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Assistive technology for children and young people with low vision (Review)

Thomas R, Barker L, Rubin G, Dahlmann-Noor A

Thomas R, Barker L, Rubin G, Dahlmann-Noor A.
Assistive technology for children and young people with low vision.
Cochrane Database of Systematic Reviews 2015, Issue 6. Art. No.: CD011350.
DOI: 10.1002/14651858.CD011350.pub2.

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[Intervention Review]

Assistive technology for children and young people with low vision

Rachel Thomas[1], Lucy Barker[2], Gary Rubin[3], Annegret Dahlmann-Noor[4]

[1]Optometry, Moorfields at Bedford Hospital, Bedford, UK. [2]Moorfields Eye Hospital NHS Foundation Trust, London, UK. [3]Institute of Ophthalmology, London, UK. [4]NIHR Biomedical Research Centre at Moorfields Eye Hospital NHS Foundation Trust and UCL Institute of Ophthalmology, London, UK

Contact: Rachel Thomas, Optometry, Moorfields at Bedford Hospital, Kempston Road, Bedford, MK42 9DJ, UK. rachel.thomas@bedfordhospital.nhs.uk.

Editorial group: Cochrane Eyes and Vision Group.
Publication status and date: New, published in Issue 6, 2015.

Citation: Thomas R, Barker L, Rubin G, Dahlmann-Noor A. Assistive technology for children and young people with low vision. *Cochrane Database of Systematic Reviews* 2015, Issue 6. Art. No.: CD011350. DOI: 10.1002/14651858.CD011350.pub2.

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ABSTRACT

Background

Recent technological developments, such as the near universal spread of mobile phones and portable computers and improvements in the accessibility features of these devices, give children and young people with low vision greater independent access to information. Some electronic technologies, such as closed circuit TV, are well established low vision aids and newer versions, such as electronic readers or off-the shelf tablet computers, may offer similar functionalities with easier portability and at lower cost.

Objectives

To assess the effect of electronic assistive technologies on reading, educational outcomes and quality of life in children and young people with low vision.

Search methods

We searched CENTRAL (which contains the Cochrane Eyes and Vision Group Trials Register) (2014, Issue 9), Ovid MEDLINE, Ovid MEDLINE In-Process and Other Non-Indexed Citations, Ovid MEDLINE Daily, Ovid OLDMEDLINE (January 1946 to October 2014), EMBASE (January 1980 to October 2014), the Health Technology Assessment Programme (HTA) (www.hta.ac.uk/), the *meta*Register of Controlled Trials (*m*RCT) (www.controlled-trials.com), ClinicalTrials.gov (www.clinicaltrials.gov) and the World Health Organization (WHO) International Clinical Trials Registry Platform (ICTRP) (www.who.int/ictrp/search/en). We did not use any date or language restrictions in the electronic searches for trials. We last searched the electronic databases on 30 October 2014.

Selection criteria

We intended to include randomised controlled trials (RCTs) and quasi-RCTs in this review. We planned to include trials involving children between the ages of 5 and 16 years with low vision as defined by, or equivalent to, the WHO 1992 definition of low vision. We planned to include studies that explore the use of assistive technologies (ATs). These could include all types of closed circuit television/electronic vision enhancement systems (CCTV/EVES), computer technology including tablet computers and adaptive technologies such as screen readers, screen magnification and optical character recognition (OCR). We intended to compare the use of ATs with standard optical aids, which include distance refractive correction (with appropriate near addition for aphakic (no lens)/pseudophakic (with lens implant) patients) and monocular/binoculars for distance and brightfield magnifiers for near. We also planned to include studies that compare different types of ATs with each other, without or in addition to conventional optical aids, and those that compare ATs given with or without instructions for use.

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Data collection and analysis

Independently, two review authors reviewed titles and abstracts for eligibility. They divided studies into categories to 'definitely include', 'definitely exclude' and 'possibly include', and the same two authors made final judgements about inclusion/exclusion by obtaining full-text copies of the studies in the 'possibly include' category.

Main results

We did not identify any randomised controlled trials in this subject area.

Authors' conclusions

High-quality evidence about the usefulness of electronic AT for children and young people with visual impairment is needed to inform the choice healthcare and education providers and family have to make when selecting a technology. Randomised controlled trials are needed to assess the impact of AT. Research protocols should carefully select outcomes relevant not only to the scientific community, but more importantly to families and teachers. Functional outcomes such as reading accuracy, comprehension and speed should be recorded, as well as the impact of AT on independent learning and quality of life.

PLAIN LANGUAGE SUMMARY

Assistive technology (electronic aids) for children and young people with low vision

Review question
To assess the effect of electronic aids on reading, educational outcomes and quality of life in children and young people with low vision, also called 'being partially sighted' or 'having a sight impairment'.

Background
New technologies that are widely available to young people, such as mobile phones and portable computers, often have accessibility features for users with visual or other impairments. Families and teachers have observed that children and young people use the magnifier functions to enlarge text or pictures, and also often use these devices to find information more independently. Electronic devices also seem more socially acceptable to children and young people, who often fear to 'stand out' from their peers when using bulky optical aids.

Research is needed to find out whether children and young people with low vision really can use these 'assistive technologies' successfully at school and at home, and whether these technologies improve their participation in education. Electronic aids should allow the young person to read more independently, faster and more accurately than without aids, and it should be easy to take the devices from one classroom to the next. How much an electronic technology is used on a daily basis is also a good indicator of how well it works for the young person.

This Cochrane Review aims to assess the effect of assistive technologies on reading, educational outcomes and quality of life in children and young people with low vision. We searched the published literature and registers of current clinical trials. We did not identify any high-quality research studies in this subject area. Possible reasons are that these technologies are still new, and also that traditionally low-vision research was carried out as 'before/after' studies, not as trials where participants are allocated to treatments on a random basis, which is the best way of making sure that any observed effects can be attributed to treatment, rather than other factors.

Worldwide there are an estimated three million children and young people with low vision. Families and healthcare and education providers need high-quality evidence to inform the choice of technology for a child or young person with low vision. Future research should measure functional outcomes, such as reading accuracy, comprehension and speed, as well as the impact of assistive technologies on independent learning and quality of life, and outcomes relevant to families and teachers.

Search date
The evidence is up to date to October 2014.

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BACKGROUND

Description of the condition

In 2004, the World Health Organization (WHO) reported that more than 161 million people worldwide were visually impaired, with 124 million classified as having low vision and 37 million classified as blind (defined as visual acuity less than 3/60 in the better-seeing eye) (World Health Organization 2004). In children, the prevalence of blindness varies from 0.3/1000 in high-income countries to over 1.0/1000 in low- and middle-income countries, equating to around 1.4 million blind children worldwide (Gilbert 2001; World Health Organization 2000). Low vision is about twice as common as childhood blindness, and might affect almost three million children worldwide (Gilbert 2008a; Gilbert 2008b).

