Measuring participation in children and young adults with visual impairment: the development of instruments

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Chapter 5

Interventions to improve functioning, participation, and quality of life in children with visual impairment: a systematic review

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Abstract

Visual impairment in childhood often has lifelong implications. In order to aim for the highest levels of functioning, participation and quality of life and to ensure children's wellbeing, children should be entitled to the most effective rehabilitation programmes. We review evidence for the effectiveness of rehabilitation interventions for children with visual impairment to improve skills and behaviour, thereby improving participation and quality of life as an ultimate goal. Of the 441 potentially relevant articles identified, 66 studies met our inclusion criteria (i.e. 28 randomised controlled trials [RCTs], 18 non-RCTs, and 20 before-after comparisons [BAs]). The results suggest that sports camps, prescription and training in the use of low vision devices and oral hygiene programmes might be effective in improving functioning and elements of participation and quality of life in children with visual impairment. Other interventions showed mixed or negative results. The results should be interpreted with caution because of moderate to high risk of bias and suboptimal reporting. Heterogeneity of results and the use of over 50 different outcome measures prevented a meta-analysis. Future studies should focus on promising interventions for which effectiveness is still unclear (e.g. mobility, social skills), with adequately designed methodology.

Introduction

In 2015, 252.6 million people worldwide were visually impaired, of whom 36 million people were classified as blind.[1] An estimated 19 million children below the age of 15 years were visually impaired (1% of the total population in this age group), of whom 1.4 million had irreversible blindness (0.08% of the total population in this age group).[2] Understandably, these children and their parents experience major challenges regarding overall development, participation in society and self-reliance.[3-5] Children with visual impairment have their whole lives ahead and, in case of incurable eye or brain diseases, often have no choice but to live with their visual impairment for many years. Therefore, aiming for the highest levels of functioning, participation in society and quality of life ensures these children's wellbeing.

Children with visual impairment require access to early intervention and low vision rehabilitation services, which aim to improve functioning in daily life and social participation, and possibly more general aspects of wellbeing such as quality of life and psychosocial functioning. The introduction of the International Classification of Functioning, Disability and Health for Children and Youth (ICF-CY) by the World Health Organisation (WHO) made the concept of participation for children relevant.[6] Although different definitions of participation exist,[7,8] we used the conceptualisation of participation by the ICF-CY in the current review. The ICF-CY defines participation as 'a person's involvement in life situations'. Furthermore, the WHO combines participation with the construct 'activities', which is defined as 'the execution of a task' and operationalises these constructs using the nine domains of the Activities & Participation component of the ICF-CY, i.e. learning and applying knowledge, general tasks and demands, communication, mobility, self-care, domestic life, interpersonal interactions and relationships, major life areas, and community, social and civic life. Quality of life is also a broad concept, and consists of physical, emotional, and social functioning.[9,10]

At present, a variety of interventions for children and their parents have been developed and implemented in early intervention and low vision rehabilitation services. Currently, in many countries including the Netherlands, facilities for people with disabilities are under pressure because of financial considerations. In view of the increasing choice of interventions available and the increased striving for professionalism in healthcare, there is a strong need for evidence regarding the effectiveness of interventions to achieve positive outcomes. Children with visual impairment are entitled to the most effective rehabilitation programmes, and the importance of assessing the effectiveness of interventions is stressed by the WHO and in the UN Convention on the Rights of Persons with Disabilities.[8,11] Binns et al. performed a systematic review on the effectiveness of low vision rehabilitation services in adults and children, but they only found two studies aimed at children aged 0-18.[12] These studies used a relatively weak before-after comparison (BA) design. One study compared reading ability before and after the prescription of optical magnifiers, but did not control for natural development over time.[13] The second study compared the possession and utilisation of low vision aids before and after low vision service

setup.[14] More recently, Thomas et al. and Barker et al. performed Cochrane systematic reviews on the effectiveness of, respectively, assistive technology and optical reading aids in children and young people with visual impairment.[15,16] Because of the focus on randomised controlled trials (RCTs) in Cochrane reviews, no studies met the inclusion criteria and they concluded that there is a lack of high quality evidence regarding the use of assistive technology and optical reading aids in children and young people with visual impairment.

Because of the limited results yielded by previous systematic reviews, no conclusions can be drawn about the effectiveness of interventions aimed to improve quality of life, participation and functioning in children with visual impairment. In view of the increasing availability of interventions, we believe it is important to conduct a broad up-to-date systematic review, using more liberal inclusion criteria, to provide a complete overview of studies performed in this field. Children, parents and health-care providers require evidence to make informed decisions about the allocation of personal, institutional and public resources. In this study we give an overview of the available evidence for the effectiveness of rehabilitation interventions for children with visual impairment to improve skills and behaviour, thereby improving functioning, participation and quality of life as an ultimate goal. Furthermore, we will critically evaluate available information from studies, resulting in an agenda for future research, implementation and practice policies.

Method of literature search

Search strategy

A review protocol was developed based on the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA)-statement (www.prisma-statement.org). A comprehensive search was performed in the bibliographic databases PubMed, Embase.com, EBSCO/PsycINFO, EBSCO/CINAHL, EBSCO/ERIC and Wiley/Cochrane Library from inception up to 21 February 2018, in collaboration with an experienced medical librarian. The following terms were used (including synonyms and closely related words) as index terms or free-text words: "Visually Impaired Persons", "Vision Disorders", "Children", "Infants", "Newborn", "Rehabilitation". The search was performed without date or language restriction. After deduplication all titles were screened and appropriate abstracts reviewed. The full search strategies for all databases can be found in Appendix 1. Relevant articles were selected using 4 steps: 1) reviewing title, 2) reviewing title and abstract, 3) reading the full text of the articles and 4) quality assessment. All steps were performed by two researchers independently. Discrepancies were resolved by discussion and/or consultation of a third researcher. Reference lists of retrieved articles and identified reviews[12,15-23] were searched by hand to ensure all relevant studies were considered. Additional strategies were used to include relevant 'grey literature', i.e. abstracts from conference proceedings, which never have been published in scientific journals. For that purpose, conference proceedings of the 9th-12th International Conference on Low Vision, ARVO 2010-2017, ESLRR 2013-2015 and ICEVI 2013-2017 were searched by hand. Because of the large number of abstracts for ARVO, the search term 'child' was used in order to identify the most relevant abstracts. In the next phase, we searched for

available full-text articles with no limitations to year of publication. Studies that were not available in full text were requested through the Inter Library Loan service only if they were published after 1990.

Study criteria

The following criteria for inclusion were used: 1) original research in English, German, French or Dutch, 2) longitudinal research design with at least two measurements, 3) included participants have visual impairment according to the WHO criteria[24] and/or the guideline on visual impairments, rehabilitation and referral[25] and are not older than 18 years, having any gender, ethnicity, intellectual capacity or eye condition (if a study only had a few participants who were older than 18 years, but the majority was younger, the study was included), 4) sample size of at least 10 participants in order to be able to pool results in meta-analyses, 5) interventions aimed at improving functioning, quality of life and/or participation. Because quality of life and participation are often indirectly measured,[7,26] the main outcome measure might be a specific part of quality of life and/or participation, operationalised through various constructs (e.g. mobility skills or reading ability). Therefore, both quality of life and participation as well as skills and behaviours, that determine these constructs, were investigated in this study. Studies were excluded if they: 1) obtained results from simulated visual impairment, 2) were only reported as abstracts, 3) involved the assessment of surgical procedures or optometric interventions to correct for example squint, amblyopia and refractive disorders.

Data extraction

The following characteristics of included studies were extracted: 1) country and year of publication; 2) study design, duration of follow-up and setting; 3) participant characteristics at baseline (i.e. sample size, mean age, age range, proportion of females and drop-out rate); 4) the degree of vision impairment and the diagnosis of visual impairment; 5) the aspect of functioning, participation or quality of life measured; 6) description of the intervention for the intervention group; and 7) description of the intervention for the control group (if applicable).

Quality assessment

A distinction was made between RCTs, non-RCTs and BAs. The Cochrane Collaboration Risk of Bias Tool (CCRBT) was used to assess the quality of RCTs.[27] For non-RCTs and BAs, the Risk Of Bias In Non-randomised Studies - of Interventions Tool (ROBINS-I) was used.[28] The CCRBT has seven parameters: 1) random sequence generation (selection bias); 2) allocation concealment (selection bias); 3) blinding of participants and personnel (performance bias); 4) blinding of outcome assessment (detection bias); 5) incomplete outcome data (attrition bias); 6) selective reporting (reporting bias); and 7) other sources of bias, such as those introduced by baseline imbalances.[27] Each parameter was assessed as low risk, high risk or unclear risk. The ROBINS-I also has seven parameters: 1) bias due to confounding; 2) bias in selection of participants into the study; 3) bias in classification of interventions; 4) bias due to deviations from intended interventions; 5) bias due to missing data; 6) bias in measurement of outcomes; and 7) bias in selection of the reported

results.[28] Each parameter was assessed as low risk, moderate risk, serious risk, critical risk or unclear risk. Assessment of study quality was done by two researchers independently. Discrepancies were resolved by discussion and/or consultation of a third researcher.

Evidence synthesis

Originally, we planned to conduct a meta-analysis to synthesise the evidence of included studies. However, this was not possible because the outcome measures differed vastly in the included studies. Therefore, a narrative method was used to synthesise evidence from the included studies. To aid comparison of the outcomes of different studies and investigate whether the results were clinically meaningful, effect sizes were calculated when possible using Cohen's d method: effect size = mean change in outcome divided by the pooled standard deviation at baseline and follow up.[29] The effect size was classified using Cohen's categories: ≤ 0.49 represented a small effect, 0.5-0.79 a medium effect and ≥0.8 a large effect. For each outcome, the mean change from baseline to follow-up and the standard deviation of this mean change was extracted for the intervention group and the control group separately, if applicable. In some cases, the standard deviation was derived from the standard error. To compare differences in change between intervention and control group, differences in change scores between the groups were divided by the standard deviations of change.

Identified studies of interventions to improve functioning, participation and quality of life

Characteristics of included studies

The database searches resulted in the identification of 27,754 articles (Figure 1). After screening of titles and abstracts, 441 articles remained of which 277 could be assessed. The available full text articles were screened on in- and exclusion criteria and assessed for eligibility. Together with articles identified through searches in reference lists of previously retrieved reviews and the grey literature, this resulted in 64 articles, describing 66 different studies (28 RCTs,[30-57] 18 non-RCTs,[58-75] and 20 BAs[13,76-94]). The articles of McMahon and Kederis described two different studies.[39,40,81,82] The 66 included studies were published between 1964 and 2018, and 37 (56.1%) of them were published in the last decade (2008-2018)[31-34,37,42,44,46,47,49-53,55-59,62-65,67,69-75,77-83,86,89,92] (Table 1). The majority of the studies was conducted in the USA,[13,30,35,38-41,43-45,48,54,61,65,66,68,69,81,82,84,86,87,94] one in Canada,[76] eleven in Europe (i.e. UK,[36,88,90] Germany,[60] the Netherlands,[31,52,64,67,71] and Greece[42,74]), 28 in Asian countries (i.e. Iran,[37] Turkey,[47,49,57,58,62,75,77,89,91] India,[34,53,55,63,70,72,73,78-80,85,92] Jordan,[59] Pakistan,[50] Japan,[93] Taiwan,[56] and Thailand[46,51]), and three in African countries (i.e. Nigeria,[32,33] and Egypt[83]). Total follow-up ranged from 2 days[38] to 3 years.[30]

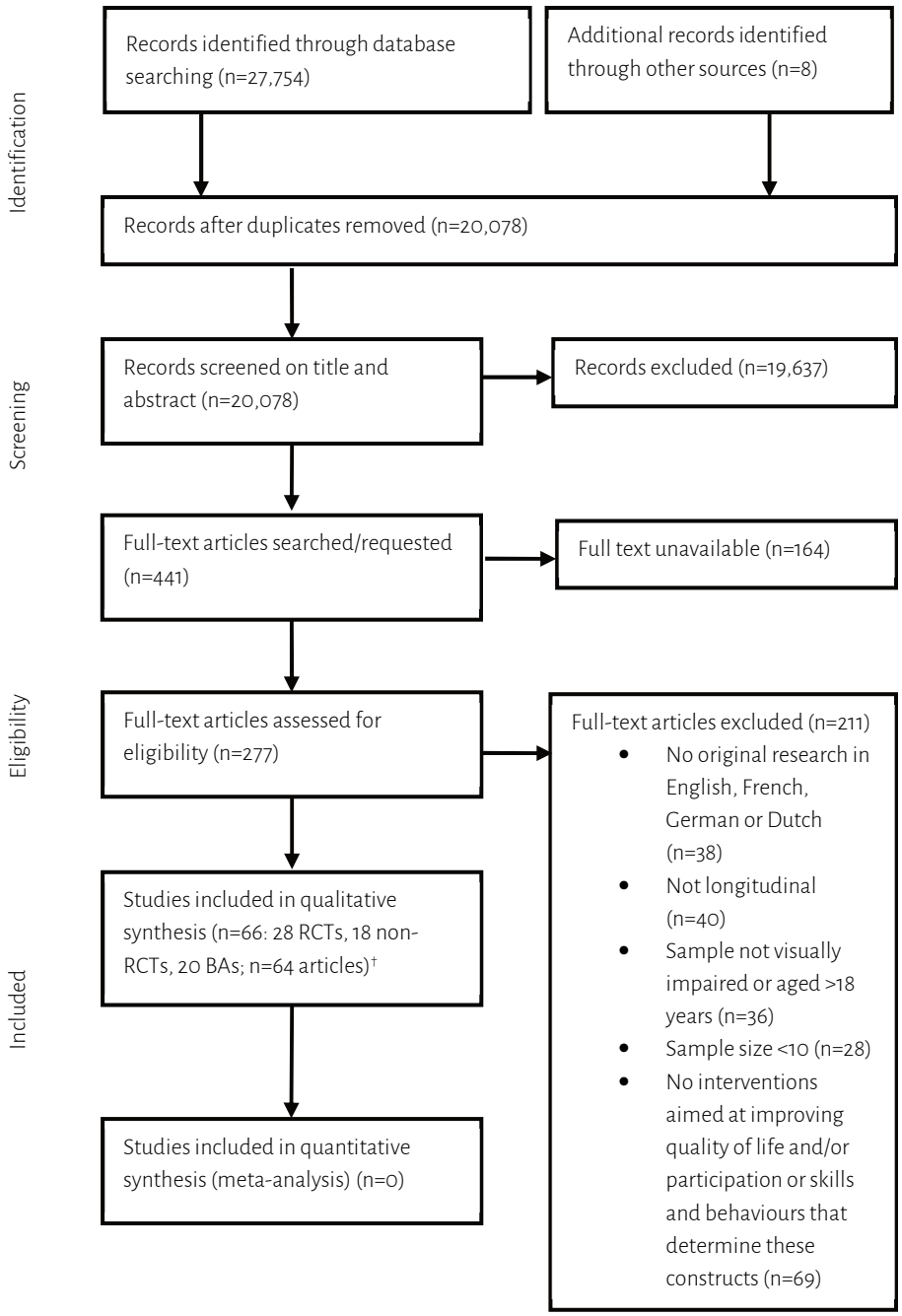


Figure 1. Flow-diagram of study inclusion process

† The articles of McMahon and Kederis described two different studies.[39,40,81,82]

Participants in included studies

Table 1 provides details on the demographic and clinical characteristics of participants included in the different studies. The studies included in total 4327 participants, with sample sizes ranging from 10[93] to 671 participants[70]. Drop-out ranged from 0%[13,31-39,41,43-45,47,49-51,53,56-63,65-69,71,72,74,75,77,78,81-84,86-89,91-94] to 54%.[79] Age of participants ranged from 2 months[30] to 23 years[86] and 0% to 70% were female.[39] Fourteen studies reported a cut-off criterion for visual acuity.[31,35,37,44,55,58,61,64,65,67,70,71,77,92] Slightly more often, studies reported the degree of visual impairment (e.g. severe visual impairment, legal blindness) or fulfilment of certain criteria for low vision (e.g. the criteria for low vision of the WHO or the International Classification of Diseases and Related Health Problems (ICD) criteria).[34,36,38,42,45,47,48,53,57,58,60,63,66,70,72,75,78,85,89] In some cases, authors quantified the number of participants with a certain degree of visual impairment, i.e. how many participants had visual impairment and how many participants were blind.[32,34,50,73,85,88,91,93] Thirteen studies reported the number of participants that fell into a visual acuity range or reported the visual acuity of each individual participant,[13,30,31,44,54,55,62,64,76,79,87,89,94] whereas 18 studies reported the diagnoses or cause of visual impairment of their participants.[13,31,38,43-45,54,55,58,60,64,67,71,78,79,83,85,94] In almost all studies, participants had visual impairment or blindness caused by various eye conditions.[13,30-66,68-82,84-92,94] In one study all participants had infantile nystagmus[67] and in one study they all had glaucoma.[83] As is often the case in studies involving children, there was large variation in the diagnoses or causes of visual impairment, but albinism, nystagmus and retinopathy of prematurity (ROP) were commonly reported. Remarkably, 17 studies reported participants had visual impairment, without providing cut-off criteria for visual acuity or information about the degree of visual impairment, nor providing information about the diagnoses of participants.[33,39-41,46,49,51,52,56,59,68,69,74,81,82,84,86,90]

Interventions and comparisons in included studies

The included studies investigated a broad range of interventions (Table 1). For studies focusing on physical performance, interventions included (group-based) training programmes,[37,42,56-58,70,73-75,93,94] provision of information,[38,86] sports camps,[61,82,84] and training in trail-following tasks.[71] For studies focusing on oral health, interventions included oral health education[34,51,63,72,91,92] and tooth brushing instructions.[46,50,53,80] Group-based programmes[32,33,41,68,69,83] and physical activity programmes[77,81,87] were used as interventions in studies focusing on psychological outcomes. Studies investigating functioning and development had intensive (home-based) early intervention programmes,[30,52,55,60] attention training,[62] creativity training,[59] prescription of low vision devices[78,79] and admission to a care unit[90] as intervention condition. With respect to reading performance, interventions included (braille) reading training,[35,36,39,40] (training in) the use of optical aids,[13,65,89] and crowded training.[67] Studies investigating social skills used social skills training,[45,49] assertiveness training,[54] communication training[43,66] and visual perception training[47] as intervention. Viewing behaviour was investigated by interventions on video games[44] and training in visual aids.[31,64,85] For studies focusing on mobility, interventions included programmed orientation and mobility instruction materials[48] and distance estimation training.[88] As comparisons in RCTs and non-RCTs, studies used a control group who received no intervention or

was put on a waiting list, a control group who received usual care, or a control group who received an alternative or light intervention. For the latter, the authors did not always state which group was the intervention group and which group was the control group (marked with * in Table 1).

