorts are available from the UK Data Service (<https://ukdataservice.ac.uk/>).

Key points

- Childhood onset vision impairment adversely impacts health and social outcomes and limit life chances.
- Many adverse impacts of childhood VI do not appear to have been ameliorated by legislation, policies and provision in the UK spanning three decades that were intended to address them.
- A specific focus on the adverse impacts of childhood vision across the life course is needed within initiatives to address inequities relating to disability.

References

- Health and Social Care Act 2012, c.7. UK Public General Acts; 2012. Available at: <https://www.legislation.gov.uk/ukpga/2012/7/contents/enacted> (18 October 2021, date last accessed).
- Equality Act 2010, c.15. Available at: <https://www.legislation.gov.uk/ukpga/2010/15/contents> (18 October 2021, date last accessed).
- Disability Discrimination Act 1995, c.50. UK Public General Acts; 1995. Available at: <https://www.legislation.gov.uk/ukpga/1995/50/contents> (18 October 2021, date last accessed).
- Housing Act 2004 c. 34. UK Public General Acts; 2004. Available at: <https://www.legislation.gov.uk/ukpga/2004/34/contents> (18 October 2021, date last accessed).
- Education Act 1981 c. 60. UK Public General Acts; 1981. Available at: <https://www.legislation.gov.uk/ukpga/1981/60/enacted> (18 October 2021, date last accessed).
- Community Care (Direct Payments) Act 1996 c. 30. UK Public General Acts; 1996. Available at: <https://www.legislation.gov.uk/ukpga/1996/30/contents> (18 October 2021, date last accessed).
- WHO. International Classification of Functioning, Disability and Health. Available at: <https://www.who.int/standards/classifications/international-classification-of-functioning-disability-and-health> (10 April 2023, date last accessed).
- Venters N. *The Past, Present and Future of Innovation in Mental Health*. NHS Digital, 2018. Available at: <https://digital.nhs.uk/blog/transformation-blog/2018/the-past-present-and-future-of-innovation-in-mental-health> (17 August 2022, date last accessed).
- The Health Foundation. *Structural Changes from Health and Social Care Act* (2012). 2013. Available at: <https://navigator.health.org.uk/theme/structural-changes-health-and-social-care-act-2012> (17 August 2022, date last accessed).
- Grant L. A *Disability History Timeline: The Struggle for Equal Rights through the Ages*. 2013. Available at: <https://ukdhm.org/v2/wp-content/uploads/2014/09/B5-Disability-Time-Line-NHS-North-West.pdf> (17 August 2022, date last accessed).
- Department for Work and Pensions, Department of Health, Department for Education and Skills, Office of the Deputy Prime Minister. *Improving the Life Chances of Disabled People. Final Report*. 2005. Available at: <http://www.mentalhealthpromotion.net/resources/improving-the-life-chances-of-disabled-people.pdf> (23 July 2023, date last accessed).
- Social Security Committee. *Social Security - Fourth Report*. 1998. Available at: <https://publications.parliament.uk/pa/cm199798/cmselect/cmsocsec/641/64102.htm> (17 August 2022, date last accessed).
- Department of Health and Social Care. *Registering Vision Impairment as a Disability*. 2018. Available at: <https://www.gov.uk/government/publications/guidance-published-on-registering-a-vision-impairment-as-a-disability> (17 August 2022, date last accessed).
- Ulldemolins AR, Lansingh VC, Valencia LG, et al. Social inequalities in blindness and visual impairment: a review of social determinants. *Indian J Ophthalmol* 2012;60:368–75.
- Varma R, Vajaranant TS, Burkemper B, et al. Visual impairment and blindness in adults in the United States. *JAMA Ophthalmol* 2016;134:802–9.
- Whillans J, Nazroo J. Social inequality and visual impairment in older people. *J Gerontol B Psychol Sci Soc Sci* 2018;73:532–42. doi: 10.1093/geronb/gbv163.
- Bountziouka V, Cumberland PM, Rahi JS. Trends in visual health inequalities in childhood through associations of visual function with sex and social position across 3 UK birth cohorts. *JAMA Ophthalmol* 2017;135:954–61.
- Department for Education and Science. *Special Educational Needs: Report of the Committee of Enquiry into the Education of Handicapped Children and Young People (the Warnock Report)*. London: HMSO, 1978.
- Skogbrott Birkeland M, Leversen I, Torsheim T, Wold B. Pathways to adulthood and their precursors and outcomes. *Scand J Psychol* 2014;55:26–32.
- Wadsworth M, Kuh D, Richards M, Hardy R. Cohort profile: the 1946 National Birth Cohort (MRC National Survey of Health and Development). *Int J Epidemiol* 2006;35:49–54.
- Power C, Elliott J. Cohort profile: 1958 British birth cohort (National Child Development Study). *Int J Epidemiol* 2006;35:34–41.
- Elliott J, Shepherd P. Cohort profile: 1970 British Birth Cohort (BCS70). *Int J Epidemiol* 2006;35:836–43.
- Bountziouka V, Cumberland PM, Rahi JS. *CLOSER Work Package 4: User Guide. Harmonised Distant Visual Acuity and Refractive Error*. London, UK: CLOSER, 2017.
- Teoh LJ, Solebo AL, Rahi JS, British Childhood Visual Impairment and Blindness Study Interest Group. Visual impairment, severe visual impairment, and blindness in children in Britain (BCVIS2): a national observational study. *Lancet Child Adolesc Health* 2021;5:190–200.
- Rahi JS, Logan S, Timms C, et al. Risk, causes, and outcomes of visual impairment after loss of vision in the non-amblyopic eye: a population-based study. *Lancet* 2002; 360:597–602.
- WHO. International Statistical Classification of Diseases and Related Health Problems (ICD-10). <https://icd.who.int/browse10/2019/en#/H53-H54> (accessed 17 August 2022).
- Ehrlich JR, Ramke J, Macleod D, et al. Association between vision impairment and mortality: a systematic review and meta-analysis. *Lancet Glob Health* 2021;9: e418–e430.
- CLOSER. *Data Harmonisation*. Available at: <https://www.closer.ac.uk/research-fund-2/data-harmonisation/> (5 March 2021, date last accessed).
- Dodgeon B, Morris T, Crawford C, et al. *CLOSER Work Package 2: Harmonised Socio-Economic Measures User Guide (Revised)*. London: CLOSER, 2019.
- Cumberland PM, Rahi JS, UK Biobank Eye and Vision Consortium Visual function, social position, and health and life chances the UK Biobank study. *JAMA Ophthalmol* 2016;134:959–66.
- Rahi JS, Cumberland PM, Peckham CS. Visual function in working-age adults: early life influences and associations with health and social outcomes. *Ophthalmology* 2009;116:1866–71.
- R Core Team. R version 4.1.0: A language and environment for statistical computing. Published online 2021. Available at: <https://www.r-project.org/> (July, 2023, date last accessed).