The leading causes of low vision in children worldwide are retinal conditions, corneal scarring (vitamin A deficiency, measles, harmful traditional practices), globe anomalies, cataract, optic nerve anomalies, glaucoma and central nervous system disorders (Gilbert 2001). A recent study in Nepal identified corneal disease as the leading cause of visual impairment, followed by retinal disease and lens pathology. In 46% of children, however, the cause of visual loss could not be identified (Shrestha 2012). In high-income countries, brain damage sustained around the time of birth has become the leading cause of severe visual impairment (Bodeau-Livinec 2007; Mitry 2013; Rahi 2003). In England and Wales, the most common conditions in children with impaired, but not severely impaired sight, are hereditary retinal conditions or congenital globe abnormalities (Mitry 2013).

In the UK, there are an estimated 25,000 children with vision impairment (VI) or severe vision impairment/blindness (SVI/BL) (Morris 2008). The cumulative incidence of SVI/BL by 16 years of age is 5.9, and that of VI around 7 per 10,000 live births (Bodeau-Livinec 2007; Rahi 2003). About 950 new cases of VI or SVI/BL are diagnosed each year (Bodeau-Livinec 2007).

Children are considered to have 'low vision' when the corrected visual acuity (VA) is between less than 6/18 (0.48 logMAR) and light perception in their better eye, or their visual field is less than 10 degrees from the point of fixation, but they use, or are potentially able to use, vision for the planning or execution, or both, of a task (World Health Organization 1992). The current version of the WHO International Classification of Diseases, ICD-10, replaced the term 'low vision' by that of 'category 1 or 2 visual impairment', i.e. 'best corrected distance acuity with both eyes open of less than 6/18 (0.48 logMAR) and better than or equal to 3/60 (1.30 logMAR) (World Health Organization 2015).

There is an overlap with the definitions of VI and SVI/BL. The exact definition of childhood blindness is variable, but usually ranges between a best-corrected visual acuity of less than 6/60 to 3/60 (1.00 to 1.30 logMAR) in the better-seeing eye in a young person under the age of 15 years (Gilbert 2001; World Health Organization 2004).

Visual impairment can result in developmental delay by reducing the range of experiences to which the child is exposed. Early assessment with provision and training of low vision aids (LVAs) is essential to improve functional vision and adaptation to visual impairment, so allowing most children to enter and remain in mainstream schools (Ducrey 1998; Massof 1998; Silver 1976). In the UK, approximately 70% of children with VI are educated in mainstream schools where the use of LVAs to enable use of printed educational materials is essential (Morris 2008). In the developing world, access to enlarged print, or methods to enlarge text (i.e. computers or photocopiers) is more spartan, and magnifiers can be provided as a cheaper and more transportable option for children with low vision. Epidemiological studies in Pakistan have demonstrated that provision of basic magnification aids would permit at least 11% of children currently educated in schools for the blind to be moved to mainstream schooling (Sight Savers International 2003). This estimate, however, was based on a sample of 1000 children in schools for the blind and was subject to selection bias due to the small percentage of children with low vision currently being educated in special schools in low- and middle-income countries; the overall potential for improvement is significantly higher. In Nepal, optical intervention provided a significant improvement to the vision of 48.2% of children in schools for the blind, enabling those learning braille to learn to read visually, or visually in conjunction with braille (Gnyawali 2012). Despite this improvement, however, only 34.8% of children were still using their LVA one year later. Damage or loss was the most common reason reported for cessation of use; however, inadequate instruction and inappropriate setting/lighting were also reported, both of which highlight the vital importance of maintenance of equipment - however basic - and instruction to enable its use (Gnyawali 2012).

Description of the intervention

A low vision aid (LVA) can be defined as any device that enables a person with low vision to improve visual performance. LVAs can be classified into non-optical aids (such as improved contrast and lighting), optical aids (magnifiers) and electronic 'assistive technologies' (AT). This review will include:

- Closed circuit television (CCTV) or electronic vision enhancement systems (EVES), which use a camera to project an image onto a screen. These can be desktop (with an integrated monitor), portable and those that plug into a television or other monitor. There are also CCTV devices with a distance camera attached.
- Computer-based access technology (for desktops, laptops and tablet computers) including screen readers with speech or braille output and screen magnification.
- Optical character recognition (OCR) that digitises the written word, which can subsequently be used with a screen reader.

Children with a visual impairment may use a combination of the above strategies to achieve different outcomes and thus facilitate access to the educational curriculum. Compared with text enlargement, LVAs may have the additional advantage of providing children and young people with greater independence of access to printed material (Corn 2002; Douglas 2011). However, peer pressure and the fear of 'standing out' may reduce the usage of LVAs by children and young people (Mason 1999). The use of information technology has become a mainstream part of children's lives, and children may therefore not view the use of technology as an inhibiting factor in comparison to the use of some optical aids. Many children have access to computer technology in the form of mobile phones, electronic readers (kindle/e-book reader) and computers (with qwerty keyboards and touch screens), both at home and within the educational environment. Use of such

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technology can be enabling to children with visual impairments, however access to such technology may require the addition of assistive or adaptive technologies.

How the intervention might work

This review will aim to assess the effect of assistive technologies (ATs) in children with low vision. The use of optical aids in children with low vision is the topic of a separate review (Barker 2014). No review will be undertaken for the use of non-optical aids. Electronic AT provide different levels of support, such as magnification of printed text and text on computer monitors, text-to-speech conversion and voice input with subsequent conversion of speech to electronic text. These technologies facilitate the interaction of sight-impaired users with written material.

Why it is important to do this review

Improving functional vision in children with vision impairment is important to enable education and personal development and to improve vision-related quality of life. The previously held belief that children with low vision should be treated as children with no vision may in the past have hampered the study and use of LVAs. The WHO identified and highlighted the provision, education and use of LVAs in children as a priority in managing children with vision impairment (World Health Organization 1992). Parents or local education authorities may purchase ATs for children and young people to help with specific functional tasks within the classroom environment. Commonly used are CCTV or EVES systems. Usage may be limited by variable acceptance of these devices, technical problems such as time required to set up the equipment in the classroom and to move it between classrooms, battery life and availability of power supply, as well as other issues including cost of purchase and maintenance/repair (Alves 2009; Kapperman 2002; Söderström 2010). In adults, a recent Cochrane review described a lack of data regarding the performance of electronic aids and their sustained use, compared to simpler and cheaper optical devices (Virgili 2013). Whilst there are objective benefits to the use of electronic LVAs, some tasks may be performed just as well with optical aids (Peterson 2003). There is, however, a lack of data on children and young people, and there is a need for further research into the comparative benefits of different types of visual aids. There is also a lack of agreement and comparative data on relevant outcomes and benefits of LVAs in children and young people. Users, i.e. children and their families and carers, and healthcare providers or commissioners require good-quality evidence to make informed choices about allocation of personal, institutional and public resources. Facilitating reading and literacy of children and young people not only optimises individuals' access to education and employment, but also benefits society. Given the increasing use of computer-based technology in mainstream schooling, it appears timely to evaluate its usefulness for students with low vision. In addition, initiatives such as the 'one laptop per child' program (www.laptop.org) have demonstrated that it is possible for low-cost technology to reach children in the developing world. ATs may have an impact on the education of children worldwide. In view of the increasing choice of technologies available, it is important to review evidence on the effect of different ATs available, and to identify outcome measures relevant to children, carers and teachers. The rationale for this review is therefore to critically evaluate information already available from high-quality trials, and to delineate a framework for future research and practice policies in both developing and developed countries.