Outcome measures of included studies

Table 1 provides an overview of the outcome measures used in the different studies that were found to assess the effectiveness of low vision rehabilitation programmes. The effectiveness was evaluated in various ways, with little consensus on the most suitable approach, which hinders comparisons between studies. Most questionnaires were used in one study only; few studies applied the same instrument, and if they did they often used different versions of the instrument. For instance the movement ABC was used in two studies[42,71] to measure fine motor skills and balance, but the studies used two different versions of the movement ABC, and only the writing task was used in one study. The Bruininks-Oseretsky Motor Proficiency Test – Short form was used in three studies[42,58,74] to measure motor skills and balance, but again studies used two different versions. Two studies had BMI as outcome measure,[56,57] whereas one study reported age and height of the participants.[94] Two studies might have used the same instrument to measure parental stress, but Platje et al. refer to the instrument as Parenting Stress Index (with references)[52] whereas Behl et al. refer to the instrument as Parenting Stress Inventory (without reference)[30] so it is unclear if the same questionnaire was used. Three studies used the Sports Camp Evaluation Instrument,[81,82,84] but no information on validity of this instrument was provided. To measure self-concept, two studies used the Tennessee Self-Concept Scale,[68,69] but two different versions were used as well. This was also the case for two studies who used two different versions of the L.V. Prasad-Functional Vision Questionnaire to measure functional vision.[78,79] Studies assessing oral health status showed more consistency in outcome measures. Three studies used the Modified Quigley Hein Plaque Index,[34,46,72] adapted by Turesky et al., whereas six studies used the Plaque Index[51,53,63,80,91,92] of Loe and Silness. In addition, three studies used the Gingival Index[46,63,91] of Loe and Silness, and one study used the Gingival Index[72] of Lobene et al. To assess oral health knowledge and oral hygiene practice, both Hebbal and Ankola, as well as Yalcinkaya and Atalay constructed their own questionnaires,[80,91] without providing any measures of reliability or validity. The questionnaire developed by Yalcinkaya and Atalay was also used in the study of Ganapathi et al.[34] Debnath et al. also constructed their own questionnaire to assess knowledge, attitude and practices regarding oral health and provided a measure for internal consistency reliability (Cronbach's Alpha).[92] Sack and Gaylord-Ross also developed their Peer Questionnaire and Teacher Observation Checklist themselves, and did not provide measures of reliability and validity either.[45] Al-Dababneh et al. constructed a Creativity Questionnaire,[59] and reported on the developmental process of the questionnaire and also provided a Cronbach's Alpha. Kim developed the Role Play Test from various sources.[54] Several studies assessed the effectiveness of a programme or training by using performance measures, such as studies evaluating reading performance by measuring reading speed, or viewing behaviour by measuring visual performance or task performance. Reporting psychometric properties for these types of measures is less common, and only three studies[13,65,89] provided a reference to the reading and writing tests they used.

Table 1. Characteristics of reviewed studies, arranged on outcome measure: 1) physical performance, 2) oral health, 3) psychological outcomes, 4) reading performance, 5) functioning & development, 6) social skills, 7) viewing behaviour, and 8) mobility skills

Author (year, country)	Study design (follow-up, setting)	Sample size, mean age (range), % female, % drop-out	Degree of vision impairment, diagnosis of visual impairment	Outcome measures	Intervention group(s)	Control group(s)
1. Physical performance						
Aki et al. (2007, Turkey)[58]	2-Arm non-RCT* (3 months, probably home)	N=40, 8.9 years (range not reported), 50% female, no drop-out	Severe visual impairment (VA ≤40/200), congenital cataract (47.5%), albinism (17.5%), rod/cone dystrophy (15%), optic atrophy (10%), other (10%)	Motor skills (BOT)	Training programme guided by a physiotherapist (3 months, 3 times per week for 1 hour)	Home training programme guided by parents (similar in dose and intensity)
Black (1978, USA)[61]	2-Arm non-RCT (30 days, residential camp)	N=30, average age not reported (14-17 years), gender not reported, no drop-out	Visual impairment (VA ≤20/200), diagnoses not reported	Dynamic balance (modified Springfield Beam-Walking Test), spatial veering (UCLA Mobility Test for the blind)	Outdoor adventure programme (12 days, 50 hours in total)	Programme of traditional physical education activities and mobility training (30 days, 50 hours in total)
Blessing et al. (1993, USA)[94]	1-Arm BA (16 weeks, probably school)	N=30, 13.5 years (8-18 years), 36.7% female, no drop-out	Visual impairment (33.3% blind, 53.5% VA ≤ 20/200, 13.3% visual field ≤ 20°), cataract (26.6%), corneal disease (20%), retinal/choroidal (13.4%), other (40%)	Cardiovascular fitness, body composition (height, weight, skinfold thickness)	Endurance training (16 weeks, 3 times per week for approximately 40 minutes)	No control group

Caliskan et al. (2011, Turkey)[57]	2-Arm RCT* (3 months, probably school)	N=46, 12.5 years (10-15 years), 43.5% female, no drop-out	Severe visual impairment (diagnosis not reported)	BMI, percent body fat	Goalball (3 days per week, 54 hours in total)	Movement education (similar in dose and intensity)
Chen & Lin (2011, Taiwan)[56]	2-Arm RCT (71 days, probably school)	N=16, 16.1 years (15-17 years), gender not reported, no drop-out	Visual impairment (diagnosis not reported)	Physical fitness (BMI, sit-and-reach, sit-up, PACER)	Rope jumping (10 weeks, 3 days per week for 50 minutes)	No intervention
Jazi et al. (2012, Iran)[37]	2-Arm RCT (8 weeks, school)	N=19, 10.3 years (8-14 years), 36.8% female, no drop-out	Visual impairment (VA ≤20/70), diagnosis not reported	Dynamic balance (Modified Bass Test of Dynamic Balance)	Group-based balance training programme (8 weeks, 2 times per week for 1 hour)	No intervention
Joseph (1984, USA)[38]	3-Arm RCT* (2 days, school)	N=50, 15.2 years (7.9-21.1 years), 56% female, no drop-out	Blind, ROP (42%), optic nerve degeneration (14%), glaucoma (8%), tapetoretinal degeneration (6%), microphthalmia (6%), macular dystrophy (4%), other (20%)	Motor skills	First arm: feedback with knowledge of results and performance (three sessions)	Second arm: feedback with knowledge of results (similar in dose and intensity) Third arm: feedback with knowledge of performance (similar in dose and intensity)
Mavrovouniotis et al. (2013, Greece)[42]	2-Arm RCT (8 weeks, school)	N=16, 15.9 years (range not reported), 43.8% female, 12.5% drop-out	Blind, diagnosis not reported	Balance (MABC-2, BOT-2)	Training with Greek dances and Pilates (8 weeks, 2 times a week for 45 minutes)	Physical education lessons (similar in dose and intensity)

Table 1. Cont'd

Author (year, country)	Study design (follow-up, setting)	Sample size, mean age (range), % female, % drop-out	Degree of vision impairment, diagnosis of visual impairment	Outcome measures	Intervention group(s)	Control group(s)
McMahon (2013, USA)[82]	1-Arm BA (1 week, sports education camp)	N=671, average age not reported (9-18 years), gender not reported, no drop-out	Visual impairment, diagnosis not reported	Physical performance (SCEI)	Sports education camp (one week)	No control group
Mohanty et al. (2015, India)[73]	2-Arm non-RCT (16 weeks, probably school)	N=83, 12.2 years (9-18 years), 31.3% female, 3.6% drop-out	Visual impairment (22.5% blind, 77.5% visual impairment), diagnosis not reported	Muscle fitness (Kraus-Weber test)	Group-based yoga program (16 weeks, 5 days per week for 60 minutes)	Waiting list
Mohanty et al. (2016, India)[70]	2-Arm non-RCT (16 weeks, probably school)	N=83, 12.6 years (9-16 years), 30.1% female, 7.2% drop-out	Legal blindness (VA <20/200 or visual field ≤20°), diagnosis not reported	*Of interest:* motor speed (FTT). *Other:* upper extremity muscle strength (handheld dynamometer), pinch strength (pinch dynamometer)	Group-based yoga programme (16 weeks, 5 times per week for 1 hour)	Waiting list
Pineio et al. (2017, Greece)[74]	2-Arm non-RCT (12 weeks, setting not reported)	N=24, average age not reported (6-14 years), gender not reported, no drop-out	Visual impairment, diagnosis not reported	Motor development (BOT-2)	Group-based exercise program (12 weeks, 3 times per week for 40 minutes)	No intervention
Ponchillia et al. (2005, USA)[84]	1-Arm BA (1 week, sports education camp)	N=321, 12.8 years (8-19 years), 45.1% female, no drop-out	Visual impairment, diagnosis not reported	*Of interest:* sports skills (SCEI). *Other:* attitudes, sports knowledge (SCEI)	Sports education camp (one week)	No control group

Reimer et al. (2011, The Netherlands)[71]	2-Arm non-RCT* (6 weeks, setting not reported)	N=22, 57 months (48-71 months), visual impairment, 36% female, no drop-out	Visual impairment (VA 20/400-20/67), albinism (36.4%), cong. cataract (17.4%), cong. nystagmus (13.6%), retinoschisis (13.6%), other (18.2%)	*Of interest:* fine motor skills (ManuVis, writing task of MABC). *Other:* Motoscopic data (head orientation, working distance)	Training in trail-following tasks using a stand magnifier (12 half-hour sessions during 6 weeks)	Training in trail-following tasks without a visual aid (similar in dose and intensity)
Robinson & Lieberman (2007, USA)[86]	1-Arm BA (6 weeks, home)	N=18, average age not reported (9-23 years), 38.9% female, no drop-out	Visual impairment, diagnosis not reported	Physical activity time	Parent resource manual	No control group
Shindo et al. (1987, Japan)[93]	1-Arm BA (6 weeks, probably school)	N=10, 17.7 years (16-22 years), 0% female, no drop-out	Visual impairment (60% visual impairment, 40% blind), diagnosis not reported	Physical and psychic symptoms (CMI), physical fitness	Endurance training (6 weeks, 3 times per week for 60 minutes)	No control group
Taskin (2016, Turkey)[75]	2-Arm non-RCT (8 weeks, setting not reported)	N=40, 15.5 years (range not reported), gender not reported, no drop-out	Visual impairment (blind 3 classification), diagnosis not reported	Auditory reaction time, maximal oxygen uptake	Aerobic training programme (8 weeks, three times per week for 60-80 minutes)	No intervention

Table 1. Cont'd

Author (year, country)	Study design (follow-up, setting)	Sample size, mean age (range), % female, % drop-out	Degree of vision impairment, diagnosis of visual impairment	Outcome measures	Intervention group(s)	Control group(s)
2. Oral health						
Arunakul et al. (2015, Thailand)[51]	3-Arm RCT (3 months, setting not reported)	N=75, 11.3 years (10-12 years), 46.7% female, no drop-out	Visual impairment, diagnosis not reported	Oral health status (plaque index, gingival index and Streptococcus mutans level)	First arm: brushing instructions, oral hygiene education kits and sodium fluoride mouth rinse Second arm: brushing instructions and oral hygiene education kits	Third arm: brushing instructions
Chowdary et al. (2016, India)[63]	3-Arm non-RCT* (6 months, school)	N=120, 11 years (6-16 years), gender not reported, no drop-out	Legal blindness, diagnosis not reported	Oral health status (plaque index, gingival index)	First arm: verbal + braille + tactile oral hygiene intervention (2 weeks, 1 time per week)	Second arm: verbal + tactile oral hygiene intervention (similar in dose and intensity) Third arm: verbal + braille oral hygiene intervention (similar in dose and intensity)

Debnath et al. (2017, India)[92]	1-Arm BA (6 months, school)	N=40, average age not reported (9-18 years), 37.5% female, no drop-out	Visual impairment (VA ≤20/200), diagnosis not reported	Oral health status (plaque index), oral health knowledge	Oral health education module (6 sessions at 1-month intervals)	No control group
Ganapathi et al. (2015, India)[34]	5-Arm RCT (8 weeks, school)	N=200, average age not reported (8-14 years), gender not reported, no drop-out	Totally blind, diagnosis not reported	Oral health status (Modified Quigley-Hein Plaque Index), oral health knowledge	First arm: oral health education by audio Second arm: oral health education by braille Third arm: oral health education by tooth models Fourth arm: oral health education by audio, braille and tooth models (multisensory group)	No intervention
Hebbal & Ankola (2012, India)[80]	1-Arm BA (18 months, school)	N=110, average age not reported (6-18 years), 32% female, 12.7% drop-out	Visual impairment (69.8% partially, 30.2% totally), diagnosis not reported	Oral health status (plaque index), oral hygiene practice	Series of interactive sessions about the Audio Tactile Performance (ATP) technique (9 months)	No control group

Table 1. Cont'd

Author (year, country)	Study design (follow-up, setting)	Sample size, mean age (range), % female, % drop-out	Degree of vision impairment, diagnosis of visual impairment	Outcome measures	Intervention group(s)	Control group(s)
Krishnakumar et al. (2016, India)[53]	2-Arm RCT* (4 months, school)	N=48, average age not reported, (6-18 years), 12.5% female, no drop-out	Visual impairment (fit into categories 3, 4 and 5 of the ICD), diagnosis not reported	Oral health status (plaque index)	Audio-tactile health education with the Audio Tactile Performance (ATP) technique (2 sessions at 2 months intervals)	Audio health education (similar in dose and intensity)
Qureshi et al. (2017, Pakistan)[50]	2-Arm RCT (30 days, school)	N=50, 12.4 years (10-15 years), 32% female, no drop-out	Visual impairment (75% partially, 25% totally), diagnosis not reported	Oral hygiene index	Guided tooth brushing program (2 sessions at 2-weeks intervals)	Verbal oral hygiene message (1 session)
Shetty et al. (2013, India)[72]	2-Arm non-RCT (3 months, school)	N=98, average age not reported (4-16 years), 46% female, no drop-out	Blind, diagnosis not reported	Oral health status (Modified Gingival Index, Modified Quigley-Hein Plaque Index, Streptococcus mutans colony count)	Oral health education programme (1 month)	Oral health education programme (2 weeks)
Smutkeeree et al. (2011, Thailand)[46]	2-Arm RCT* (6 months, school)	N=60, 11 years (10-12 years), visual impairment, 43.3% female, 5% drop-out	Visual impairment, diagnosis not reported	Oral health status (plaque index of Turesky Modification of Quigley-Hein, gingival index)	Verbal and tactile instructions on horizontal Scrub method of tooth brushing	Verbal and tactile instructions on modified Bass method of tooth brushing