- 33 Yekta A, Hooshmand E, Saatchi M, et al. Global prevalence and causes of visual impairment and blindness in children: a systematic review and meta-analysis. *J Curr Ophthalmol* 2022;34:1–15.
- 34 Silverwood R, Narayanan M, Dodgeon B, Ploubidis G. *Handling Missing Data in the National Child Development Study: User Guide (Version 2)*. London: UCL Centre for Longitudinal Studies, 2021. Available at: <https://cls.ucl.ac.uk/wp-content/uploads/2020/04/Handling-missing-data-in-the-National-Child-Development-Study-User-Guide.pdf> (5 July 2023, date last accessed).
- 35 White IR, Carlin JB. Bias and efficiency of multiple imputation compared with complete-case analysis for missing covariate values. *Statist Med* 2010;29: 2920–31.
- 36 Lee KJ, Carlin JB, Simpson JA, Moreno-Betancur M. Assumptions and analysis planning in studies with missing data in multiple variables: moving beyond the MCAR/MAR/MNAR classification. *Int J Epidemiol* 2023;52:1268–75.
- 37 VICTAR. *Vision Impairment Centre for Teaching and Research University of Birmingham*. 2021. Available at: <https://www.birmingham.ac.uk/research/victar/index.aspx> (10 March 2022, date last accessed).
- 38 Visual Impairment Education Workforce. *Key Issues for VI Education in England*. Available at: <https://viewweb.org.uk/view-statement-on-the-key-issues-for-vi-education-in-england/> (10 March 2022, date last accessed).
- 39 Sparkes I. *Disability and Education, UK*. 2019. Available at: <https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/disability/bulletins/disabilityandeducationuk/2019> (24 April 2023, date last accessed).
- 40 Horvat-Gitsels LA, Cortina-Borja M, Rahi JS. Do adolescents with impaired vision have different intentions and ambitions for their education, career and social outcomes compared to their peers? Findings from the Millennium Cohort Study. *Br J Ophthalmol* 2022;bjophthalmol-2021-320972. doi: 10.1136/bjophthalmol-2021-320972. Note: References 41–48 are available in the Supplementary Material.