OBJECTIVES

To assess the effect of electronic assistive technologies on reading, educational outcomes and quality of life in children and young people with low vision.

METHODS

Criteria for considering studies for this review

Types of studies

We intended to include randomised controlled trials (RCTs) and quasi-RCTs in this review. We considered within-subject studies, in which the order of presentation of devices was randomised, as quasi-RCTs. Within-subject studies are similar in design to conventional cross-over studies, but instead of offering interventions sequentially, low vision aid (LVA) studies frequently offer several types of aids sequentially in one study session and also measure outcomes sequentially, in the same session.

Types of participants

We intended to include trials involving children between the ages of 5 and 16 years with low vision as defined by, or equivalent to, the WHO 1992 definition (World Health Organization 1992): "A person with low vision is one who has impairment of visual functioning even after treatment and/or standard refractive correction, and has a visual acuity of less than 6/18 to light perception, or a visual field of less than 10° from the point of fixation, but who uses, or is potentially able to use, vision for the planning and/or execution of a task". In logMAR equivalents, this may equate to visual acuity worse than 0.48, but better than or equal to 2.7 logMAR (Schulze-Bonsel 2006).

We decided to exclude pre-school age children, as young children tend to hold objects close to their face to achieve magnification and LVAs are not usually prescribed to this age group. If LVAs, including electronic aids, are presented to children under the age of five years, the aim is to introduce children to the concept of electronic devices in a playful manner and not actually to improve access to visual information.

Types of interventions

We planned to include studies that explore the use of assistive technologies (ATs). These would include all types of closed circuit television/electronic vision enhancement systems (CCTV/EVES) and computer technology including tablet computers and adaptive technologies such as screen readers, screen magnification and optical character recognition (OCR). We intended to compare the use of ATs with standard optical aids, which include distance refractive correction (with appropriate near addition for aphakic (no lens)/pseudophakic (with lens implant) patients) and monocular/binoculars for distance and brightfield magnifiers for near. We also planned to include studies that compare different types of ATs with each other, without or in addition to conventional optical aids, and those that compare ATs given with or without instructions for use.

A separate Cochrane review has explored the effects of optical aids in the same population (Barker 2014). The motivation to split the topic into two reviews lies in the difference in what these technologies try to achieve. Optical aids are prescribed to facilitate reading and access to printed material by

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providing magnification. Some electronic ATs have a broader aim: facilitating access to education, but also to social media and real-time information available via the internet, for example maps/directions, educational or leisure activities offered in the vicinity etc. As such, a comparison of optical aids with ATs has to be limited to outcomes on which both types of devices can have an effect, such as reading and access to educational materials.

Types of outcome measures

Low vision affects many aspects of a person's life. Interventions aim to improve one or more different area(s) of difficulty. Outcome areas relevant to low vision include mobility, activities of daily living (ADL), self esteem (happiness, mental health), literacy (reading, writing, access to information), visual functioning, use of LVAs, social contact/participation, use of technology and employment (Douglas 2013). A recent systematic review of the effectiveness of low vision service provision categorised outcomes into five groups: objective/clinical outcomes, ADL/functional outcomes, vision-related quality of life (VRQoL), psychological status and general health-related quality of life (HRQoL) (Binns 2012). Outcome measures for objective outcomes include near visual acuity (VA), distance VA and reading accuracy, comprehension and speed (Binns 2012). A range of questionnaires is available to measure functional outcomes relating to ADL, psychological status, VRQoL and HRQoL, such as the Manchester Low Vision Questionnaire (MLVQ) (Harper 1999), the Low Vision Quality of Life Questionnaire (LVQoL) (Wolffsohn 2000), the National Eye Institute Visual Function Questionnaire (NEI-VFQ) (Mangione 1998; Mangione 2001), and the Impact of Vision Impairment Profile (IVI) (Hassell 2000; Weih 2002). Only a few tools have been developed and validated for use in children and young people, and even fewer have been developed with focus groups of children and young people. Examples include the Impact of Vision Impairment Profile for Children (IVI_C) (Cochrane 2011), the Cardiff Visual Ability Questionnaire for Children (CVAQL) to assess VRQoL (Khadka 2010), the Functional Vision Questionnaire for Children and Young People with Visual Impairment (FVQ CYP) (Tadić 2013), and the general health-related Pediatric Quality of Life Inventory (Varni 2001; Varni 2002).

The aim of ATs is not to improve all of the above outcomes. Rather they aim to assist with specific visual tasks. In an educational setting they are intended to improve access to written material from the conventional curriculum. They may also be useful for independence in ADL. Outcome measures potentially appropriate to evaluate the effectiveness of LVA ATs are therefore those related to vision-related quality of life, as well as measures of visual function related to reading (for example, reading speed) and literacy (reading accuracy and comprehension).

Reading performance has been found to be one of the best predictors of patient-reported visual ability and VRQoL (Hazel 2000; McClure 2000). Reading is an important function in daily life. It is a standard outcome in studies monitoring conditions causing visual impairment and in clinical trials evaluating the effectiveness of interventions (Rubin 2013). Reading speed may be the most appropriate primary reading-related outcome, as it evaluates the functional visual effect of the aid. CCTV, electronic reading aids, tablet computers and mobile phones can all be used to scan and enlarge text. Maximum reading speed may be the most commonly used outcome in assessing the effect of reading aids, and is the primary outcome explored in a Cochrane review on reading aids for adults with low vision (Virgili 2013). It is typically stable across a range of print sizes over a certain threshold (critical print/font size), whereas at smaller print sizes, below the critical print/font size, the reading speed slows and the reading acuity limit is reached (Ahn 1995a; Ahn 1995b; Bailey 2003). Using standardised reading charts such as those in the Minnesota Low-Vision Reading test (MNREAD), a plot of reading speed against font size (adjusted for reading distance and expressed in logMAR) can be obtained (Legge 2007). Typically, reading speed also slows above a certain magnification due to the restricted field of view and a lack of a proportional increase in the size of saccades (fast movements of the eyes) (Dickinson 2000).

The use of different font sizes in various studies is a methodological problem for meta-analysis. The most recent update of the Cochrane review on reading aids for adults with low vision included only studies assessing reading speed "when reading ordinary print size", i.e. 10 to 14 points (Virgili 2013). However, there is no universal agreement on ordinary print size for children. Books for young readers frequently use a large font size, i.e. 14 points or larger. School textbooks frequently reduce font size as their target audience matures, but there are no standards, and no recommendations as to when 'standard adult font size' (usually 9 to 14 points) should be used.

The type of reading material also influences reading speed. Research studies often use standardised reading charts such as the MNREAD and, more recently, the International Reading Speed Texts (IReST). Repeated, standardised assessment of reading performance requires a collection of texts of similar difficulty. Whilst the MNREAD chart contains single short sentences, IReST consists of 10 paragraphs of text (around 130 words each) and offers the advantage of a longer paragraph, which facilitates more accurate measurement of reading speed and judgement of fluency and mistakes (Trauzettel-Klosinski 2012). IReST has been evaluated in a cohort of normal sighted young adults and in patients with age-related macular degeneration, but has not been validated in children and young people.