Yalcinkaya & Atalay (2006, Turkey)[91]	1-Arm BA (9 months, school)	N=65, average age not reported (7-17 years), 41.5% female, no drop-out	Visual impairment (43.1% totally, 56.9% partially), diagnosis not reported	Oral health hygiene (plaque index, gingival index), oral health knowledge	Oral health education program (3 sessions at 2-month intervals)	No control group
3. Psychological outcomes						
Dursun et al. (2015, Turkey)[77]	1-Arm BA (3 months, ice-skating centre)	N=20, 12.0 years (8-16 years), visual impairment, 40.0 % female, no drop-out	Visual impairment (VA ≤20/200), diagnosis not reported	Sleep quality (PSQI), self-concept (PHCSCS), behavioural and emotional states (SDQ)	Ice-skating programme (3 months, 2 times per week for 1 hour)	No control group
Eniola & Adebiyi (2007, Nigeria)[33]	2-Arm RCT* (6 weeks, training location: Hall of Civil Service Commission)	N=32, average age not reported (range not reported), visual impairment, 56% female, no drop-out	Visual impairment, diagnosis not reported	Motivation to work (WVI)	Group motivation skills based on emotional intelligence (6 weeks, 2 sessions per week)	Group motivation skills based on goal setting (similar in dose and intensity)
Eniola & Ajobiewe (2013, Nigeria)[32]	3-Arm RCT (8 weeks, classroom)	N=120, average age not reported (12-21 years), 23% female, no drop-out	Visual impairment (75.8% totally, 24.2% partially), diagnosis not reported	Psychological wellbeing (AVRPWB)	First arm: group Emotional Intelligence Training (EIT) (8 weeks, 8 sessions of 2 hours) Second arm: group Locus of Control Training (LCT) (similar in dose and intensity)	No intervention

Table 1. Cont'd

Author (year, country)	Study design (follow-up, setting)	Sample size, mean age (range), % female, % drop-out	Degree of vision impairment, diagnosis of visual impairment	Outcome measures	Intervention group(s)	Control group(s)
Johnson & Johnson (1991, USA)[68]	2-Arm non-RCT (4 weeks, setting not reported)	N=14, average age not reported (12-18 years), 28% female, no drop-out	Visual impairment, diagnosis not reported	Self-concept (TSCS), attitude towards blindness (AB scale), Locus of control (North Carolina Internal-External Scale: Short Form)	Group counselling activities (4 weeks, 12 sessions)	No intervention
Levin & Rotheram-Fuller (2011, USA)[69]	2-Arm non-RCT (4 months, classroom)	N=30, average age not reported (14-21), 43% female, no drop-out	Visual impairment, diagnosis not reported	Self-determination (AIR), self-concept (TSCS:2), self-esteem (subscale BASC-2)	Group-based empowered curriculum (15 weeks, 2 times per week for 45 minutes)	Waiting list
Locke & Gerler (1981, USA)[41]	4-Arm RCT (15 weeks, classroom)	N=42, average age not reported (range not reported), gender not reported, no drop-out	Visual impairment, diagnosis not reported	*Of interest:* self-image (Self-Appraisal Inventory-Primary Level). *Other*: attitude toward school (School Sentiment Index-Primary Level), classroom behaviour (PBRS)	First arm: Human Development Programme (HDP) (15 weeks, 3 times per week) Second arm: Developing Understanding of Self and Others (DUSO) program (similar in dose and intensity)	Third arm: group comparison programme in which they played games (similar in dose and intensity) Fourth arm: no intervention

McMahon (2013, USA)[81]	1-Arm BA (1 week, sports education camp)	N=671, average age not reported (9-18 years), gender not reported, no drop-out	Visual impairment, diagnosis not reported	*Of interest:* self-perception (SCEI). *Other:* sports knowledge, BMI	Sports education camp (1 week)	No control group
Mohamed et al. (2011, Egypt)[83]	1-Arm BA (duration not reported, ophthalmology outpatient clinic and Research Institute of Ophthalmology)	N= 50, 15.9 years, (12-18 years), 40% female, no drop-out	Visual impairment, primary glaucoma (20%), secondary glaucoma (80%)	*Of interest:* anxiety (CMAS), depression (CDI), self-esteem (self-esteem inventory), activities of daily living. *Other:* knowledge about glaucoma, expectations (ECES)	Group-based educational programme (15 sessions)	No control group
Shapiro et al. (2005, USA)[87]	1-Arm BA (1 week, summer sports camp)	N=43, 13.0 years (8-21 years), 37.2% female, no drop-out	Visual impairment (32.6% VA 20/200-20/400 or visual field 5-20°, 16.3% VA <20/400 or visual field <5°, 20.9% blind, 30.2% unknown), diagnosis not reported	Perception of competence (SPPC, SPPA)	Summer sports camp (1 week)	No control group
4. Functioning & development						
Al-Dababneh et al. (2015, Jordan)[59]	2-Arm non-RCT (3 months, school)	N=41, average age not reported (9-10 years), 65% female, no drop-out	Visual impairment, diagnosis not reported	Creativity (creativity questionnaire)	Training programme for developing creative abilities (3 months, 2 times per week for 45 minutes)	No intervention

Table 1. Cont'd

Author (year, country)	Study design (follow-up, setting)	Sample size, mean age (range), % female, % drop-out	Degree of vision impairment, diagnosis of visual impairment	Outcome measures	Intervention group(s)	Control group(s)
Beelmann & Brambring (1998, Germany)[60]	2-Arm non-RCT (24 months on average, home)	N=50, average age not reported (9.5-36 months), 42% female, no drop-out	Congenital blindness, ROP (42%), optic atrophy (18%), other (40%)	Development (BEB-KV)	Home-based early intervention (1 time per 2 weeks)	Usual care
Behl et al. (1993, USA)[30]	2-Arm RCT (3 years, home)	N=35, 13.8 months (2-30 months), 51.3% female, 31.4% drop-out	Visual impairment (~66.7% VA 20/200-20/800, ~33.3% VA 20/900-20/2400), diagnosis not reported	Child functioning (BDI), family functioning (PSI, FSS, FRS, FILE, FACES III)	Individualised home-based intervention (average of 19.6 months, 1 time per week for 1 hour)	Parent group meetings (average of 20.1 months, 12 times per year)
Çalik et al. (2012, Turkey)[62]	2-Arm non-RCT (6 weeks, probably school)	N=20, 9.85 years (7-12 years), gender not reported, no drop-out	Visual impairment (20% VA 40/200, 25% VA 20/200, 35% VA 10/200, 20% VA 2/200), diagnosis not reported	Cognition (modified child MMSE), activities of daily living (NPI), quality of life (LVQOL)	Educational attention training programme (Pay Attention©) (6 weeks, 3 times per week for 30 minutes)	No intervention

Christy (2012, India)[55]	4-Arm RCT* (9 months, rehabilitation centre/home)	N=89, 11.7 years (8-15 years), 35% female, 7.9% drop-out	Visual impairment (VA 6/12-light perception, or visual field <20°, 38% VA 6/12-6/18, 36% VA 6/18-6/60, 26% VA <6/60), retinal degeneration (25%), retinal dystrophy (16%), refractive error (12%), whole globe (11%), cornea (7%), albinism (6%), optic nerve disorders (5%), glaucoma (5%), other (11%)	Impact of vision impairment (IVI)	First arm: centre-based low vision service (3 days of training for 4-6 hours, and 6-12 days of follow-up training for 2-5 hours at 15 days intervals) Second arm: community-based low vision service (similar in dose and intensity) Third arm: centre-based and community-based low vision service (similar in dose and intensity)	Fourth arm: centre-based low vision service with non-interventional follow-up (3 days of initial training for 4-6 hours, and 6-12 days of non-interventional follow-up at 15 days intervals)
Ganesh et al. (2013, India)[78]	1-Arm BA (2 months, rehabilitation centre)	N=35, 10.5 years (6-15 years), 20% female, no drop-out	Visual impairment (visually impaired according to WHO criteria for low vision), retinal dystrophy (37.1%), amblyopia (22.9%), albinism (17.2%), other (22.8%)	Functional vision (LVP-FVQ)	Prescription of low vision devices + training in use of low vision devices	No control group

Table 1. Cont'd

Author (year, country)	Study design (follow-up, setting)	Sample size, mean age (range), % female, % drop-out	Degree of vision impairment, diagnosis of visual impairment	Outcome measures	Intervention group(s)	Control group(s)
Gothwal et al. (2015, India)[79]	1-Arm BA (3-4 months, rehabilitation centre)	N=397, 11.9 years (8-16 years), 43% female, 54% drop-out	Visual impairment (1.6% VA ≥20/40 with visual field restriction, 6% VA 20/40-20/60, 76.5% VA 20/60-20/200, 16% VA <20/200), retinal cause (e.g. cone dystrophy, retinitis pigmentosa, Stargardt's, 55%), non-retinal cause (e.g. optic atrophy, glaucoma, 45%)	Functional vision (LVP-FVQ II)	Prescription of low vision devices + training in use of low vision devices, orientation and mobility, computer use, and activities of daily living	No control group
Platje et al. (2018, the Netherlands)[52]	2-Arm RCT (~14 months, rehabilitation centre/home)	N=86, 3.3 years (1-5 years), 42% female, 10.47% drop-out	Visual impairment, diagnosis not reported	Parental sensitivity and quality of parent-child interaction (NICHHDS), Parenting self-efficacy (self-efficacy subscale NRQ), parenting stress (PSI)	Attachment-based video-feedback parenting intervention (VIPP-V) (5 sessions of 1.5 hour every 2-3 weeks, and 2 booster sessions of 1.5 hour every 4-5 weeks) in combination with care as usual	Care as usual

Williams (1985, UK)[90]	1-Arm BA (duration not reported, residential care unit)	N=29, 8.3 years (2.7-13.11 years), gender not reported, 48.3% drop-out	Visual impairment, diagnosis not reported	Development (subscales Reynell-Zinkin Scales)	Admission to the care unit	No control group
5. Reading performance						
Corn et al. (2002, USA)[13]	1-Arm BA (~6 months, school)	N=185, 10.5 years (range not reported), 34% female, no drop-out	Visual impairment (15.2% VA 20/32-30/63, 37.5% VA 20/80-20/180, 39.1% VA 20/200-20/400, 8.2% 20/500-20/1000), albinism (21.2%), macular (18.4%), other (60.6%)	Reading speed and comprehension rates (Informal Reading Inventory)	Prescription of optical devices and training in their use	No control group
Farmer & Morse (2007, USA)[65]	2-Arm non-RCT (~8 months, classroom)	N=16, average age not reported (range not reported), gender not reported, no drop out	Visual impairment (VA ≤20/70), diagnosis not reported	Reading skills (BRI)	Education programme and classroom assistance in magnifier use + six magnifier training sessions	Education programmem and classroom assistance in large print use
Heber et al. (1967, USA)[35]	2-Arm RCT (2 years, school)	N=54, average age not reported (range not reported), gender not reported, no drop-out	Visual impairment (VA ≤20/200), diagnosis not reported	Braille reading (Traditional Braille Reading Tasks, Braille Recognition Task, Ammons Wide Range Vocabulary Test)	Braille Tape Reader training (2 years, 3 times per week for 50 minutes; 14 weeks in year 1(n=30), 27 weeks in year 2 (n=54))	Traditional braille materials (similar in dose and intensity)

Table 1. Cont'd

Author (year, country)	Study design (follow-up, setting)	Sample size, mean age (range), % female, % drop-out	Degree of vision impairment, diagnosis of visual impairment	Outcome measures	Intervention group(s)	Control group(s)
Howell (1977, UK)[36]	3-Arm RCT (5 weeks, school)	N=24, average age not reported (10-21 years), 50% female, no drop-out	Legal blindness, diagnosis not reported	*Of interest:* braille reading rate and comprehension (DRT). *Other:* brain wave patterns (EEG)	First arm: freehand rapid braille reading (5 weeks, 5 times per week) Second arm: pacing rapid braille reading (similar in dose and intensity)	No intervention
Huurneman et al. (2016, The Netherlands)[67]	2-Arm non-RCT (5-9 weeks, setting not reported)	N=35, 9.3 years (range not reported), gender not reported, no drop-out	Visual impairment (VA 20/31-20/400), infantile nystagmus (48.6% albinism and infantile nystagmus, 51.4% idiopathic infantile nystagmus)	*Of interest:* maximum reading speed, critical print size, reading acuity, acuity reserve. *Other:* crowded distance visual acuity, distance crowding extent, reading acuity	Crowded training (5 weeks, 2 times per week)	Uncrowded training (similar in dose and intensity)
Kederis et al. (1964, USA)[39]	2-Arm RCT (~3 months, school)	N=30, average age not reported (range not reported), 70% female, no drop-out	Visual impairment, diagnosis not reported	Braille reading (Gates Basic Reading Test)	Group-based practice under conditions of successively reduced exposed times (22 sessions, 5 times per week)	No intervention

Kederis et al. (1964, USA)[40]	2-Arm RCT (2.5 months, school)	N=32, average age not reported (range not reported), 50% female, 6.3% drop-out	Visual impairment, diagnosis not reported	Braille reading (Gates Basic Reading Test)	Pacing training (20 sessions, 5 times per week for 1.5 hour)	No intervention
Uysal & Düger (2012, Turkey)[89]	1-Arm BA (3 months, school)	N=35, 10.9 years (range not reported), 51.4% female, no drop-out	Visual impairment (satisfying criteria for low vision according to ICD-10-CM, 34.3% VA 20/80-20/150, 65.7% VA 20/200-20/400), diagnosis not reported	*Of interest:* writing speed (Jebsen-Taylor Hand function Test), legibility of writing, reading speed. *Other:* preferred font size and type	Writing and reading training with optical adaptations (3 months, 2 times per week for 45 minutes)	No control group
6. Social skills						
Bieber-Schut (1991, Canada)[76]	1-Arm BA (4 days, rehabilitation centre)	N=12, average age not reported (13-18 years), 50% female, 25% drop-out	Visual impairment (8.3% VA 20/100, 33.3 % VA <20/200-light perception, 58.3% blind), no diagnosis reported	Social skills (SSI)	Developmental drama workshop (4 days)	No control group
Grumpelt & Rubin (1972, USA)[66]	2-Arm non-RCT (duration not reported, school)	N=66, average age not reported (15-19 years), gender not reported, no drop-out	Blindness, diagnosis not reported	Speed listening skills	Speed listening training at 275-300 words per minute	Speed listening training at the standard 175 words per minute

Table 1. Cont'd

Author (year, country)	Study design (follow-up, setting)	Sample size, mean age (range), % female, % drop-out	Degree of vision impairment, diagnosis of visual impairment	Outcome measures	Intervention group(s)	Control group(s)
Kim (2003, USA)[54]	2-Arm RCT (12 weeks, school)	N=26, 16.1 years (13-19 years), 46.2% female, 11.5% drop-out	Visual impairment (7.7% visual field restriction, 30.8% VA 20/200, 19.2% VA 20/400, 42.2% VA 20/600), ROP (19.2%), optic nerve hypoplasia (19.2%), other (61.5%)	Social skills (SSRS), assertiveness (MRAS), self-criticism and helplessness (subscales MCDS), assertive behaviour (RPT)	Group-based assertiveness training (12 weeks, 1 session per week)	No intervention
McConnell (1994, USA)[43]	2-Arm RCT (5 weeks, home)	N=20, 16.7 years (15-18 years), 50% female, no drop-out	Visual impairment, optic atrophy (15%). Stargardt's maculopathy 10%), nystagmus (10%), other (65%)	*Of interest:* adolescent-parent communication (PAC). *Other*: career certainty/indecision (CDS), importance of work (CSS)	The Partner's Programme (5 weeks)	No intervention
Sacks & Gaylord-Ross (1989, USA)[45]	3-Arm RCT (4 weeks, school)	N=15, 9.7 years (7-12 years), 40% female, no drop-out	Legal blindness (20% VA 20/200, 33.3% VA 20/400, 13.3% VA 20/800, 6.7% light perception, 26.7% no light perception), optic nerve (40%), ROP (13.3%), glaucoma (13.3%), albinism (13.3%), other (20%)	Social skills (behavioural measures), social competence (PCSC), social validation (Peer questionnaire, Teacher Observation Checklist)	First arm: peer-mediated social skills training (4 weeks, 3 times per week for 40 minutes) Second arm: teacher-directed social skills training (similar in dose and intensity)	Third arm: no intervention