In addition to reading performance, **literacy** outcomes, such as reading accuracy and comprehension, can give additional functional information. A measure of reading ability used in children with vision impairment is the Neale Analysis of Reading Ability (NARA), currently available in its second edition (NARA II) (Neale 1997). This is a comprehensive assessment of reading ability aimed for use with pupils aged 6 to 12 years, and is also recommended for use beyond the age of 12 years in children with sensory impairment. The test material consists of six paragraphs that increase in length from 26 to 140 words, and increase in difficulty. The test is designed to assess oral reading ability in terms of reading rate, accuracy and comprehension. Validation data are available for normally sighted individuals, and also for children and young people with visual impairment (Douglas 2002; Hill 2005). There are two parallel versions of the test, which permits the same child to be re-tested without remembering a previous test and thereby altering the score. The child's scores are converted into reading ages for accuracy, comprehension and speed. Accuracy is determined by noting reading errors such as mispronunciations, substitutions, refusals, additions, omissions and reversals. Comprehension is measured by asking the child a number of set questions concerning the passage he or she has just read. Reading speed is measured by timing the passages read

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and converting this into words per minute over the total number of passages read. Results can be plotted as graphs comparing the performance of VI students with normal-sighted age-matched peers (Douglas 2002; Hill 2005).

All literacy evaluations need to take into account that children are learning to read, i.e. are developing a skill. Children with low vision often read print more slowly and less accurately than normal, sighted peers (Douglas 2004; Gompel 2004). Comprehension may also be delayed; this may be linked to general delay in reading development (Douglas 2002). Other literacy tests used in educational settings, such as the National Foundation for Educational Research (NFER) and Access Reading Test (ART), include access features for children with low vision (enlarged print, braille, extended time), but no data from children with low vision are available.

Usage of ATs is a further important primary outcome measure. ATs are more costly than optical and non-optical aids. Peer pressure and the fear of 'standing out' may lead to optical aids being used infrequently or abandoned (Mason 1999). However, as the use of technology is mainstream, the acceptance of technological solutions even with adaptive technologies may be higher than with conventional optical aids. Electronic ATs are regularly provided to children of school age by the Educational Authority to tackle specific functional tasks within the classroom environment. The use of these ATs is limited by the acceptance of these devices by the child, in addition to other practical implementation factors such as the training and support of teachers and support staff and the day to day issues of moving equipment to different locations and equipment maintenance.

Lastly, with a view to costs of purchase and maintenance, the useful lifespan of a device is a relevant point. The lifespan of AT may be longer or shorter than that of conventional optical aids; due to their different capabilities, including magnification functions, one device may also be useful to the same user for longer despite potential worsening or improvement in visual function.

Primary outcomes

- Maximum reading speed in words per minute using MNREAD, IReST, NARA or NARA I.

Secondary outcomes

The following outcomes will have been assessed using a standardised chart such as MNREAD or IReST, or a standardised literacy test such as NARA.

- Reading accuracy as errors per words read.
- Reading comprehension as number of correctly answered set questions concerning the text read.
- Reading acuity in logMAR, defined as the smallest print/font that the child/young person can read without making significant errors.
- Critical print/font size, defined as the smallest print/font that the child/young person can read with maximum speed.
- Fatigue-free reading duration in minutes.

The following outcomes have been measured with a different means of assessment (i.e. not standardised chart or literacy test).

- Acceptance of the LVA, as reflected in usage (days per week, hours per day, at home and at school).
- Independent learning, i.e. ability to access the curriculum independently, as assessed by questionnaires.
- VRQoL, evaluated using any validated VRQoL scale for children.
- HRQoL evaluated using any validated HRQoL scale for children.
- Useful lifespan of device.

With regard to the time points of evaluation, general child development and, particularly, the development of reading and literacy skills will affect the effect size of interventions at given time points. One would expect an increase in reading speed with time as a younger child learns to read, regardless of LVA use, but using an aid may allow faster development of reading skills. On the other hand, a child's ability may have improved to a degree over that period of time, just as his/her general development has progressed.

For this review, we intended to consider the following time points:

- Primary outcome: 3 and 12 months (+/- 3 months) after the intervention and relevant instructions, if any, have been issued, where three months is a proof of concept.
- Secondary outcomes: 12 months (+/- 3 months). Useful lifespan of device may exceed the second time point; we will note data if available.

Ultimate outcomes such as educational attainment, as measured in educational progress, would be desirable, but due to the length of follow-up required, these are unlikely to be captured in research studies.

Adverse outcomes

No adverse outcome is expected, and any adverse effects on visual function would be detected by primary and secondary outcome measures. We planned to summarise narratively any unexpected adverse outcome reported by study authors.

Economic data

No systematic review of economic data has been conducted in this review, but we intended to report on the unit cost of devices as well as on costs of healthcare personnel involved and overall health service cost for each programme when available in included studies.

Search methods for identification of studies

Electronic searches

We searched CENTRAL (which contains the Cochrane Eyes and Vision Group Trials Register) (2014, Issue 9), Ovid MEDLINE, Ovid MEDLINE In-Process and Other Non-Indexed Citations, Ovid MEDLINE Daily, Ovid OLDMEDLINE (January 1946 to October 2014), EMBASE (January 1980 to October 2014), the Health Technology Assessment Programme (HTA) (www.hta.ac.uk/), the *meta*Register of Controlled Trials (*m*RCT) (www.controlled-trials.com), ClinicalTrials.gov (www.clinicaltrials.gov) and the World Health Organization (WHO) International Clinical Trials Registry Platform (ICTRP) (www.who.int/ictrp/search/en). We did not use any date or language restrictions in the electronic searches for trials. We last searched the electronic databases on 30 October 2014.

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See Appendices for details of search strategies for CENTRAL (Appendix 1), MEDLINE (Appendix 2), EMBASE (Appendix 3), HTA (Appendix 4), *m*RCT (Appendix 5), ClinicalTrials.gov (Appendix 6) and the ICTRP (Appendix 7).

Searching other resources

We also planned to manually search the references listed in retrieved articles. We contacted manufacturers of LVAs/AT to request any information of which they are aware about studies or research regarding their products.

Data collection and analysis

Selection of studies

Independently, two review authors reviewed titles and abstracts for eligibility. They divided studies into categories to 'definitely include', 'definitely exclude' and 'possibly include', and made final judgements about inclusion/exclusion by obtaining full-text copies of the studies in the 'possibly include' category. Abstracts and, where necessary, full text articles would have been translated into English, if necessary, before a final decision was made regarding inclusion/exclusion. Disagreements between the two review authors were resolved by discussion or a designated third author, or both.

Data extraction and management

Independently, two authors planned to extract data using a data extraction form (see Table 1) developed in conjunction with the Cochrane Eyes and Vision Group, using Chapter 16 of the *Cochrane Handbook for Systematic Reviews of Interventions* for guidance (Higgins 2011a). Data were to be entered into RevMan (RevMan 2014) software by one author and independently reviewed and cross-checked by a second author.