Uysal & Düger (2012, Turkey)[47]	2-Arm RCT (3 months, school)	N=40, 10.9 years (range not reported), 42.5% female, no drop-out	Visual impairment (fitting into the low vision category according to the ICD-10-CM), diagnosis not reported	*Of interest:* social skills (SSAT-VI), activity performance (COPM). *Other:* visual perception	Visual perception training with computer (3 months, 2 days per week for 45 minutes)	Visual perception training with paper and pen (similar in dose and intensity)
Yildiz & Duy (2013, Turkey)[49]	2-Arm RCT (4 months, probably school)	N=16, 13.5 years (range not reported), 37% female, no drop-out	Visual impairment, diagnosis not reported	Empathic skills (KA-SI Empathic Tendency Scale), communication (CSS)	Group-based psycho-education programme (9 sessions)	No intervention
7. Viewing behaviour						
Boonstra et al. (2012, The Netherlands)[31]	2-Arm RCT* (6 weeks, probably rehabilitation centre)	N=21, 4.7 years (3-6.5 years), 33% female, no drop-out	Visual impairment (VA ≤20/50, 26.3% VA ≤20/200, 26.3% VA 20/200-20/100, 47.4% VA 20/100-20/50), albinism (38.1%), nystagmus (19.0%), other (42.8%)	Viewing behaviour (duration of observation, viewing distance)	Training with a magnifier (6 weeks, 2 times per week or 30 minutes)	Training without a magnifier (similar in dose and intensity)
Cox et al. (2009, The Netherlands)[64]	2-Arm non-RCT* (8 weeks, home or school)	N=42, 4.7 years (range not reported), 36.4% female, 21.4% drop-out	Visual impairment (VA ≤20/50, 33.3% VA ≤20/200, 48.5% VA 20/200-20/100, 18.2% VA 20/100-20/50), albinism (36.4%), cataract (15.2%), nystagmus (12.1%), other (36.4%)	Task performance (number of trails followed, number of trails followed correctly)	Training with magnifier use (6 weeks, 12 30-minute sessions)	Training without magnifier (similar in dose and intensity)

Table 1. Cont'd

Author (year, country)	Study design (follow-up, setting)	Sample size, mean age (range), % female, % drop-out	Degree of vision impairment, diagnosis of visual impairment	Outcome measures	Intervention group(s)	Control group(s)
Nyquist et al. (2016, USA)[44]	3-Arm RCT (~2.5 weeks, probably school)	N=24, 14.2 years (9-18 years), gender not reported, no drop-out	Visual impairment (VA 20/60-20/800 and visual field ≥35°, 12.5% VA 20/800, 20.8% VA 20/400, 4.2% VA 20/300, 58.3% VA 20/200, 4.2% VA 20/60), albinism (33.3%), stargardt's macular dystrophy (16.7%), ROP (12.5%), cong. cataract (8.3%), other (29.2%)	Visual functioning (foveal motion perception, single target motion discrimination, multi-target direction comparisons, visual crowding, and visual search)	First arm: action video game (AVG) (10 sessions of 40-50 minutes, 3-5 times per week) Second arm: modified attentional tracking (MAT) (similar in dose and intensity)	Third arm: control video game similar to Tetris (similar in dose and intensity)
Ritchie et al. (1989, India)[85]	1-Arm BA (6 weeks, rehabilitation centre)	N=48, average age not reported (1.5-6 year), gender not reported, 37.5% drop-out	Severe visual impairment (50% partially sighted, 50% blind), cong. cataract (16.7%), albinism (13.3%), Leber's (13.3%), other (56.7%)	Visual functioning (responding correctly to questions about a set of visual material)	Training in use of a visual aid (6 weeks)	No control group
8. Mobility skills						
Ungar et al. (1997, UK)[88]	1-Arm BA (3 weeks, setting not reported)	N=26, 8.5 years (5-11.9 years), visual impairment, gender not reported, no drop-out	Visual impairment (38.5% congenitally blind, 61.5% residual vision), diagnosis not reported	Performance in estimating distances	Training in strategies to work out distances from a map (30 minutes)	No control group

Wood (1978, USA)[48]	3-Arm RCT (16 weeks, classroom)	N=42, 10.6 years (5.1-9.7 years), gender not reported, 14.3% drop-out	Severe visual impairment (light perception or less), diagnosis not reported	Motor, sensory, concept and mobility skills (PMS)	First arm: programmed orientation and mobility instruction materials (16 weeks, 5 times per week for 40 minutes per day)	Second arm: distal control group that received a regular educational programme Third arm: onsite control group that received a regular educational programme

* No intervention or control group were reported in the article, and no hypotheses on which of the groups would be superior were made

AB Scale: Attitudes Toward Blindness Scale; AIR: AIR Self-Determination Scale; AVRPWB: Adapted Version of Ryff Scale of Psychological Well-being; BASC: Behaviour Assessment System for Children; BDI: Battelle Developmental Inventory; BEB-KV: Bielefeld Developmental Test for Blind Infants and Pre-schoolers; BMI: Body Mass Index; BOT: Bruininks-Oseretsky Test of Motor Proficiency Short Form; BRI: Basic Reading Inventory; CDI: Children Depression Inventory; CDS: Career Decision Scale; CMAS: Children Manifest Anxiety Scale; CMI: Cornell Medical Index; COPM: Canadian Occupational Performance Measure; DRT: Diagnostic Reading Test; CSS: Career Salience Scale; CSS: Communication Skills Scale; ECES: Eye Care Expectations Survey; EEG: electroencephalograph; FACES: Family Adaptability and Cohesion Evaluation Scales; FILE: Family Inventory of Life Events and Changes; FSS: Family Support Scale; FRS: Family Resource Scale; FTT: Finger Tapping Test; LVP-FVQ: LV Prasad-Functional Vision Questionnaire; LVQOL: Low Vision Quality of Life questionnaire; MABC: Movement Assessment Battery for Children; ManuVis: manual skills test for children (6-12 years) with visual impairment; MCDS: Modified Cognitive Distortion Scales; MMSE: Mini-Mental State Examination; Movement ABC: movement assessment for children; MRAS: Modified Rathus Assertiveness Schedule; MVPT: Motor Free Visual Perception Test; NICHHDS: National Institute of Child Health and Human Development Scales; NPI: Northwick Park Index of Independence; NRQ: Nurturing Role Questionnaire; PAC: Parent-Adolescent Communication Scale; PACER: Progressive Aerobic Cardiovascular Endurance Run; PBRS: Pupil Behaviour Rating Scale; PCSC: Perceived Competence Scale for Children; PHCSCS: Piers-Harris Children's Self-Concept Scale; PMS: Peabody Mobility Scale; PSI: Parenting Stress Inventory; PSQI: Pittsburgh Sleep Quality Index; RCT: Randomised Controlled Trial; RPT: Role Play Test; SCEI: sports camp evaluation instrument; SDQ: Strengths and Difficulties Questionnaire; SPPA: Self-Perception Profile for Adolescents; SPPC: Self-Perception Profile for Children; SSAT-VI: Social Skills Assessment Tool for Children with Visual Impairments; SSI: Social Skills Inventory; SSRS: Social Skills Rating System; TSCS: Tennessee Self-Concept Scale; WVI: Work Value Inventory

Quality of included studies

Almost all RCTs had an unclear risk of selection bias, because in most cases methods of randomisation were not described,[31-35,37-42,45,48,49,51,53,56,57] and allocation concealment was never described in all but two studies[50,55] (Table 2 and 3, Figure 2, Appendix 2). Due to the nature of interventions offered in rehabilitation, all RCTs used a pragmatic design in which blinding of personnel and participants was not feasible. For the majority of studies, the risk of detection bias was rated as unclear, because it was not reported whether outcome assessment was done by a blinded assessor.[32,33,36-43,46-49,51,53,55-57] Eight studies were rated as having low risk of bias on this aspect, because the assessor was blinded[30,31,34,35,50,52,54] or outcomes were electronically obtained.[44] Furthermore, one study was rated as having high risk of bias because of using an unmasked assessor.[45] Risk of attrition bias (i.e. no or low drop-out, drop-out unrelated to outcome or treatment allocation) was rated low for all but one RCT, which was rated as unclear risk because the drop-out was 36% and it was unknown in which group drop-out occurred.[31] Risk of reporting bias was often unclear, because trial registrations and study protocols were not available.[30-33,35-51,53,54,56,57] The study of Ganapathi et al. was rated as having high risk of reporting bias, because post-test measures were not performed for the control group,[34] whereas the studies of Platje et al. and Christy were rated as low risk of reporting bias, because a protocol and/or trial registration was available.[52,55,95] Other sources of bias were often rated as unclear,[31-41,43,45-49,53,55,56] because no information on baseline imbalances were provided, or it was unclear whether baseline imbalances were statistically significant. Seven studies were rated as having low risk of bias on this aspect, because baseline differences between groups were not statistically significant or baseline differences were adjusted in the analyses.[30,42,44,50-52,54,57] From all RCTs, the study of Qureshi et al. and Platje et al. were rated as having the least risk of bias,[50,52] whereas the study of Sacks and Gaylord-Ross was rated as having the most risk of bias.[45]

All BAs and most of the non-RCTs[58,59,61-65,67,69,71-73,75] were rated as having serious risk of bias due to confounding. For BAs, this is linked to the study design chosen, whereas for non-RCTs, most studies did not control or correct for all possible confounders. Five studies used proper matching techniques to control for confounding.[60,66,68,70,74] Almost all non-RCTs[58,59,61,63,65-75] and BAs[13,76,77,80-85,87-94] were rated as having low bias in selection of participants, because all eligible participants were included. Bias in the selection of participants was rated as moderate for three non-RCTs, because of low response rates[62,64] or the intervention and follow-up did not coincide for all participants.[60] Moreover, three BAs were rated as having moderate bias, all because of low response rates.[78,79,86] All non-RCTs were rated as having low risk of bias in classification of interventions, because the intervention status was well defined. For BAs, this could not be assessed because only one intervention was offered. All non-RCTs and BAs were rated as having low risk of bias due to deviations from intended interventions, and most non-RCTs[58-63,65-75] and BAs[13,77-84,86-89,91-94] were rated as having low risk of bias due to missing data because no or low drop-out, or drop-out was unrelated to the outcome or treatment. For one non-RCT[64] and three BAs[76,85,90] the risk of bias due to missing data was unclear, because no information on reasons for drop-out were provided, or it was unknown in which group drop-out occurred. For both non-RCTs and BAs, the assessment of

bias in the measurements of outcomes were mixed. Three non-RCTs were rated as having low risk on this aspect, because the assessors were blinded.[64,70,73] Seven studies were rated as having moderate risk, because it was unknown whether the assessors were blinded, but it was thought to have minimal influence on the outcome,[63,65-67,71,74,75] whereas seven studies were rated as having serious risk (i.e. unknown whether the assessor was blinded and a subjective outcome or different time-points of measurements for groups).[59-62,68,69,72] The study of Aki et al. was rated as having unclear risk of bias in measurements of outcome, because it was unclear who the assessors were.[58] In the BAs, nine studies were rated as having moderate risk of bias,[13,80,82,85,88,89,91-94] whereas the remaining studies were rated as having serious risk of bias.[76-79,81,83,84,86,87,90] All non-RCTs and all but one of the BAs[79] were rated as having moderate risk of bias in selection of reported results. None of the studies had a protocol available, but there were no indications of selective reporting or subgroup analyses. The study of Gothwal et al. was rated as having serious risk of bias on this aspect, because they performed an explorative study, making it likely that they only reported the results that were of significance.[79] All BAs and most of the non-RCTs[58-65,67-69,71-73,75] were rated as having serious overall risk of bias. Only the studies of Grumpelt and Rubin[66], Pineio et al.[74] and Mohanty et al.[70] were rated as having moderate overall risk of bias, and the study of Mohanty et al.[70] was rated as having the least risk of bias.

Table 2. Risk of bias overview for RCTs based on the Cochrane Collaboration Risk of Bias Tool (CCRBT)

	Random sequence generation: selection bias	Allocation concealment: selection bias	Blinding of participants and personnel: performance bias	Blinding of outcome assessment: detection bias	Incomplete outcome data: attrition bias	Selective reporting: reporting bias	Other sources of bias
Arunakul et al. (2015, Thailand)[51]	?	?	-	?	+	?	+
Behl et al. (1993, USA)[30]	+	?	-	+	+	?	+
Boonstra et al. (2012, The Netherlands)[31]	?	?	-	+	?	?	?
Caliskan et al. (2011, Turkey)[57]	?	?	-	?	+	?	+
Chen & Lin (2011, Taiwan)[56]	?	?	-	?	+	?	?
Christy (2012, India)[55]	+	+	-	?	+	+	?
Eniola & Adebiyi (2007, Nigeria)[33]	?	?	-	?	+	?	?
Eniola & Ajobiewe (2013, Nigeria)[32]	?	?	-	?	+	?	?
Ganapathi et al. (2015, India)[34]	?	?	-	+	+	-	?
Heber et al. (1967, USA)[35]	?	?	-	+	+	?	?
Howell (1977, UK)[36]	+	?	-	?	+	?	?
Jazi et al. (2012, Iran)[37]	?	?	-	?	+	?	?
Joseph (1984, USA)[38]	?	?	-	?	+	?	?
Kederis et al. (1964, USA)[39]	?	?	-	?	+	?	?
Kederis et al. (1964, USA)[40]	?	?	-	?	+	?	?
Kim (2003, USA)[54]	+	?	-	+	+	?	+
Krishnakumar et al. (2016, India)[53]	?	?	-	?	+	?	?
Locke & Gerler (1981, USA)[41]	?	?	-	?	+	?	?
Mavrovouniotis et al. (2013, Greece)[42]	?	?	-	?	+	?	+
McConnell (1994, USA)[43]	+	?	-	?	+	?	?
Nyquist et al. (2016, USA)[44]	+	?	-	+	+	?	+

Platje et al. (2018, the Netherlands)[52]	+	?	-	+	+	+	+
Qureshi et al. (2017, Pakistan)[50]	+	+	-	+	+	?	+
Smutkeeree et al. (2011, Thailand)[46]	+	?	-	?	+	?	?
Sacks & Gaylord-Ross (1989, USA)[45]	?	?	-	-	+	?	?
Uysal & Düger (2012, Turkey)[47]	+	?	-	?	+	?	?
Wood (1978, USA)[48]	?	?	-	?	+	?	?
Yildiz & Duy (2013, Turkey)[49]	?	?	-	?	+	?	?

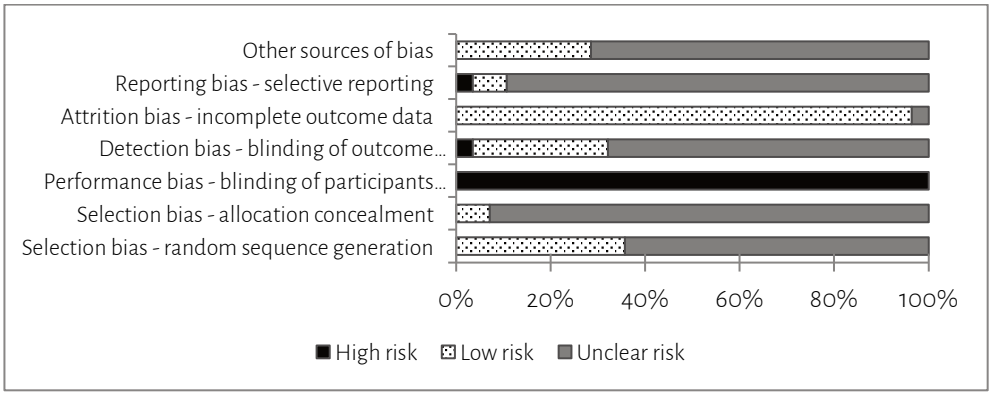
?: unclear risk of bias; -: high risk of bias; +: low risk of bias

Table 3. Risk of bias overview for non-RCTs and BAs based on the Risk Of Bias In Non-randomised Studies - of Interventions Tool (ROBINS-I)

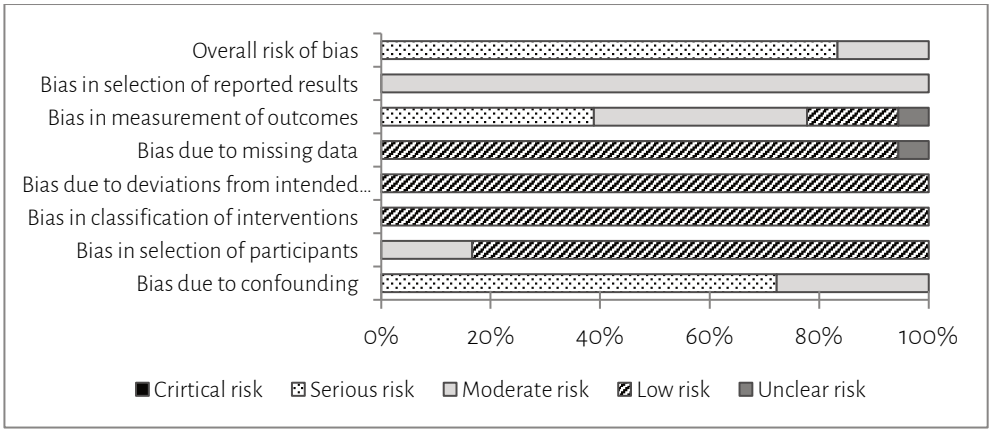
	Bias due to confounding	Bias in selection of participants	Bias in classification of interventions	Bias due to deviations from intended interventions	Bias due to missing data	Bias in measurement of outcomes	Bias in selection of reported results	Overall risk of bias
Aki et al. (2007, Turkey)[58]	++	++++	++++	++++	++++	?	+++	++
Al-Dababneh et al. (2015, Jordan)[59]	++	++++	++++	++++	++++	++	+++	++
Beelmann & Brambring (1998, Germany)[60]	+++	+++	++++	++++	++++	++	+++	++
Bieber-Schut (1991, Canada)[76]	++	++++	N/A	++++	?	++	+++	++
Black (1983, USA)[61]	++	++++	++++	++++	++++	++	+++	++
Blessing et al. (1993, USA)[94]	++	++++	N/A	++++	++++	+++	+++	++
Çalik et al. (2012, Turkey)[62]	++	+++	++++	++++	++++	++	+++	++
Chowdary et al. (2016, India)[63]	++	++++	++++	++++	++++	+++	+++	++
Corn et al. (2002, USA)[13]	++	++++	N/A	++++	++++	+++	+++	++
Cox et al. (2009, The Netherlands)[64]	++	+++	++++	++++	?	++++	+++	++
Debnath et al. (2017, India)[92]	++	++++	N/A	++++	++++	+++	+++	++
Dursun et al. (2015, Turkey)[77]	++	++++	N/A	++++	++++	++	+++	++
Farmer & Morse (2007, USA)[65]	++	++++	++++	++++	++++	+++	+++	++
Ganesh et al. (2013, India)[78]	++	+++	N/A	++++	++++	++	+++	++
Gothwal et al. (2015, India)[79]	++	+++	N/A	++++	++++	++	++	++
Grumpelt et al.(1968, USA)[66]	+++	++++	++++	++++	++++	+++	+++	+++
Hebbal et al. (2012, India)[80]	++	++++	N/A	++++	++++	+++	+++	++
Huurneman et al. (2016, The Netherlands)[67]	++	++++	++++	++++	++++	+++	+++	++

Johnson & Johnson (1991, USA)[68]	+++	++++	++++	++++	++++	++	+++	++
Levin & Rotheram-Fuller (2011, USA)[69]	++	++++	++++	++++	++++	++	+++	++
McMahon (2013, USA)[81]	++	++++	N/A	++++	++++	++	+++	++
McMahon (2013, USA)[82]	++	++++	N/A	++++	++++	+++	+++	++
Mohamed et al. (2011, Egypt)[83]	++	++++	N/A	++++	++++	++	+++	++
Mohanty et al.(2015, India)[73]	++	++++	++++	++++	++++	++++	+++	++
Mohanty et al. (2016, India)[70]	+++	++++	++++	++++	++++	++++	+++	+++
Pineio et al. (2017, Greece)[74]	+++	++++	++++	++++	++++	+++	+++	+++
Ponchillia et al. (2005, USA)[84]	++	++++	N/A	++++	++++	++	+++	++
Reimer et al. (2011, The Netherlands)[71]	++	++++	++++	++++	++++	+++	+++	++
Ritchie et al. (1989, India)[85]	++	++++	N/A	++++	?	+++	+++	++
Robinson & Lieberman (2008, USA)[86]	++	+++	N/A	++++	++++	++	+++	++
Shapiro et al. (2005, USA)[87]	++	++++	N/A	++++	++++	++	+++	++
Shetty et al. (2013, India)[72]	++	++++	++++	++++	++++	++	+++	++
Shindo et al. (1987, Japan)[93]	++	++++	N/A	++++	++++	+++	+++	++
Taskin (2016, Turkey)[75]	++	++++	++++	++++	++++	+++	+++	++
Ungar et al. (1997, UK)[88]	++	++++	N/A	++++	++++	+++	+++	++
Uysal & Duger. (2012, Turkey)[89]	++	++++	N/A	++++	++++	+++	+++	++
Williams (1985, UK)[90]	++	++++	N/A	++++	?	++	+++	++
Yalcinkaya & Atalay (2006, Turkey)[91]	++	++++	N/A	++++	++++	+++	+++	++

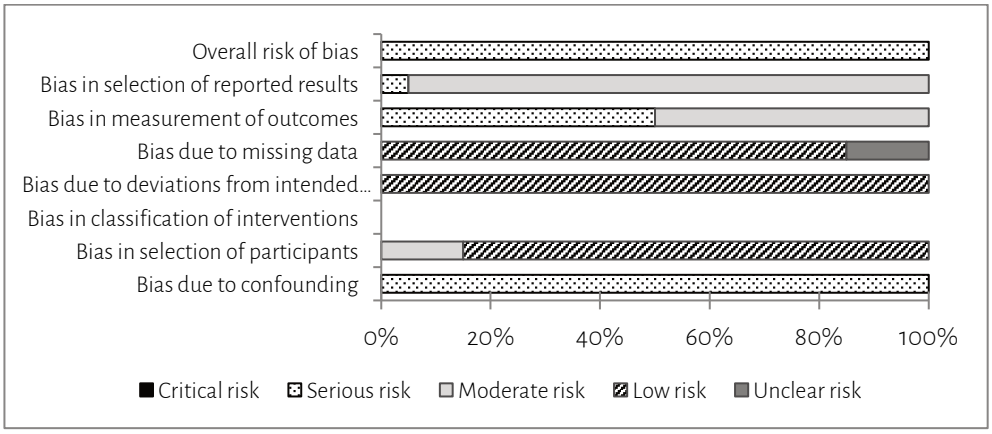
?: unclear risk of bias; +: critical risk of bias; ++: serious risk of bias; +++: moderate risk of bias; ++++: low risk of bias



a. Risk of bias graph for RCTs



b. Risk of bias graph for non-RCTs



c. Risk of bias graph for BAs

Figure 2. Risk of bias graphs for a) RCTs; b) non-RCTs; and c) BAs: review authors' judgements about each risk of bias parameter presented as percentages across all included studies

Effectiveness of interventions to improve quality of life, functioning and participation

Main outcomes of the included studies and effect sizes (if applicable) are presented in Table 4. Twenty-two of the 66 (33.3%) included studies did not provide sufficient details on pre- and post-intervention data for effect sizes to be calculated.[32,35-37,44,45,48,49,59,61,65,66,68,73,76,78,84-86,88,90,92] This makes it even more difficult to perform study comparisons. Below the key findings of each of the included studies are described, grouped by the main subjects of the studies.

Physical performance

Seventeen studies focused on physical performance of which five were RCTs,[37,38,42,56,57] seven were non-RCTs,[58,61,70,71,73-75] and five were BAs.[82,84,86,93,94] Four studies assessed the effectiveness of interventions on (fine) motor skills,[38,58,71,74] whereas (dynamic) balance was evaluated in three studies.[37,42,61] Physical performance and fitness was assessed in four studies[56,73,82,93], whereas body composition was assessed in two studies.[57,94] Two studies investigated cardiovascular parameters.[75,94] Motor speed,[70] physical activity time,[86] sports skills,[84] and auditory reaction time[75] were all evaluated in one study.

Joseph investigated whether different types of verbal information feedback had a positive impact on motor skills of children who are blind (i.e. insufficient vision to read print or use their vision for learning). Mean performance significantly increased over the course of the sessions for all groups (small to moderate effect sizes), but the most extensive programme improved performance the most (although not significantly). Moreover, results were not maintained once verbal information feedback was stopped.[38] Robinson and Lieberman investigated the effectiveness of providing information to parents via the parent resource manual on physical activity time of children with visual impairment, but found no differences.[86] Reimer et al. examined the effect of training in trail-following tasks on fine motor skills of children with vision impairment (visual acuity between 20/400-20/67). The trail-following tasks consisted of sheets with four trails of small symbols printed on them, with a picture marking its beginning to a corresponding picture marking its end. For this purpose they compared a group of children who followed the trails with a stand magnifier (intervention) with a group who followed the trails without a visual aid using their finger (control). Significant improvements in fine motor skills were found after training for both groups (moderate to large effect sizes), irrespective of the use of a visual aid during training.[71]

Eleven studies investigated (group-based) training programmes. Jazi et al. examined the effect of balance exercises on the dynamic balance of children with visual impairment (i.e. visual acuity 20/70 or worse in the better eye after correction). Children in the intervention group scored significantly higher on dynamic balance after the programme, whereas no difference was found in the control group.[37] Similarly, Mavrovouniotis et al. examined the effect of Greek dances and Pilates on balance of children who are blind. After the programme, children in the intervention group had improved significantly, whereas no difference was found in the control group. Effect

sizes for the intervention group were large.[42] Pineio et al. investigated the impact of an adapted kinetic intervention programme on the motor development of children with visual impairment. Participants in the intervention group improved significantly on all subscales and the complete test (large effect size), but no difference was found in the control group.[74] Aki et al. compared the effectiveness of a motor training programme guided by a physiotherapist (intervention) or delivered at home by parents who were instructed by the physiotherapist (control) on the motor skills of children with visual impairment (i.e. fit into the severe low vision category according to ICD-9; visual acuity 40/200 or worse). The intervention group significantly improved on all subtests, whereas the control group significantly improved on seven of the eight subtest. A large effect size was found for the intervention group, whereas a small effect size was found for the control group. Post intervention scores on five of the eight subtests were significantly higher for the intervention group compared to the control group, while no difference was found in the remaining subtests. The authors concluded that training programmes in both a clinical environment provided by a physiotherapist, as well as a home surrounding provided by parents can improve the motor proficiency of children with low vision. They found that complex skills such as balance, coordination and response to stimuli could be trained by a physiotherapist because changing the specific activities according to the child's reactions requires specific knowledge.[58] Shindo et al. investigated the impact of endurance training on physical and psychic symptoms and physical resources in young males with visual impairment or blindness. Physical and psychic symptoms improved in all participants after training, and some parameters of physical resources (i.e. maximal oxygen uptake, maximal ventilation and workload) also increased significantly (small to large effect sizes). However, no difference was found on any of the other parameters (i.e. stepping rate, pedalling speed and strength, muscle strength, skinfold thickness, body height and weight).[93] Similarly, Blessing et al. evaluated the effects of endurance training on cardiovascular fitness and body composition of visually impaired children. They found significant improvements in skinfold thickness (small effect sizes) and cardiovascular variables (small to moderate effect sizes) after training. Weight increased significantly after training (small effect size), but according to the authors, this might partly be caused by maturational changes. Moreover, the weight gain was thought to be primarily an accumulation of lean tissue as the result of the endurance training.[94] Taskin evaluated the effectiveness of an aerobic training programme on auditory reaction time and maximal oxygen uptake in children with visual impairment (blind 3 classification). Both outcomes improved significantly in the intervention group, but not in the control group (large effect size). The difference between the intervention and control group was statistically significant for both outcomes after the intervention (large effect size).[75] Mohanty et al. investigated the effect of yoga training on motor speed in children with legal blindness (visual acuity less than 20/200 or visual field limited to 20°), and found significant improvement in motor speed for the intervention group (moderate effect sizes), but no significant differences for the control group. The authors suggest that yoga may offer an effective, safe alternative training modality for enhancing health in children with visual impairment.[70] In a second study, Mohanty et al. applied yoga to increase muscular fitness in visually impaired children. At baseline, there was no difference between the intervention and the control group, whereas after the intervention the

yoga group had a significantly higher proportion of participants who passed the test.[73] Chen and Lin studied the impact of rope jumping exercise on physical fitness of visually impaired students. The intervention group showed significant improvements in sit-and-reach and aerobic capacity (moderate effect sizes), but no differences were found for body mass index and sit-up. The control group showed no significant improvements on any of the variables. The difference between the intervention and control group was statistically significant after the intervention for sit-and-reach and aerobic capacity (small to moderate effect sizes).[56] Last, in children with severe visual impairment, Caliskan et al. compared a goalball intervention with movement education. Body fat percentage decreased in both groups, but only in the goalball group significantly (small effect size). Body mass index decreased significantly in the goalball group (small effect size) but increased in the movement education group. The authors conclude that maturation confounds the results, but movement education might be preferred for boys, whereas goalball might be preferred for girls.[57]

Three studies investigated the effectiveness of sports camps. Black et al. compared the effectiveness of an outdoor adventure camp (intervention) with a traditional residential physical activity programme (control) on dynamic balance and spatial veering in children with visual impairment (visual acuity of 20/200 or less). Both dynamic balance and spatial veering improved significantly in the intervention group, while no significant improvements were found in the control group.[61] Ponchillia et al. investigated the impact of a sports education camp on sports skills of children with visual impairment, and found significant improvements in sports skills after the intervention.[84] A similar study conducted by McMahon in which children also significantly improved their sports skills. Effect sizes were all small.[82]

Oral health

Self-care is one of the domains of the Activity and Participation component of the ICF-CY, and oral health is part of self-care. Therefore, studies focusing on oral health were included in this systematic review. All studies originated from Asian countries. Ten studies aimed to investigate the effect of different methods to improve oral health in children with visual impairment: five RCTs,[34,46,50,51,53] two non-RCTs,[63,72] and three BAs.[80,91,92] All studies assessed the effectiveness of interventions on oral health status. Furthermore, three studies also considered the effectiveness of interventions on oral health knowledge,[34,91,92] and two studies on oral hygiene practice.[80,92]

Six studies evaluated the effectiveness of various oral health education programmes. Ganapathi et al. evaluated the effectiveness of various sensory input models on oral health education among blind children. They compared four intervention groups with a control group. The intervention groups received oral health education by either audio, braille, tactile tooth models or a combination of the previous (multisensory). In all intervention groups, oral health knowledge significantly increased and plaque scores significantly decreased after the intervention (moderate to large effect sizes), but no post-measures were taken for the control group. For increasing knowledge, the multisensory group was significantly superior to the audio and tooth models

group, which were significantly superior to the braille group. For plaque scores, the multisensory group, audio group and tooth models group were significantly superior to the braille group.[34] In a similar study in children with legal blindness from birth, Chowdary et al. compared an intervention group who received a combination of verbal, braille and tactile oral hygiene awareness intervention with two control groups, one of which received a verbal and tactile oral hygiene awareness intervention whereas the other received a verbal and braille oral hygiene awareness intervention. All groups showed a significant, gradual decline in plaque and gingival scores from baseline to follow-up (large effect sizes). At six months follow-up, the intervention group showed significantly greater decline in plaque scores compared to the control groups. For gingival scores, the verbal and braille group showed the greatest decline, and this was significantly different from the verbal and tactile group.[63] Arunakul et al. compared visually impaired children in two intervention groups with a control group. The intervention groups received oral hygiene education kits and brushing instructions either with sodium fluoride mouth rinse or without sodium fluoride mouth rinse, whereas the control group received brushing instructions only. All groups improved significantly in gingival index and plaque index (large effect sizes), but only the intervention groups improved their *Streptococcus mutans* level (moderate to large effect sizes). The intervention groups improved significantly compared with the control group (small to large effect sizes).[51] Shetty et al. investigated blind children and compared an intervention group who received a one-month oral health education programme with a control group who received the education programme for two weeks. Both groups improved significantly on gingival index, plaque index and number of the counted colonies of the bacteria *S. mutans* (small to large effect sizes). The intervention group improved significantly compared with the control group (large effect sizes).[72] Yalcinkaya and Atalay found significant improvements in oral health knowledge, plaque index and gingival index after completion of their oral health education programme (small to large effect sizes) in a sample comprising of blind and visually impaired children.[91] Similarly, Debnath et al. found significant improvements in children with visual impairment (visual acuity ≤20/200) regarding knowledge, attitudes and practices (e.g. number of times brushing twice daily, use of floss) regarding oral health after their intervention, and a significant change in the percentage of children having a fair plaque index.[92]

Four studies assessed the effectiveness of tooth brushing instructions. Smutkeeree et al. compared the effectiveness of two methods of tooth brushing, namely the horizontal scrub method (intervention) and the modified bass method (control) in children with visual impairment. Both groups significantly reduced the plaque index and gingival index (large effect sizes), and there was no significant difference between the groups.[46] Hebbal and Ankola investigated the effectiveness of the audio tactile performance technique on oral health status and oral hygiene practice in children with blindness and visual impairment. After the programme, the number of children having proper oral hygiene practice increased, although the result was not significant. The plaque index decreased significantly after the programme (large effect size).[80] Krishnakumar et al. also investigated the effectiveness of the audio tactile performance technique in children with visual impairment (i.e. fitting into categories 3, 4 and 5 of visual impairment

according to the ICD) and compared it to a control group receiving audio education. Plaque scores of the intervention group decreased significantly (large effect size), whereas no difference was found in the control condition.[53] Qureshi et al. compared an intervention group who received a guided tooth brushing programme with a control group who received a verbal oral hygiene message in children with blindness and visual impairment. The intervention group significantly reduced their oral hygiene index score (large effect size).[50]