Assessment of risk of bias in included studies

Two authors were to work independently to review the risk of bias of included studies using The Cochrane Collaboration's 'Risk of bias' assessment tool, detailed in Chapter 8 of the *Cochrane Handbook for Systematic Reviews of Interventions* as guidance (Higgins 2011b). The five main domains of the tool include:

Selection bias (systematic differences between baseline characteristics of the groups that are compared)

Studies were to be graded by the review authors as 'high risk', 'low risk' or 'unclear risk' based on the method of randomisation (sequence generation) and allocation concealment. If an 'unclear risk' assessment was made, study authors were to be contacted to provide further information to enable a more detailed risk assessment.

Performance bias (systematic differences between groups in the care that is provided, or in exposure to factors other than the interventions of interest)

Masking of participants would not be possible given the nature of the intervention in question. We therefore planned not to grade studies on the basis of masking alone. A judgement regarding performance bias was to be made by the review authors, taking into consideration the instruction and education given to participants for each visual aid and the 'learning-effect' time allocated before the final assessment.

Attrition bias (systematic differences between groups in withdrawals from a study)

Incomplete outcome data were to be recorded and attempts were going to be made to contact the study authors in order to obtain complete data. A judgement of 'high risk', 'low risk' or 'unclear risk' of attrition bias was to be made by the review authors with regard to the completeness of the data and the handling of incomplete data in the studies.

Detection bias (systematic differences between groups in how outcomes are determined)

Masking of study investigators and personnel would not be possible due to the nature of the intervention in question. Detection bias would occur if the allocated intervention, i.e. use of the optical aid, was visible to the outcome assessor. One way of reducing this risk would be to record reading on audiotape, or as an audiofile, and later to have masked evaluation by a masked observer. We planned to judge studies on use of masking strategies. Detection bias may, in turn, affect reporting, if assessors chose to exclude some participants or type of devices based on performance, thereby introducing reporting bias.

Reporting bias (systematic differences between reported and unreported findings)

Where a study protocol is available, the review authors planned to compare the published protocol with the final outcomes reported to assess the risk of selective outcome reporting as 'high risk', 'low risk' or 'unclear risk'. Where no protocol was available, the full text article was to be studied to make this judgement.

Other bias

The review authors planned to judge whether each study design was subject to any other risks for the introduction of bias that are not detailed above. In particular, we expected studies with within-person design to be commonly used in assessing the benefit of LVA, as a previous Cochrane Review found this to be the case in studies investigating the use of LVAs in adults (Virgili 2013). A particular problem with this design in paediatric studies is that by the time participants start using a second intervention they may have matured and acquired more skills, which may influence the effect size of the second intervention. Chapter 16 of the *Cochrane Handbook for Systematic Reviews of Interventions* recommends that when cross-over studies are evaluated, review authors should take into account whether the condition is chronic and stable, whether the intervention provides temporary relief and not permanent change, whether the outcome can be repeated in the second period if it occurs in the first, whether the effect of the first intervention lasts into the second treatment period, and whether the trial length is sufficient to allow appropriate use of the intervention (Higgins 2011a).

Within-person studies can provide randomisation by including independent sequence generation and allocation concealment. We planned to grade both sequence generation and allocation concealment as factors carrying a 'low risk' of bias in these studies (Virgili 2013). We planned to ask two questions to rate the quality of randomisation and allocation in this type of study: 1. Does knowledge of the first LVA selected affect recruitment into the trial, and 2. Does the order in which the LVAs are used affect the results?

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For within-person studies testing several devices within the same research session, knowledge of the first LVA should not affect recruitment. In such situations we planned to consider two additional items for question 2: 1) period effect, that is, whether the condition might change during subsequent phases of testing of each device; and 2) carry-over effect and period-by-treatment interaction, that is, whether the effect on performance of using a specific device affects the performance of the devices assessed afterwards (Virgili 2013).

We did not plan to mask review authors to any aspect of the study design, and any disagreement was to be settled by discussion or a third designated author, or both.

Measures of treatment effect

We planned to summarise results in a 'Summary of findings' table using seven relative and absolute measures of effect.

The primary outcome (reading speed) is a continuous variable, as are reading accuracy, comprehension, acuity, print/font size, duration and acceptance/usage. Validated VRQoL and HRQoL tools also deliver continuous scores.

When continuous data were available, we planned to extract data on the mean and standard deviation (SD) in each group, i.e. for intervention and comparator. If data appeared skewed, we intended to comment on whether means were an appropriate summary measure. RevMan would calculate the mean difference and 95% confidence intervals (CI). When dealing with cross-over studies we intended to use the generic inverse variance method (Higgins 2011b).

Non-continuous variables were not to be included in the meta-analysis. These may include data assessed by non-validated questionnaires, such as 'independent learning', and data such as 'cost-effectiveness' and 'adverse outcomes'. Relevant data were to be collated and reported in tables.

Unit of analysis issues

Individual patients/children, rather than individual eyes, were to be used as the unit of randomisation, as the use of electronic LVAs and ATs is always binocular.

Although near and distance visual acuity is commonly measured for individual eyes in a clinical setting, reading speeds and educational assessments are routinely obtained with both eyes open. This allows a more functional assessment, based on the better seeing eye and excluding artefacts such as, for example, an increase in nystagmus amplitude by covering one eye. Studies that measure outcome in the better eye were to be included.

As the main outcome is measured at the person level, we did not expect any unit of analysis issues.

Dealing with missing data

Study authors were to be contacted to obtain missing data where necessary. Where not available, or forthcoming, the details of the missing data and the handling of this in the outcome reporting was to be looked at and reported in detail.

Assessment of heterogeneity

We planned to examine the characteristics of the included studies to identify clinical, methodological and statistical heterogeneity. Methodological heterogeneity may arise from differences in interventions, masking, allocation concealment, outcomes and their measurement.

If a sufficient number of studies had been identified, we would have used the I^2 statistic with CIs along with inspection of forest plots (poor overlap of CIs) to assess heterogeneity, as detailed in Chapter 9 of the *Cochrane Handbook for Systematic Reviews of Interventions* (Deeks 2011). The interpretation of this statistic would have been in line with the guidance in the *Handbook*, where an I^2 value of over 50% is considered to represent 'substantial' (50% to 90%), or 'considerable' (75% to 100%) heterogeneity.

Assessment of reporting biases

Assessment of selective outcome reporting bias was to be carried out as detailed in the Assessment of risk of bias in included studies section above. If 10 or more studies had been included in analysis, we planned to construct a funnel plot and examine it for asymmetry in order to assess small study effects, including publication bias.

Data synthesis

Meta-analysis was to be carried out if more than one RCT was identified and there was sufficient homogeneity in study design to yield a meaningful analysis. It would have been conducted according to Chapter 9 of the *Cochrane Handbook for Systematic Reviews of Interventions* (Deeks 2011).

Since a within-subject design is common in research on the effectiveness of LVAs (Virgili 2013), these studies were to be included if the devices were presented in randomised or quasi-randomised order. This study design leads to specific issues, such as within-subject correlation and multiplicity of testing. We planned to deal with these issues using methods suggested in Elbourne 2002 and in Chapter 16 of the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011a).