Psychological outcomes

Nine studies assessed the effectiveness of interventions on psychological outcomes, which we considered to be part of the concept quality of life, including three RCTs,[32,33,41] two non-RCTs,[68,69] and four BAs.[77,81,83,87] One study looked at the effectiveness of interventions on self-image,[41] one study on psychological wellbeing,[32] one study on motivation to work,[33] one study on self-determination,[69] three studies on self-concept,[68,69,77] two studies on self-esteem,[69,83] one study on attitude towards blindness and locus of control,[68] one study on sleep quality and behavioural and emotional states,[77] one study on perception of competence,[87] one study one self-perception,[81] and one study on anxiety, depression and activities of daily living.[83]

Six studies assessed the effectiveness of group-based programmes. Locke and Gerler compared different training programmes' impact on self-image in children with visual impairment. Both the two intervention groups and the two control groups improved after the intervention, but none of these changes were statistically significant.[41] Eniola and Ajobiewe compared locus of control training and emotional intelligence training with a control group to assess its effectiveness on psychological wellbeing in children with visual impairment and blindness. The two intervention groups improved significantly compared to the control group, although emotional intelligence training was superior to locus of control training.[32] In a similar study, Eniola and Adebiyi compared emotional intelligence training with goal setting with respect to motivation to work in children with visual impairment. Motivation to work increased significantly in both groups (large effect sizes), and the data suggest that emotional intelligence might have a more positive impact than goal setting, although no significant difference was found.[33] According to the study of Levin and Rotheram-Fuller, a group-based empowered curriculum did not lead to changes in self-determination, self-concept and self-esteem in children with visual impairment. No changes for the control group were found either. Despite lack of results in quantitative findings, the authors state that data that were derived qualitatively suggest that the empowered curriculum is a useful intervention for engaging students with visual impairment.[69] In contrast, investigating children with visual impairment, Johnson and Johnson were able to find significant improvements in self-concept in an intervention group which received group counselling, compared to the control group that received no intervention. They also found significant improvements in attitude towards blindness and locus of control in the intervention group compared to the control group.[68] Mohamed et al. conducted a study among adolescents with primary or secondary glaucoma in which they evaluated a group-based educational programme as well. After the programme, children reported significantly less problems in activities of daily living. Furthermore, children's

scores on anxiety, depression and self-esteem all improved significantly. Large effect sizes were found for anxiety and self-esteem, whereas the effect size for depression was small.[83]

Three studies evaluated the effectiveness of physical activity programmes. McMahon investigated the effectiveness of a sports camp on self-perception, which improved significantly among children with visual impairment (moderate to large effect sizes).[81] In a similar study, Shapiro et al. found significant improvements in perception of competence of children with visual impairment who attended a sports camp (small effect sizes).[87] Dursun et al. evaluated the effectiveness of an ice-skating programme on sleep quality, self-concept and behavioural and emotional states in children with visual impairment (best corrected visual acuity of 20/200 in the better eye). Sleep quality improved significantly after the programme (moderate effect size), while self-concept deteriorated significantly (large effect size). Mixed results were found for behavioural and emotional states (moderate to large effect sizes). The authors hypothesised that ice-skating requires reasonable balance and motor skills, which are often less developed in children with visual impairment compared to controls. As other studies indicate a strong correlation between self-esteem and motor performance, ice-skating may have provoked negative thoughts about themselves.[77]

Functioning and development

Nine studies focused on functioning and development. Of those, three were RCTs,[30,52,55] three were non-RCTs,[59,60,62] and three were BAs.[78,79,90] Two studies assessed the effectiveness of interventions on functional vision,[78,79] and two on general development.[60,90] One study looked at the effectiveness on child and family functioning,[30] and one study focused on cognition, activities of daily living and quality of life.[62] One study focused on positive parenting,[52] one on creativity,[59] and one on impact of vision impairment.[55]

Four studies investigated the effectiveness of intensive (home-based) early intervention programmes. Behl et al. compared children with visual impairment (visual acuity 20/200 or worse) in a group who received an intensive, individualised, home-based intervention with a group who received usual care, i.e. parent group meetings which were less intensive. In both groups child functioning improved (large effect sizes), and although there was no significant difference in total score on any of the time points between groups, data suggests that the usual care group improved more. For family functioning, there were no significant differences between groups on any of the time points, and mixed results were found for the outcome measures. Some outcomes improved due to the intervention (in both groups) (e.g. the Family Support Scale), whereas no difference or deteriorations occurred in other outcomes (e.g. the Family Resource Scale). Effect sizes were small to moderate.[30] Beelmann and Brambring also compared a home-based early intervention programme with care as usual in children with congenital blindness. In full-term children, the intervention group was significantly superior to the control group on general development at 30 months (large effect size), but not at any of the other time points. In preterm children, differences between the intervention and control group tended to be small, but data suggested superiority of

children in the control group, particularly at older ages (small to moderate effect sizes.)[60] In children with visual impairment, Platje et al. compared an intervention group who received an attachment-based video-feedback parenting intervention (VIPP-V) in combination with care as usual to a control group who received only care as usual. No differences were found in parental sensitivity or quality of parent-child interaction, but parenting self-efficacy significantly increased in the intervention group (small effect sizes) and there was a trend towards decreased parenting stress (small effect sizes).[52] Christy compared four methods of low vision service delivery in children with visual impairment (best corrected visual acuity less than 6/12 to light perception in the better eye, or visual field <20°. Significant differences after low vision service provision on impact of vision impairment were found for all groups (small to large effect sizes). The effect sizes of the centre- and community-based arm was significantly higher than in the other arms.[55]

Calik et al. investigated the effectiveness of attention training on cognition, quality of life and activities of daily living of children with visual impairment. After the programme, children in the intervention group showed significant improvements on cognition (large effect size), quality of life (small effect size) and activities of daily living (large effect size), while the control group showed no difference. Significant differences between the groups in cognition, quality of life and activities of daily living were found after the programme, in favour of the intervention group (small to large effect sizes).[62] Al-Dababneh et al. investigated whether a training programme aimed at developing creative abilities would increase the creativity of children with visual impairment. They found that the intervention group gained significantly more than the control group in all scale dimensions.[59] Williams et al. evaluated the effect of admission to a care unit on the development of children with visual impairment. After the programme, children showed significant improvement on social adaptation and sensorimotor understanding. There was a trend towards significance for exploration of the environment, but there was no difference in responses to sound and verbal comprehension nor in expressive language. The authors hypothesised that this might be caused by the institutionalised setting, the lack of formal speech and communication training in the unit or the way in which the staff interacted with the children was not sufficiently modified to take account of the children's handicaps.[90]

Two studies assessed the effectiveness of the prescription of low vision devices and training in their usage on functional vision. Participants in the study of Gothwal et al. were prescribed optical devices (including telescopes and magnifiers), electronic devices (including portable video magnifiers and closed-circuit television) and/or nonoptical devices (e.g. reading stand, reading lamp, filter for glare control and needle threader). Children were provided training in the use of the prescribed devices and optional training in orientation and mobility, computer use and activities of daily living. The authors found a significant improvement in children with visual impairment on the LVP-FVQ II score, an instrument to assess functional vision, indicating improvements on that domain after the prescription and training in the usage of low vision devices (moderate effect size).[79] In line with these results is the study of Ganesh et al., who prescribed telescopes, magnifiers and nonoptical devices (e.g. lamps, reading stands, writing guides, bold-

lined note books and large print books) and provided training in its use. They found significant improvements on the LVP-FVQ scores post visual rehabilitation in children with visual impairment (i.e. inclusion in the category of visually impaired as per the WHO criteria for low vision), especially in those activities related to academic output.[78]

Reading performance

Eight studies focused on reading performance: four RCTs[35,36,39,40], two non-RCTs,[65,67] and two BAs.[13,89] All studies looked at the effectiveness of interventions on (braille) reading skills.[13,35,36,39,40,65,67,89] Moreover, two of the studies investigated the effectiveness on comprehension,[13,36] one study on critical print size, reading acuity and acuity reserve,[67] and one study focused on writing speed and legibility of writing.[89]

Four studies assessed the effectiveness of various (braille) reading training programmes. Howell investigated the effectiveness of braille training in legally blind subjects (i.e. using braille as primary reading media) using either the freehand method or the pacing method, whereas the control group received no intervention. The two intervention groups significantly increased their braille reading rate compared to the control group; there was no significant difference between the intervention groups. Training did not result in significant differences in comprehension for any of the groups.[36] Kederis et al. also investigated the effect of pacing training in braille readers. Both the intervention group and the control group showed large significant reductions in reading time (small to large effect sizes), but the groups did not differ significantly from each other. The authors hypothesised that the reduction was mainly caused by motivation (i.e. those with the greatest reduction received a monetary award), and training did not have an influence. Furthermore, comprehension in the experimental and control group deteriorated, although not significantly.[40] In a second study, Kederis et al. again found that motivation was probably the only factor that caused a significant change in reading among braille readers. Both the experimental and the control group significantly decreased their reading time (moderate to large effect sizes), and the control group showed a greater reduction than the intervention group, although the groups did not differ significantly. Again, reductions in reading time were accompanied by deteriorations in comprehension, both for the experimental and the control group (small to large effect sizes).[39] Last, Heber evaluated the effectiveness of braille tape reader training in children using braille (visual acuity 20/2000 or less in the better eye after best correction). The intervention group increased their reading speed compared to the control group, but the results were not transferred to reading braille in a traditional manner.[35]

Three studies investigated the effectiveness of (training in) the use of optical aids. Farmer and Morse compared a group of children with low vision (visual acuity 20/70 or worse) who received training with magnifiers (intervention) with a group of children who received training in large print use (control). Both groups improved on their reading skills, but the intervention group made more profound gains. Children in the control group only increased their reading rate, whereas children in the intervention group improved in type size, reading rate and reading comprehension.[65] Uysal

and Düger investigated the effect of reading and writing training with the use of optical assistance prescribed by an ophthalmologist (e.g. eyeglasses, telescopic glasses and magnifying glasses) on reading and writing speed and writing legibility in children with visual impairment (i.e. satisfying the criteria for low vision according to the ICD-10). After attending training, children significantly increased their reading and writing speed, but writing legibility was not significantly improved; effect sizes were all small.[89] Similarly, Corn et al. evaluated the effect of the prescription of optical devices (including magnifiers, monocular telescopes and light-absorptive lenses) on reading and comprehension rates of children with visual impairment. They found that using optical devices improved silent reading and silent comprehension rates, but not oral reading and oral comprehension rates. The authors state that this might suggest that for children with low vision, oral reading does not demonstrate the level of skills that children have. Effect sizes were all small, except for silent reading speed, where a large effect size was found.[13]

Huurneman et al. compared a group of children with infantile nystagmus (visual acuity 20/31-20/400) who received crowded training (intervention) with a group who received uncrowded training (control). In the uncrowded training group, children had to report the orientation of a C by pressing a corresponding key on the keyboard. Feedback was given after each trial. Letter size was reduced if at least 7 of 10 answers were correct; otherwise, letter size was increased. The crowded training group was instructed to identify a target C surrounded by six Cs of the same size in another orientation. Children had to report the orientation of the target C. Spacing was reduced if at least 7 of 10 answers were correct; otherwise spacing was increased. The authors concluded that training significantly improved reading acuity and affected minimum critical print size, irrespective of training condition, although moderate effect sizes were found for the intervention group, versus small effect sizes for the control group. Training did not have an influence on maximum reading speed and acuity reserve.[67]

Social skills

Seven studies focused on social skills, including five RCTs,[43,45,47,49,54] one non-RCT,[66] and one BA.[76] Four studies had social skills as an outcome measure.[45,47,54,76] Furthermore, one study looked at the effectiveness of interventions on social competence and social validation,[45] one study focused on activity performance,[47] one study on adolescent-parent communication,[43] one study on empathic skills and communication skills,[49] one study on assertiveness, self-criticism and helplessness,[54] and one study on speed of listening skills.[66]

Two studies investigated the effectiveness of social skills training. Yildiz and Duy investigated whether a group-based psycho-education programme had a positive effect on the empathic and communication skills of children with visual impairment. Compared to the pre-test, the intervention group improved significantly on both empathy and communication after the intervention, but the differences between the groups were not statistically significant.[49] In legally blind children (congenitally visually impaired), Sacks and Gaylord-Ross compared two intervention groups, who received either peer-mediated social skills training or teacher-directed

social skills training with a control group. For both intervention groups, significant improvements were found on social skills, social competence and social validation, while the control group only showed improvements on a few aspects of social skills. Both intervention groups improved significantly more than the control group on social competence. Upon closer examination, the changes in the peer-mediated group were larger than in the teacher-directed group, but this result was not statistically significant.[45]

Kim assessed the effectiveness of assertiveness training in children with visual impairment, and compared the intervention group to a control group who received no intervention. After the intervention, there were no significant differences between the intervention and control group on social skills as rated by participants, parents and teachers, assertiveness as rated by participants and observers and cognitive distortions as rated by participants. Both the intervention and the control group improved on all measures from pre-test to post-test, except for assertiveness rated by participants, which improved in the intervention group but deteriorated in the control group.[54] Bieber-Schut investigated whether developmental drama workshops had a positive influence on the social skills of children with visual impairment, which was indeed the case.[76] Uysal and Düger evaluated the effectiveness of visual perception training in children with visual impairment (i.e. fitting into the low vision category according to the ICD-10-CM) and compared a group of children who trained with a computer (intervention) to a group who trained with paper and pencil (control). Both groups improved significantly on social skills (small to moderate effect sizes) and activity performance (large effect sizes), and neither of the groups was superior to the other.[47]

Two studies examined the effectiveness of communication training. McConnell studied whether the Partner's Programme was effective on enhancing adolescent-parent communication in visually impaired children. They did not find any significant differences in adolescent-parent communication, and effect sizes were small.[43] Grumpelt and Rubin assessed the effectiveness of speed listening training at high speed (intervention) compared to normal speed (control) in blind children. Both groups significantly deteriorated at post-test, delivered at high speed, as compared to pre-test, which was delivered at normal speed, but the intervention group deteriorated less.[66]

Viewing behaviour

Four studies focused on viewing behaviour. Of those, two were RCTs,[31,44] one was a non-RCT,[64] and one was a BA.[85] Two studies evaluated the effectiveness of interventions on visual functioning,[44,85] one study on viewing behavior,[31] and one study on task performance.[64]

Nyquist et al. investigated the effectiveness of video games on visual functioning in children with visual impairment (best corrected binocular visual acuity 20/60-20/800 and visual field at least 35°). Visual functioning included foveal motion perception, single target motion discrimination, multi-target direction comparisons, visual crowding, and visual search. They compared two intervention groups, who either received an action video game or modified attentional tracking, to a control group who received a control video game. The action video game was called "Ratchet and Clank: Dreadlocked", which was played on a PlayStation 2. In the modified attentional tracking

task, the participant has to track target balls and discriminate motion direction. The control group received a video game called "Lumines", which is similar to "Tetris". Both intervention groups showed significant improvements after training, except for foveal motion perception, whereas no difference was found for the control group, except for visual search. Data suggested that modified attention tracking resulted in more profound improvements than action video games, but there was no significant difference between the groups.[44]

Three studies assessed the effectiveness of training in visual aids. Investigating children with visual impairment (visual acuity 20/50 or less in the better eye after best possible correction), Boonstra et al. compared a group who received training with a magnifier (intervention) to a group who received training without a magnifier. After training, both groups significantly improved their duration of observing time and the distance from which they viewed the symbols on the LH chart (consisting of Lea symbols) near vision test single and on the LH chart near vision line (moderate effect sizes). There was no significant difference between the groups.[31] A study using the same criteria for visual impairment was conducted by Cox et al., who found that both the experimental and control group improved significantly in the number of trails followed after training (large effect sizes). They employed the same training strategy as Reimer et al.:[71] children in the intervention group followed trails (made of small symbols printed on a sheet) with a stand magnifier, whereas children in the control group followed trails without a visual aid using their finger. When looking at the proportion of trails followed correctly, the children in the intervention group who were trained with the magnifier gained significantly more than the children in the control group who were trained without a magnifier.[64] Last, Ritchie evaluated whether children with severe visual impairment who received training in the use of a visual aid improved their visual functioning, i.e. whether children correctly responded to questions about a set of visual material presented to them. Children were prescribed a lobster pot stand magnifier, a fleximag stand magnifier, closed-circuit television, a monocular telescope or a binocular telescope, or a combination of these visual aids. The material chosen varied for the aid prescribed, and included various near visual (motor) tasks. In this study, 50% of the children improved on visual functioning.[85]

Mobility

Two studies focused on mobility: one RCT,[48] and one BA.[88] One study assessed the effectiveness of interventions on motor, sensory, concept and mobility skills[48] and the other study on the performance of estimating distances.[88]

In children with severe visual impairment (i.e. light perception or less), Wood compared an intervention group who received programmed orientation and mobility instruction materials to a distal control group and an onsite control group. Both control groups received a regular educational programme. Compared to the control groups, the intervention group improved significantly on all intervention content areas.[48] Ungar et al. evaluated a training for estimating distances from a map in children with visual impairment, and concluded that they improved.[88]

Table 4. Characteristics of reviewed studies, divided into study focus: 1) physical performance, 2) oral health, 3) psychological outcomes, 4) reading performance, 5) functioning & development, 6) social skills, 7) viewing behaviour, and 8) mobility skills

Author (year, country)	Outcome per group baseline versus follow-up	Results and effect size baseline versus follow-up	Outcome per group versus comparator	Results and effect size per group versus comparator
1. Physical performance				
Aki et al. (2007, Turkey, 2-arm non-RCT)[58]	Pre-test vs. post-test for a) intervention motor skills b) control motor skills	a) significant improvement (ES: -1.501) b) significant improvement (ES: -0.408)	Intervention vs. control at a) post-test motor skills b) gain motor skills	a) significant differences on various subtests in favour of intervention b) intervention gained more (ES: 1.083)
Black (1978, USA, 2-arm non-RCT)[61]	Pre-test vs. post-test for a) intervention dynamic balance b) intervention spatial veering c) control dynamic balance d) control spatial veering	a) significant improvement b) significant improvement c) no significant results d) no significant results	Intervention vs. control at a) pre-test dynamic balance b) pre-test spatial veering c) post-test dynamic balance d) post-test spatial veering e) gain spatial veering	a) no significant difference b) no significant difference c) significant difference in favour of intervention d) significant difference in favour of intervention e) intervention gained significantly more
Blessing et al. (1993, USA, 1-arm BA)[94]	Pre-test vs. post-test for a) weight b) skinfold thickness c) cardiovascular variables	a) significant increase (ES: -0.116) b) significant improvement (ES: 0.134) c) significant improvements (ES: 0.339; 0.787)	N/A	N/A

Caliskan et al. (2011, Turkey, 2-arm RCT)[57]	Pre-test vs. post-test for a) intervention BMI b) intervention percent body fat c) control BMI d) control percent body fat	a) significant decrease (ES: 0.111) b) significant decrease (ES: 0.480) c) non-significant increase (ES: -0.169) d) non-significant decrease (ES: 0.272)	Intervention vs. control at a) gain BMI b) gain percent body fat	a) intervention decreased more (ES: -0.282) b) intervention decreased more (ES: -0.088)
Chen & Lin (2011, Taiwan, 2-arm RCT)[56]	Pre-test vs. post-test for a) intervention BMI b) intervention sit-and-reach c) intervention sit-up d) intervention PACER e) control BMI f) control sit-and-reach g) control sit-up h) control PACER	a) non-significant decrease (ES: 0.070) b) significant improvement (ES: -0.751) c) non-significant improvement (ES: -0.015) d) significant improvement (ES: -0.649) e) non-significant decrease (ES: 0.010) f) non-significant deterioration (ES: 0.007) g) non-significant deterioration (ES: 0.015) h) non-significant improvement (ES: -0.102)	Intervention vs. control at a) gain BMI b) gain sit-and-reach c) gain sit-up d) gain PACER	a) intervention decreased more (NS; ES: -0.051) b) intervention gained significantly more (ES: 0.583) c) intervention gained more (NS; ES: 0.031) d) intervention gained significantly more (ES: 0.433)
Jazi et al. (2012, Iran, 2-arm RCT)[37]	Pre-test vs. post-test for a) intervention dynamic balance b) control dynamic balance	a) significant improvement b) non-significant deterioration	Intervention vs. control at a) pre-test dynamic balance b) post-test dynamic balance c) gain dynamic balance	a) no significant difference b) significant difference in favour of intervention c) intervention gained more

Table 4. Cont'd

Author (year, country)	Outcome per group baseline versus follow-up	Results and effect size baseline versus follow-up	Outcome per group versus comparator	Results and effect size per group versus comparator
Joseph (1984, USA, 3-arm RCT)[38]	Pre-test vs. post-tests for a) intervention motor skills b) knowledge of results control motor skills c) knowledge of performance control motor skills	a) significant improvement (ES: -0.701; -0.299), deterioration at T3 (ES: 0.676) b) significant improvement (ES: -0.725; -0.405), deterioration at T3 (ES: 0.729) c) significant improvement (ES: -0.349; -0.219), deterioration at T3 (ES: 0.855)	Intervention vs. control at a) gain intervention vs. knowledge of results motor b) gain intervention vs. knowledge of performance motor skills c) gain knowledge of performance vs. knowledge of results motor skills	a) similar gain at T2, similar deterioration at T3 (ES: 0.000; 0.093) b) intervention gained more (ES: -0.401; -0.094) c) knowledge of results gained more (ES: -0.408; -0.100)
Mavrovouniotis et al. (2013, Greece, 2-arm RCT)[42]	Pre-test vs. post-test for a) intervention MABC-2 b) intervention BOT-2 c) control MABC-2 d) control BOT-2	a) significant improvements (ES: -0.953; -3.278) b) significant improvements (ES: -0.982; -1.291) c) non-significant improvements/deteriorations (ES: -0.240; 0.693) d) non-significant improvements (ES: -0.353; 0)	Intervention vs. control at a) pre-test MABC-2 b) pre-test BOT-2 c) post-test MABC-2 d) post-test BOT-2 e) gain MABC-2 f) gain BOT-2	a) no significant differences b) no significant differences c) significant differences in favour of intervention d) significant differences in favour of intervention e) intervention gained more (ES: 1.337; 2.306) f) intervention gained more (ES: 0.939; 1.398)

McMahon (2013, USA, 1-arm BA)[82]	Pre-test vs. post-test for a) standing long jump b) overarm throw c) underarm throw d) throwing speed	a) significant improvement (ES: -0.213) b) significant improvement (ES: -0.075) c) significant improvement (ES: -0.243) d) non-significant deterioration (ES: 0.156)	N/A	N/A
Mohanty et al. (2015, India, 2-arm non-RCT)[73]	Pre-test vs. post-test for intervention muscle fitness	Significant improvement	Intervention vs. control at a) pre-test muscle fitness b) post-test muscle fitness	a) no significant difference b) significant difference in favour of intervention
Mohanty et al. (2016, India, 2-arm non-RCT)[70]	Pre-test vs. post-test for a) intervention motor speed b) control motor speed	a) significant improvement (ES: -0.578; -0.678) b) non-significant improvement (ES: -0.057; -0.100)	Intervention vs. control at gain motor speed	Intervention gained significantly more (ES: 0.461; 0.634)
Pineio et al. (2017, Greece, 2-arm non-RCT)[74]	Pre-test vs. post-test for a) intervention motor development b) control motor development	a) significant improvement (ES: -4.788) b) no difference (ES: -0.016)	Intervention vs. control at gain motor development	Intervention gained more (ES: 1.363)
Ponchillia et al. (2005, USA, 1-arm BA)[84]	Pre-test vs. post-test sport skills	Participants significantly increased performance in sport skills	N/A	N/A

Table 4. Cont'd

Author (year, country)	Outcome per group baseline versus follow-up	Results and effect size baseline versus follow-up	Outcome per group versus comparator	Results and effect size per group versus comparator
Reimer et al. (2011, The Netherlands, 2-arm non-RCT)[71]	Pre-test vs. post-test for a) intervention ManuVis b) intervention Movement ABC c) control ManuVis d) control Movement ABC	a) improvement (ES: 0.836) b) improvement (ES: 0.626) c) improvement (ES: 0.733) d) improvement (ES: 1.351)	Intervention vs. control at a) pre-test ManuVis b) post-test ManuVis c) post-test Movement ABC d) gain ManuVis e) gain Movement ABC	a) no significant differences b) significant differences in favour of intervention c) no significant differences d) control gained more (ES: -0.414) e) control gained more (ES: -0.991)
Robinson et al. (2007, USA, 1-arm BA)[86]	Pre-test vs. post-test physical activity time	Significant improvement for boys, not for girls; decrease for the total group	N/A	N/A
Shindo et al. (1987, Japan, 1-arm BA)[93]	Pre-test vs. post-test for a) CMI b) physical fitness tests	a) improvement b) significant improvement in 7/22 variables (ES oxygen uptake: -0.896; 0.957; ES heart rate: -0.348; ES ventilation: -0.533)	N/A	N/A
Taskin (2016, Turkey, 2-arm non-RCT)[75]	Pre-test vs. post-test for a) intervention reaction time b) intervention oxygen uptake c) control reaction time d) control oxygen uptake	a) significant improvement (ES: 0.888) b) significant improvement (ES: -2.404) c) no difference (ES: 0.000) d) no difference (ES: 0.000)	Intervention vs. control at a) gain auditory reaction time b) gain maximal oxygen uptake	a) intervention gained more (ES: 0.848) b) intervention gained more (ES: 2.720)

2. Oral health				
Arunakul et al. (2015, Thailand, 3-arm RCT)[51]	Pre-test vs. post-test for a) mouth rinse+OHE intervention plaque b) mouth rinse+OHE intervention gingival index c) mouth rinse+OHE intervention Streptococcus mutans d) OHE intervention plaque index e) OHE intervention gingival index f) OHE intervention Streptococcus mutans g) control plaque index h) control gingival index i) control Streptococcus mutans	a) significant improvement (ES: 7.048) b) significant improvement (ES: 3.959) c) significant improvement (ES: 0.868) d) significant improvement (ES: 7.048) e) significant improvement (ES: 4.025) f) significant improvement (ES: 0.662) g) significant improvement (ES: 1.643) h) significant improvement (ES: 2.190) i) non-significant improvement (ES: 0.563)	Intervention vs. control at a) gain mouth rinse+OHE vs. OHE plaque index b) gain mouth rinse+OHE vs. OHE gingival index c) gain mouth rinse+OHE vs. OHE Streptococcus mutans d) OHE vs. control plaque index e) OHE vs. control gingival index f) OHE vs. control Streptococcus mutans g) gain mouth rinse+OHE vs. control plaque index h) gain mouth rinse+OHE vs. control gingival index i) gain mouth rinse+OHE vs. control Streptococcus mutans	a) mouth rinse+OHE gained significantly more (ES: 0.000) b) no significant difference (ES: 0.073) c) mouth rinse+OHE gained more (ES: 0.117) d) OHE gained significantly more (ES: 0.515) e) OHE gained significantly more (ES: 1.379) f) OHE gained more (ES: 0.383) g) mouth rinse+OHE gained significantly more (ES: 0.515) h) mouth rinse+OHE gained significantly more (ES: 0.426) i) mouth rinse+OHE gained more (ES: 0.519)

Table 4. Cont'd

Author (year, country)	Outcome per group baseline versus follow-up	Results and effect size baseline versus follow-up	Outcome per group versus comparator	Results and effect size per group versus comparator
Chowdary et al. (2016, India, 3-arm non-RCT)[63]	Pre-test vs. post-tests for a) intervention plaque index b) intervention gingival index c) verbal+tactile control plaque index d) verbal+tactile control gingival index e) verbal+braille control plaque index f) verbal+braille control gingival index	a) gradual significant improvement (ES: 2.562; 4.271) b) gradual significant improvement (ES: 2.121; 3.729) c) gradual significant improvement (ES: 1.027; 1.967) d) gradual significant improvement (ES: 1.001; 1.729) e) gradual significant improvement (ES: 1.754; 3.258) f) gradual significant improvement (ES: 0.923; 3.432)	Intervention vs. control at a) gain intervention vs. verbal+tactile plaque index b) gain intervention vs. verbal+tactile gingival index c) gain intervention vs. verbal+braille plaque index d) gain intervention vs. verbal+braille gingival index e) gain verbal+tactile vs. verbal+braille plaque index f) gain verbal+tactile vs. verbal+braille gingival index	a) intervention gained significantly more (ES: -0.872; -1.288) b) intervention gained significantly more at three months (ES: -0.371; -0.664) c) intervention gained significantly more (ES: -0.795; -1.784) d) mixed results (NS; ES: -0.405; 0.608) e) mixed results (NS; ES: -0.459; 0.250) f) verbal+tactile gained more at 1 month (NS), verbal+braille gained significantly more at 3 and 6 months (ES: -1.038; 0.038)
Debnath et al. (2017, India, 1-arm BA)[92]	Pre-test vs. post-test for a) knowledge, attitude, practices of oral health b) plaque index	a) significant improvement b) significant improvement	N/A	N/A

Ganapathi et al. (2015, India, 5-arm RCT)[34]	Pre-test vs. post-test for a) audio intervention oral health knowledge b) audio intervention oral health status c) braille intervention oral health knowledge d) braille intervention oral health status e) tooth models intervention oral health knowledge f) tooth models intervention oral health status g) multisensory intervention oral health knowledge h) multisensory intervention oral health status	a) significant improvement (ES: -3.881) b) significant improvement (ES: 1.223) c) significant improvement (ES: -2.163) d) significant improvement (ES: 0.563) e) significant improvement (ES: -4.076) f) significant improvement (ES: 1.098) g) significant improvement (ES: -5.456) h) significant improvement (ES: 1.329)	Intervention vs. control at a) gain audio vs. braille oral health knowledge b) gain audio vs. braille oral health status c) gain audio vs. tooth models oral health knowledge d) gain audio vs. tooth models oral health status e) gain audio vs. multisensory oral health knowledge f) gain audio vs. multisensory oral health status g) gain braille vs. tooth models oral health knowledge h) gain braille vs. tooth models soral health status i) gain braille vs. multisensory oral health knowledge j) gain braille vs. multisensory oral health status k) gain tooth models vs. multisensory knowledge l) gain tooth models vs. multisensory oral health status	a) audio gained significantly more (ES: -2.080) b) audio gained significantly more (ES: 0.589) c) tooth models gained more (NS; ES: 0.119) d) audio gained more (NS; ES: 0.196) e) multisensory gained significantly more (ES: 0.795) f) audio gained more (NS; ES: 0.116) g) tooth models gained significantly more (ES: 2.008) h) tooth models gained significantly more (ES: -0.430) i) multisensory gained significantly more (ES: 2.710) j) multisensory gained significantly more (ES: -0.536) k) multisensory gained significantly more (ES: 0.622) l) multisensory gained more (NS; ES: -0.092)

Table 4. Cont'd

Author (year, country)	Outcome per group baseline versus follow-up	Results and effect size baseline versus follow-up	Outcome per group versus comparator	Results and effect size per group versus comparator
Hebbal & Ankola (2012, India, 1-arm BA)[80]	Pre-test vs. post-test for a) oral health status b) oral hygiene practice	a) significant improvement (ES: 1.578) b) non-significant improvement	N/A	N/A
Krishnakumar et al. (2016, India, 2-arm RCT)[53]	Pre-test vs. post-test for a) intervention plaque index b) control plaque index	a) significant improvement (ES: 1.054) b) no difference (ES: 0.051)	Intervention vs. control at a) gain plaque index	a) intervention gained more (ES: 1.227)
Qureshi et al. (2017, Pakistan, 2-arm RCT)[50]	Pre-test vs. post-test for a) intervention oral hygiene index b) control oral hygiene index	a) significant improvement (ES: 1.432) b) non-significant improvement (ES: 0.318)	Intervention vs. control at a) pre-test oral hygiene index b) post-test oral hygiene index c) gain oral hygiene index	a) no significant difference b) no significant difference c) intervention gained more (ES: 0.566)
Shetty et al. (2013, India, 2-arm non-RCT)[72]	Pre-test vs. post-tests for a) intervention plaque index b) intervention gingival index c) intervention Streptococcus mutans count d) control plaque index e) control gingival index f) control Streptococcus mutans count	a) significant improvement (ES: 1.061; 1.846) b) significant improvement (ES: 1.346; 1.962) c) significant improvement d) significant improvement (ES: 0.413; 0.873) e) significant improvement (ES: 0.709; 1.131) f) significant improvement	Intervention vs. control at a) gain post-test 1 plaque index b) gain post-test 1 gingival index c) gain post-test 2 plaque index d) gain post-test 2 gingival index	a) intervention gained significantly more (ES: -1.237) b) intervention gained significantly more (ES: -1.052) c) intervention gained significantly more (ES: -1.188) d) intervention gained significantly more (ES: -1.027)