Subgroup analysis and investigation of heterogeneity

We did not plan any subgroup analysis.

Sensitivity analysis

Sensitivity analysis was to be conducted to establish the effect of assumptions made when dealing with missing data, excluding studies at 'high risk' of bias (Higgins 2011b). If the inclusion of some studies was uncertain because of high-risk characteristics such as lack of allocation concealment or incompleteness of data or other factors emerging during review of studies, we planned to carry out the meta-analysis twice, once including all studies, and a second time only including only those that definitely met all inclusion criteria.

Summary of findings

We planned to prepare a 'Summary of findings' table (Higgins 2011a), using the following outcomes:

- Maximum reading speed at three months
- Maximum reading speed at 12 months
- Reading accuracy at 12 months

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- Reading acuity in logMAR at 12 months
- Fatigue-free reading duration at 12 months
- VRQoL/HRQoL at 12 months
- Acceptance (usage) at 12 months

We did not plan to distinguish between low/medium/high-risk populations. We intended to use the GRADE approach (see below) to assess the quality of the evidence (GRADE Working Group).

GRADE Working Group grades of evidence:

- High quality: Further research is very unlikely to change our confidence in the estimate of effect.
- Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
- Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
- Very low quality: We are very uncertain about the estimate.

RESULTS

Description of studies

Results of the search

The electronic searches yielded a total of 976 references (Figure 1). The Trials Search Co-ordinator removed 148 duplicate records, screened 828 records and removed 601 references that were not relevant to the scope of the review. We screened the remaining 227 references and discarded 224 reports as not relevant. We reviewed three full-text reports and excluded the studies, see Characteristics of excluded studies for details. Contacting device manufacturers did not yield any ongoing or recent studies.

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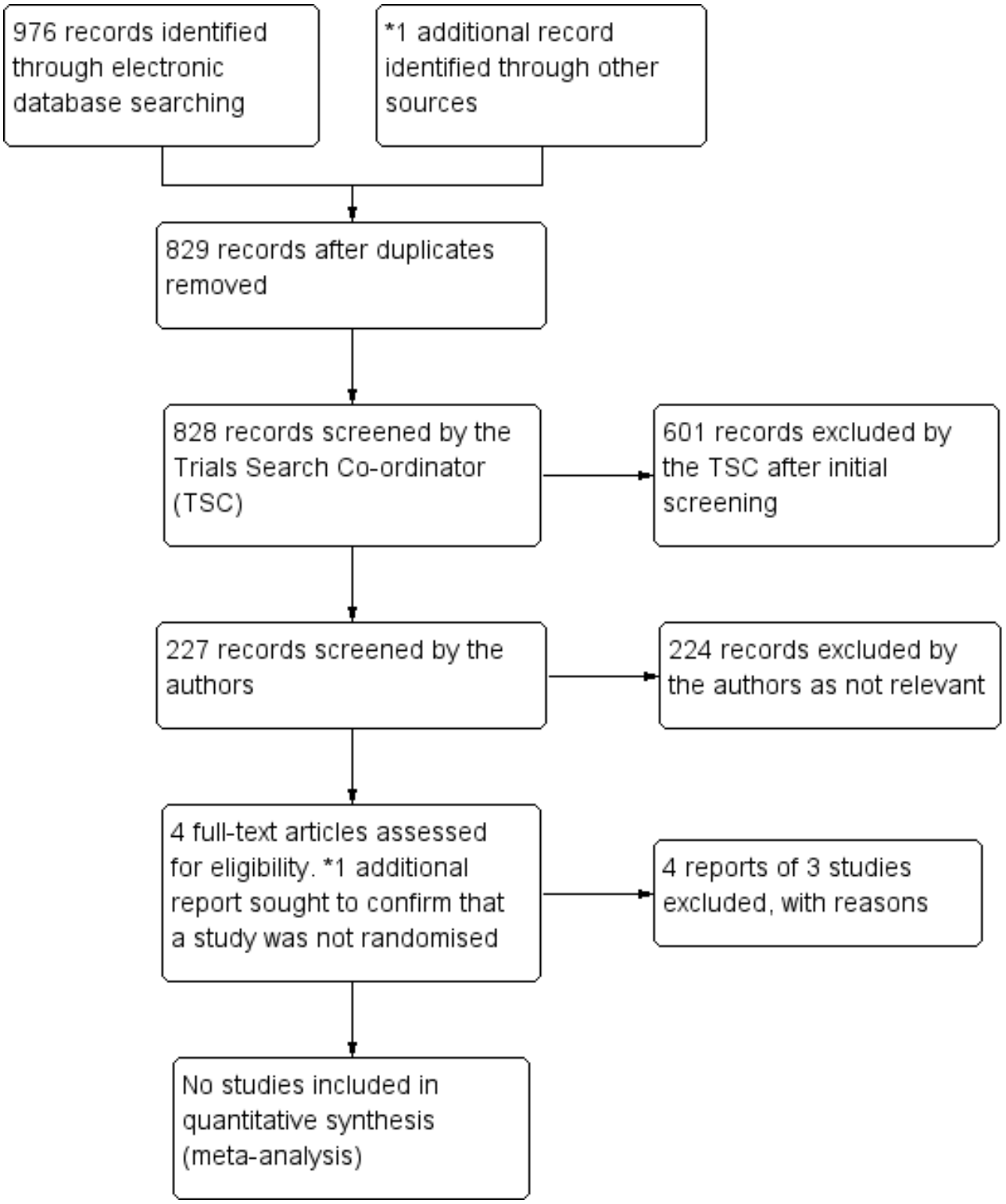
Figure 1. Results for searching for studies for inclusion in the review



Included studies

No studies met the inclusion criteria.

Excluded studies

Of the three studies that potentially met our inclusion criteria, one required clarification of participant age (Peterson 2003). We contacted the authors and were informed that this study included adults only. One project published as a conference proceeding

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compared a portable CCTV (p-CCTV) system with a stand magnifier, and the study population included children (Usomoto 2002). However, this study did not randomise participants, devices were not randomised and the study design was a before/after within-person comparison. Outcomes were reading performance on Continuous Text Card and MNREAD charts. The study found that distance visual acuity in participants younger than 20 years improved from 0.990 logMAR to 0.42 logMAR by p-CCTV use, and that near acuity improved by 0.4 logMAR across paediatric and adult participants. 65.5% of participants under the age of 20 years expressed an interest in using p-CCTV as a low vision aid (Usomoto 2002).

The third potential study for inclusion, Project Magnify (NCT00366392), compared two strategies to improve reading ability. However, there did not appear to be a randomisation of participants. We searched the published literature for reports about this project and identified one report (Farmer 2007). Review of the full-text paper confirmed the absence of randomisation and also revealed that this project did not relate to electronic aids, but compared magnifiers with enlarged print reading materials for students with low vision.

Risk of bias in included studies

No studies were included in the review.

Effects of interventions

No studies were included in the review.

DISCUSSION

Summary of main results

We did not identify randomised controlled trials in the subject area of assistive technologies (AT) for children and young people with low vision. The only study that recruited children and compared optical aids with an assistive technology, portable CCTV, used a within-person design with no randomisation and has been published as conference proceeding only (Usomoto 2002). This is surprising, given that AT is important to children and young people with vision impairment and their parents: the topic of glasses and adaptive equipment was the most common topic brought up by children when interviewed about the impact of vision impairment on their daily life (Decarlo 2012). High-quality evidence about AT for this group is lacking.

AUTHORS' CONCLUSIONS

Implications for practice

At present, there is no evidence from controlled clinical trials to guide choice of assistive technologies (ATs) in clinical and educational practice.

Implications for research

High-quality evidence about the usefulness of AT for children and young people with visual impairment is needed to inform the choice healthcare and education providers and family have to make when selecting a technology. There may be perceived barriers to carrying out randomised controlled trials with children, such as uncertainties about families' willingness to take part, and difficulties with assessments standardised across age groups and levels of vision impairment. However, if researchers are willing to undertake a randomised controlled trial and develop a protocol that children and families agree with, recruitment of children and young people is usually not difficult. Such protocols should carefully select outcomes relevant not only to the scientific community, but more importantly to families and teachers. Many new technologies allow visually impaired individuals an unprecedented level of independent access to information, and this aspect of the usefulness of AT should be explored in future research. Visual acuity for distance and near is not sufficient to measure the impact of AT on a child's and young person's life. Functional outcomes such as reading accuracy, comprehension and speed should be recorded, as well as the impact of AT on independent learning and quality of life.

Future updates of this review will summarise results related to the seven outcomes detailed in the section Measures of treatment effect.

ACKNOWLEDGEMENTS

The Cochrane Eyes and Vision Group created and executed the electronic search strategies. We thank Catey Bunce, Gianfrancesco Villani and Elizabeth Clearfield for their comments on the protocol and/or full review, and Gianni Virgili, Jennifer Evans and Anupa Shah for their assistance in the editorial process.

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* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
NCT00366392	Not a RCT; compared magnifiers with enlarged print reading materials for students with low vision
Peterson 2003	Study included adults only
Usomoto 2002	Study design was a before/after within-person comparison

RCT: randomised controlled trial

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ADDITIONAL TABLES

Table 1. Data extraction form

Review author							
Study ID							
Dates when study was conducted		If not available, comment "dates not available"					
Funding source(s)			Declarations of interest by researchers			Methods	
Study design	· Parallel group RCT · Paired eye or intra-individual RCT · Cluster RCT · Cross-over RCT · Other, specify						
Eyes	· One eye included in study · Two eyes included in study, both eyes received same treatment · Two eyes included in	Participants					

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Table 1. Data extraction form

	study, eyes received different treatments							
Country			Setting			Number of participants		
		Number of men			Number of women			
	Average age			Age range				
Ethnic group			Inclusion criteria			Exclusion criteria		
	Interventions	Intervention Comparator	Intervention 1 = Standard care (baseline refractive correction), or LVA (specify type) Intervention 2 = LVA (specify type) additional interventions: LVA - specify type					
Outcomes (as defined in study) **Please specify which**		**Primary outcome** • Maximum reading speed in words per minute using MNREAD, IReST, NARA or NARA II **Secondary outcomes**						

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Table 1. Data extraction form

		• Reading accuracy as errors per words read • Reading comprehension as number of correctly answered set questions concerning the text read • Reading acuity in logMAR, defined as the smallest print/font size that the child/young person can read without making significant errors • Critical print/font size, defined as the smallest print/font that

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Table 1. Data extraction form

			the child/young person can read with maximum speed • Fatigue-free reading duration in minutes, All assessed using a standardised chart such as MNREAD or IReST or a standardised literacy test such as NARA. • Acceptance of the LVA, as reflected in usage (days per week, hours per day, at home and at school) • Independent learning, i.e. ability to indepen-		

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Table 1. Data extraction form

		dently access the curriculum, as assessed by questionnaires • VRQoL, evaluated using any validated VRQoL scale for children • HRQoL evaluated using any validated HRQoL scale for children • Cost-effectiveness • Adverse outcomes, for example loss of motivation to use the device		
Interventions compared		Intervention 1 = Standard care (baseline refractive correction), or		

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Table 1. Data extraction form

		LVA (specify type) Intervention 2 = LVA (specify type) Additional interventions: LVA - specify type					
PRIMARY OUTCOME: Maximum reading speed		Intervention 1	Intervention 2				
Time point		Total number of participants	Mean	Standard deviation*	Total number of participants	Mean	Standard deviation*
3 months							
12 months							
		Intervention 3	Intervention 4				
Time point		Total number of participants	Mean	Standard deviation*	Total number of participants	Mean	Standard deviation*
3 months							
12 months							
		SECONDARY OUTCOMES: Copy table for each		Intervention 1			

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Table 1. Data extraction form

		secondary outcome					
Intervention 2	Time point		Total number of participants	Mean	Standard deviation*		
Total number of participants	Mean	Standard deviation*	3 months				
			12 months				
					Intervention 3		
Intervention 4	Time point		Total number of participants	Mean	Standard deviation*		
Total number of participants	Mean	Standard deviation*	3 months				
			12 months				
			Notes	Date conducted	Specify dates of recruitment of participants mm/yr to mm/yr		
	Sources of funding			Declaration of interest			

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Table 1. Data extraction form

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APPENDICES

Appendix 1. CENTRAL search strategy

#1 MeSH descriptor: [Vision, Low] this term only
#2 MeSH descriptor: [Visually Impaired Persons] this term only
#3 MeSH descriptor: [Blindness] this term only
#4 (low* or handicap* or subnormal* or impair* or partial* or disab*) near/3 (vision or visual* or sight*)
#5 (hemianop* or quadrantanop* or amauros*)
#6 #1 or #2 or #3 or #4 or #5
#7 MeSH descriptor: [User-Computer Interface] this term only
#8 MeSH descriptor: [Computer Graphics] explode all trees
#9 MeSH descriptor: [Image Enhancement] explode all trees
#10 MeSH descriptor: [Programming Languages] this term only
#11 MeSH descriptor: [Software] this term only
#12 MeSH descriptor: [Software Design] this term only
#13 MeSH descriptor: [Semantics] this term only
#14 MeSH descriptor: [Data Display] this term only
#15 MeSH descriptor: [Hypermedia] this term only
#16 MeSH descriptor: [Image Processing, Computer-Assisted] this term only
#17 MeSH descriptor: [Signal Processing, Computer-Assisted] this term only
#18 MeSH descriptor: [Microcomputers] this term only
#19 MeSH descriptor: [Computer Terminals] this term only
#20 MeSH descriptor: [Sensory Aids] this term only
#21 MeSH descriptor: [Communication Aids for Disabled] this term only
#22 MeSH descriptor: [Audiovisual Aids] this term only
#23 MeSH descriptor: [Self-Help Devices] this term only
#24 MeSH descriptor: [Equipment Design] this term only
#25 assistive near/2 (technolog* or product*)
#26 electronic vision enhancement
#27 EVES
#28 screen near/2 (reader* or magnif*)
#29 software near/2 (reader* or magnif*)
#30 image near/2 (enhance* or camera* or monitor*)
#31 view* near/2 (enhance* or camera* or monitor*)
#32 optical character recognition
#33 haptic icon*
#34 closed-circuit television or CCTV
#35 #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22 or #23 or #24 or #25 or #26 or #27 or #28 or #29 or #30 or #31 or #32 or #33 or #34
#36 #6 and #35

Appendix 2. MEDLINE (OvidSP) search strategy

1. randomized controlled trial.pt.
2. (randomized or randomised).ab,ti.
3. placebo.ab,ti.
4. dt.fs.
5. randomly.ab,ti.
6. trial.ab,ti.
7. groups.ab,ti.
8. or/1-7
9. exp animals/
10. exp humans/
11. 9 not (9 and 10)
12. 8 not 11
13. vision low/
14. visually impaired persons/
15. blindness/
16. ((low$ or handicap$ or subnormal$ or impair$ or partial$ or disab$) adj3 (vision or visual$ or sight$)).tw.
17. (hemianop$ or quadrantanop$ or amauros$).tw.
18. or/13-17

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19. user-computer interface/
20. exp Computer Graphics/
21. Image Enhancement/
22. Programming Languages/
23. Software/
24. Software Design/
25. Semantics/
26. Data Display/
27. Hypermedia/
28. Image Processing, Computer-Assisted/
29. Signal Processing, Computer-Assisted/
30. Microcomputers/
31. Computer Terminals/
32. Sensory Aids/
33. Communication Aids for Disabled/
34. Audiovisual Aids/
35. Self-Help Devices/
36. Equipment Design/
37. (assistive adj2 (technolog$ or product$)).tw.
38. electronic vision enhancement.tw.
39. EVES.tw.
40. (screen adj2 (reader$ or magnif$)).tw.
41. (software adj2 (reader$ or magnif$)).tw.
42. (image adj2 (enhance$ or camera$ or monitor$)).tw.
43. (view$ adj2 (enhance$ or camera$ or monitor$)).tw.
44. optical character recognition.tw.
45. haptic icon$.tw.
46. (closed-circuit television or CCTV).tw.
47. or/19-46
48. 18 and 47
49. 12 and 48

The search filter for trials at the beginning of the MEDLINE strategy is from the published paper by Glanville et al (Glanville 2006).

Appendix 3. EMBASE (OvidSP) search strategy

1. exp randomized controlled trial/
2. exp randomization/
3. exp double blind procedure/
4. exp single blind procedure/
5. random$.tw.
6. or/1-5
7. (animal or animal experiment).sh.
8. human.sh.
9. 7 and 8
10. 7 not 9
11. 6 not 10
12. exp clinical trial/
13. (clin$ adj3 trial$).tw.
14. ((singl$ or doubl$ or trebl$ or tripl$) adj3 (blind$ or mask$)).tw.
15. exp placebo/
16. placebo$.tw.
17. random$.tw.
18. exp experimental design/
19. exp crossover procedure/
20. exp control group/
21. exp latin square design/
22. or/12-21
23. 22 not 10
24. 23 not 11
25. exp comparative study/
26. exp evaluation/

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27. exp prospective study/
28. (control$ or prospectiv$ or volunteer$).tw.
29. or/25-28
30. 29 not 10
31. 30 not (11 or 23)
32. 11 or 24 or 31
33. low vision/
34. blindness/
35. visual impairment/
36. ((low$ or handicap$ or subnormal$ or impair$ or partial$ or disab$) adj3 (vision or visual$ or sight$)).tw.
37. (hemianop$ or quadrantanop$ or amauros$).tw.
38. or/33-37
39. computer interface/
40. computer graphics/
41. image enhancement/
42. computer language/
43. semantics/
44. information processing/
45. hypermedia/
46. image processing/
47. signal processing/
48. microcomputer/
49. computer terminal/
50. sensory aid/
51. communication aid/
52. audiovisual aid/
53. self help/
54. equipment design/
55. (assistive adj2 (technolog$ or product$)).tw.
56. electronic vision enhancement.tw.
57. EVES.tw.
58. (screen adj2 (reader$ or magnif$)).tw.
59. (software adj2 (reader$ or magnif$)).tw.
60. (image adj2 (enhance$ or camera$ or monitor$)).tw.
61. (view$ adj2 (enhance$ or camera$ or monitor$)).tw.
62. optical character recognition.tw.
63. haptic icon$.tw.
64. (closed-circuit television or CCTV).tw.
65. or/39-64
66. 38 and 65
67. 32 and 66

Appendix 4. Health Technology Assessment Programme (HTA) search strategy

low vision

Appendix 5. *meta*Register of Controlled Trials search strategy

Visual Impairment OR Low Vision

Appendix 6. ClinicalTrials.gov search strategy

(Visual Impairment OR Low Vision) AND (Technology OR Computer OR Software OR Electronic OR Device OR Camera)

Appendix 7. ICTRP search strategy

Visual Impairment OR Low Vision = Condition AND Technology OR Computer OR Software OR Electronic OR Device OR Camera = Intervention

CONTRIBUTIONS OF AUTHORS

Rachel Thomas - Design and co-ordination of review and writing the protocol. Review of studies identified in the search and draft of full review.
Lucy Barker - Design of review and writing the protocol. Critical review of final text.

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Gary Rubin - Design of review and writing the protocol. Critical review of final text.
Annegret Dahlmann-Noor - Guarantor of review. Design of review and writing the protocol. Review of studies identified in the search and finalisation of full review.

DECLARATIONS OF INTEREST

Rachel Thomas has no commercial or proprietary interests to declare.
Lucy Barker has no commercial or proprietary interests to declare.
Gary Rubin has no commercial or proprietary interests to declare.
Annegret Dahlmann-Noor has no commercial or proprietary interests to declare.

SOURCES OF SUPPORT

Internal sources

- National Institute for Health Research (NIHR) Biomedical Research Centre, UK.

  The research is supported by the NIHR Biomedical Research Centre based at Moorfields Eye Hospital NHS Foundation Trust and University College London (UCL) Institute of Ophthalmology. The views expressed are those of the author(s) and not necessarily those of the NHS, the NIHR or the Department of Health.

External sources

- National Institute for Health Research (NIHR), UK.
  - Richard Wormald, Co-ordinating Editor for the Cochrane Eyes and Vision Group (CEVG) acknowledges financial support for his CEVG research sessions from the Department of Health through the award made by the National Institute for Health Research to Moorfields Eye Hospital NHS Foundation Trust and UCL Institute of Ophthalmology for a Specialist Biomedical Research Centre for Ophthalmology.
  - The NIHR also funds the CEVG Editorial Base in London.

  The views expressed in this publication are those of the authors and not necessarily those of the NIHR, NHS, or the Department of Health.

DIFFERENCES BETWEEN PROTOCOL AND REVIEW

We have added the updated definition of low vision as stated by the WHO ICD-10 to the Background section.
Non-randomised studies are listed under Characteristics of excluded studies and not discussed in detail in the discussion section of the review.

INDEX TERMS

Medical Subject Headings (MeSH)

*Self-Help Devices; Vision, Low [*rehabilitation]

MeSH check words

Adolescent; Child; Child, Preschool; Humans

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