Smutkeeree et al. (2011, Thailand, 2-arm RCT)[46]	Pre-test vs. post-test 1 for a) intervention plaque index b) intervention gingival index c) control plaque index d) control gingival index Pre-test vs. post-test 2 for e) intervention plaque index f) intervention gingival index g) control plaque index h) control gingival index	a) significant improvement (ES: 0.972) b) significant improvement (ES: 1.412) c) significant improvement (ES: 1.485) d) significant improvement (ES: 1.153) e) significant improvement (ES: 1.083) f) significant improvement (ES: 0.882) g) significant improvement (ES: 0.971)	Intervention vs. control at a) pre-test plaque index b) pre-test gingival index c) post-test 1 plaque index d) post-test 1 gingival index e) post-test 2 plaque index f) post-test 2 gingival index g) gain post-test 1 plaque index h) gain post-test 1 gingival index i) gain post-test 2 plaque index j) gain post-test 2 gingival index	a) no significant difference b) no significant difference c) no significant difference d) no significant difference e) no significant difference f) no significant difference g) control gained more (ES: 0.433) h) control gained more (ES: 0.290) i) control gained more (ES: 0.044) j) control gained more (ES: 0.383)
Yalcinkaya & Atalay (2006, Turkey, 1-arm BA)[91]	Pre-test vs. post-tests for a) plaque index b) gingival index c) oral health knowledge	a) significant improvement (ES: 0.435; 1.044) b) significant improvement (ES: 0.520; 1.000) c) significant improvement on all items except for importance of tooth brushing	N/A	N/A
3. Psychological outcomes				
Dursun et al. (2015, Turkey, 1-arm BA)[77]	Pre-test vs. post-test for a) sleep quality b) self-concept c) behavioural and emotional states	a) significant improvement (ES: 0.784) b) significant deterioration (ES: 1.991) c) mixed results (ES: -0.684; 1.473)	N/A	N/A

Table 4. Cont'd

Author (year, country)	Outcome per group baseline versus follow-up	Results and effect size baseline versus follow-up	Outcome per group versus comparator	Results and effect size per group versus comparator
Eniola & Adebiyi (2007, Nigeria, 2-arm RCT)[33]	Pre-test vs. post-test for a) intervention motivation b) control motivation	a) significant improvement (ES: -4.510) b) significant improvement (ES: -4.045)	Intervention vs. control at gain motivation	Intervention gained more (ES: 4.352)
Eniola & Ajobiewe (2013, Nigeria, 3-arm RCT)[32]	Pre-test vs. post-test for a) EIT intervention psychological well-being b) LCT intervention psychological well-being c) control psychological well-being	a) significant improvement b) significant improvement c) significant improvement	Intervention vs. control at post-test psychological well-being	EIT intervention had the highest post-test adjusted mean score, followed by the LCT intervention and last the control
Johnson & Johnson (1991, USA, 2-arm non-RCT)[68]	N/A	N/A	Intervention vs. control at a) pre-test self-concept b) pre-test attitude towards blindness c) pre-test locus of control d) gain self-concept e) gain attitude towards blindness f) gain locus of control	a) no significant differences b) no significant difference c) no significant difference d) intervention gained significantly more e) intervention gained significantly more f) intervention gained significantly more

Levin & Rotheram-Fuller (2011, USA, 2-arm non-RCT)[69]	Pre-test vs. post-test for a) intervention self-determination b) intervention self-concept c) intervention self-esteem d) control self-determination e) control self-concept f) control self-esteem	a) no significant results (ES: -0.266; 0.239 b) no significant results (ES: -0.008) c) no significant results (ES: 0.435) d) no significant results (ES: -0.392; 0.297) e) no significant results (ES: -0.104) f) no significant results (ES: 0.017)	Intervention vs. control at a) pre-test self-determination b) pre-test self-concept c) pre-test self-esteem d) gain self-determination e) gain self-concept f) gain self-esteem	a) no significant differences b) no significant difference c) no significant difference d) no significant differences (ES: -0.149; 0.464) e) control gained more (ES: 0.098) f) control deteriorated less (ES: 0.342)
Locke & Gerler (1981, USA, 4-arm RCT)[41]	Pre-test vs. post-test for a) HDP intervention self-image b) DUSO intervention self-image c) play self-image d) control self-image	a) non-significant improvement (ES: -0.573) b) non-significant improvement (ES: -0.430) c) non-significant improvement (ES: -0.213) d) non-significant improvement (ES: -0.253)	Intervention vs. control at a) gain HDP vs. play self-image b) gain HDP vs. control self-image c) gain DUSO vs. play self-image d) gain DUSO vs. control self-image	a) HDP gained more (ES: 0.438) b) HDP gained more (ES: 0.537) c) DUSO gained more (ES: 0.208) d) DUSO gained more (ES: 0.322)
McMahon (2013, USA, 1-arm BA)[81]	Pre-test vs. post-test for self-perception	Significant improvement (ES: 0.518; 1.099)	N/A	N/A
Mohamed et al. (2011, Egypt, 1-arm BA)[83]	Pre-test vs. post-test for a) anxiety b) depression c) self-esteem d) activities of daily living	a) significant improvement (ES: 1.584) b) significant improvement (ES: 0.486) c) significant improvement (ES: -1.980) d) significant improvements	N/A	N/A

Table 4. Cont'd

Author (year, country)	Outcome per group baseline versus follow-up	Results and effect size baseline versus follow-up	Outcome per group versus comparator	Results and effect size per group versus comparator
Shapiro et al. (2005, USA, 1-arm BA)[87]	Pre-test vs. post-test for a) social acceptance b) athletic competence c) physical appearance	a) improvement (ES: -0.212) b) improvement (ES: -0.271) c) improvement (ES: -0.186)	N/A	N/A
4. Functioning and development				
Al-Dababneh et al. (2015, Jordan, 2-arm non-RCT)[59]	N/A	N/A	Intervention vs. control at gain in creativity	Intervention gained significantly more at all scale dimensions
Beelmann & Brambring (1998, Germany, 2-arm non-RCT)[60]	N/A	N/A	Intervention vs. control at a) full-term children various developmental ages b) pre-term children at various developmental ages	a) significant difference in favour of intervention at age 30 months (ES: 1.348); mixed results for other ages (ES: -0.196; 0.821) b) mixed results (ES: -0.722; 0.249)

Behl et al. (1993, USA, 2-arm RCT)[30]	Pre-test vs. T1 for a) intervention child functioning b) intervention family functioning c) control child functioning d) control family functioning Pre-test vs. T2 for e) intervention child functioning f) intervention family functioning g) control child functioning h) control family functioning Pre-test vs. T3 for i) intervention child functioning j) intervention family functioning k) control child functioning l) control family functioning	a) improvement (ES: -1.240) b) mixed results (ES: -0.465; 0.203) c) improvement (ES: -1.352) d) mixed results (ES: -0.248; 0.276) e) improvement (ES: -2.175) f) mixed results (ES: -0.782; 0.663) g) improvement (ES: -2.729) h) mixed results (E: -0.262; 0.276) i) improvement (ES: -2.428) j) mixed results (ES: -0.783; 0.017) k) improvement (ES: -2.975) l) mixed results (ES: -0.504; 0.602)	Intervention vs. control at a) pre-test child functioning b) pre-test family functioning c) T1 child functioning d) T1 family functioning e) T2 child functioning f) T2 family functioning g) T3 child functioning h) T3 family functioning i) gain T1 child functioning j) gain T1 family functioning k) gain T2 child functioning l) gain T2 family functioning m) gain post-test 3 child functioning n) gain T3 family functioning	a) no significant difference b) significant difference in FRS in favour of control c) no significant difference d) no significant differences e) no significant difference f) no significant differences g) no significant difference h) no significant differences i) control gained more (ES: -0.193) j) mixed results (ES: -0.617; 0.255) k) control gained more (ES: -0.311) l) mixed results (ES: -0.358; 0.873) m) control gained more (ES: -0.389) n) intervention gained more (ES: 0.129; 1.119)

Table 4. Cont'd

Author (year, country)	Outcome per group baseline versus follow-up	Results and effect size baseline versus follow-up	Outcome per group versus comparator	Results and effect size per group versus comparator
Çalik et al. (2012, Turkey, 2-arm non-RCT)[62]	Pre-test vs. post-test for a) intervention cognition b) intervention activities of daily living c) intervention quality of life d) control cognition e) control activities of daily living f) control quality of life	a) significant improvement (ES: -1.084) b) significant improvement (ES: -1.081) c) significant improvement (ES: -0.385) d) non-significant improvement (ES: -0.118) e) non-significant improvement (ES: -0.100) f) no difference (ES: 0.007)	Intervention vs. control at a) pre-test cognition b) pre-test activities of daily living c) pre-test quality of life d) post-test cognition e) post-test activities of daily living f) post-test quality of life g) gain cognition h) gain activities of daily living i) gain quality of life	a) no significant difference b) no significant difference c) no significant difference d) significant difference in favour of intervention e) significant difference in favour of intervention f) significant difference in favour of intervention g) intervention gained more (ES: -0.373) h) intervention gained more (ES: -0.991) i) intervention gained more (ES: -0.359)

Christy (2012, India, 4-arm RCT)[55]	Pre-test vs. post-test for a) centre-based impact of vision impairment b) community-based impact of vision impairment c) centre- and community-based impact of vision impairment d) non-interventional centre-based impact of vision impairment	a) significant improvement (ES: 0.558) b) significant improvement (ES: 0.726) c) significant improvement (ES: 1.156) d) significant improvement (ES: 0.292)	Intervention vs. control at a) gain centre vs. community impact of vision impairment b) gain centre vs. centre and community impact of vision impairment c) gain centre vs. centre non-interventional impact of vision impairment d) gain community vs. centre and community impact of vision impairment e) gain community vs. centre non-interventional impact of vision impairment f) gain centre and community vs. centre non-interventional impact of vision impairment	a) community gained more (ES: -0.162) b) centre and community gained significantly more (ES: -0.686) c) centre gained more (ES: 0.135) d) centre and community gained significantly more (ES: -0.538) e) community gained more (ES: 0.272) f) centre and community gained significantly more (ES: 0.727)
Ganesh et al. (2013, India, 1-arm BA)[78]	Pre-test vs. post-test functional vision	Significantly less often LVP-FVQ answer 4 (unable to do activity due to visual reasons) was chosen for the items 'copying from the blackboard', 'reading textbook at arm's length', 'writing along a straight line', 'applying paste on a tooth brush', and 'making out whether someone is calling you by waving hand from across road'	N/A	N/A

Table 4. Cont'd

Author (year, country)	Outcome per group baseline versus follow-up	Results and effect size baseline versus follow-up	Outcome per group versus comparator	Results and effect size per group versus comparator
Gothwal et al. (2015, India, 1-arm BA)[79]	Pre-test vs. post-test functional vision	Significant improvement (ES: -0.69)	N/A	N/A
Platje et al. (2018, the Netherlands, 2-arm RCT)[52]	Pre-test vs. post-test 1 for a) intervention sensitivity b) intervention interaction c) intervention stress d) intervention self-efficacy e) control sensitivity f) control interaction g) control stress h) control self-efficacy Pre-test vs. post-test 2 for i) intervention sensitivity j) intervention interaction k) intervention stress l) intervention self-efficacy m) control sensitivity n) control interaction o) control stress p) control self-efficacy	a) improvement (ES: -0.162) b) improvement (ES: -0.465) c) improvement (ES: 0.297) d) improvement (ES: -0.239) e) improvement (ES: -0.038) f) improvement (ES: -0.127) g) deterioration (ES: -0.051) h) improvement (ES: -0.179) i) improvement (ES: -0.051) j) improvement (ES: -0.303) k) improvement (ES: 0.204) l) improvement (ES: -0.359) m) improvement (ES: -0.110) n) improvement (ES: -0.052) o) no difference (ES: 0.000) p) improvement (ES: -0.013)	Intervention vs. control at a) gain post-test 1 sensitivity b) gain post-test 1 interaction c) gain post-test 1 stress d) gain post-test 1 self-efficacy e) gain post-test 2 sensitivity f) gain post-test 2 interaction g) gain post-test 2 stress h) gain post-test 2 self-efficacy	a) intervention gained more (ES: 0.123) b) intervention gained more (ES: 0.370) c) intervention gained more (ES: -0.360) d) intervention gained more (ES: 0.097) e) control gained more (ES: -0.063) f) intervention gained more (ES: 0.257) g) intervention gained more (ES: -0.216) h) intervention gained more (ES: 0.373)

Williams (1985, UK, 1-arm BA)[90]	Pre-test vs. post-test for a) social adaptation b) sensorimotor understanding c) exploration environment d) response to sound and verbal comprehension e) expressive language	a) significant improvement b) significant improvement c) non-significant improvement d) no difference e) no difference	N/A	N/A
5. Reading performance				
Corn et al. (2002, USA, 1-arm BA)[13]	Pre-test vs. post-test for a) silent comprehension b) oral comprehension c) silent reading speed d) oral reading speed	a) significant improvement (ES: -0.487) b) non-significant improvement (ES: -0.257) c) significant improvement (ES: -1.305) d) non-significant improvement (ES: -0.142)	N/A	N/A
Farmer & Morse (2007, USA, 2-arm non-RCT)[65]	Pre-test vs. post-test for a) intervention type size b) intervention reading rate c) intervention comprehension d) control type size e) control reading rate f) control comprehension	a) improvements b) improvements c) improvements d) no differences e) improvements f) no differences	N/A	N/A
Heber et al. (1967, USA, 2-arm RCT)[35]	N/A	N/A	Intervention vs. control at a) gain T1 reading rate b) gain T2 reading rate	a) intervention gained more b) no difference

Table 4. Cont'd

Author (year, country)	Outcome per group baseline versus follow-up	Results and effect size baseline versus follow-up	Outcome per group versus comparator	Results and effect size per group versus comparator
Howell (1977, UK, 3-arm RCT)[36]	Pre-test vs. post-test for a) freehand intervention comprehension b) pacing intervention comprehension c) control comprehension	a) no difference b) no difference c) no difference	Intervention vs. control at a) gain freehand vs. control reading rate b) gain pacing vs. control reading rate c) gain freehand vs. pacing reading rate	a) freehand gained significantly more b) pacing gained significantly more c) no difference
Huurneman et al. (2016, The Netherlands, 2-arm non-RCT)[67]	Pre-test vs. post-test for a) intervention reading speed b) intervention critical print size c) intervention reading acuity d) intervention acuity reserve e) control reading speed f) control critical print size g) control reading acuity h) control acuity reserve	a) no difference (ES: -0.024) b) significant improvements (ES: 0.526) c) significant improvements (ES: 0.537) d) no difference (ES: 0.000) e) no difference (ES: 0.032) f) significant improvements (ES: 0.166) g) significant improvements (ES: 0.422) h) no difference (ES: -0.243)	Intervention vs. control at a) gain reading speed b) gain critical print size c) gain reading acuity d) gain acuity reserve	a) intervention gained more (ES: 0.054) b) intervention gained more (ES: 0.341) c) intervention gained more (ES: 0.115) d) control gained more (ES: -0.246)
Kederis et al. (1964, USA, 2-arm RCT)[39]	Pre-test vs. post-test for a) intervention reading time b) intervention comprehension c) control reading time d) control comprehension	a) significant improvements (ES: 0.631; 0.729) b) non-significant deteriorations (ES: 0.000; 0.131) c) significant improvements (ES: 0.768; 1.060) d) non-significant deteriorations (ES: 0.340; 0.870)	Intervention vs. control at a) gain reading time b) gain comprehension	a) control gained more (ES: -0.270; -0.093) b) intervention gained more (ES: -0.877; -0.239)

Kederis et al. (1964, USA, 2-arm RCT)[40]	Pre-test vs. post-test for a) reading time b) comprehension	a) significant improvements (ES: 0.348; 1.323) b) non-significant deteriorations (ES: 0.136; 0.379)	Intervention vs. control at gain reading time	Intervention gained more (NS)
Uysal & Düger (2012, Turkey, 1-arm BA)[89]	Pre-test vs. post-test for a) writing speed b) legibility of writing c) reading speed	a) significant improvement (ES: 0.321) b) non-significant improvement (ES: -0.049) c) significant improvement (ES: -0.418)	N/A	N/A
6. Social skills				
Bieber-Schut (1991, Canada, 1-arm BA)[76]	Pre-test vs. post-test for social skills	Significant improvement	N/A	N/A
Grumpelt & Rubin (1972, USA, 2-arm non-RCT)[66]	Pre-test vs. post-test for a) intervention speed listening b) control speed listening	a) significant deterioration b) significant deterioration	Intervention vs. control at a) pre-test speed listening b) post-test speed listening c) gain speed-listening skills	a) no significant difference b) significant difference in favour of intervention c) intervention deteriorated significantly less

Table 4. Cont'd

Author (year, country)	Outcome per group baseline versus follow-up	Results and effect size baseline versus follow-up	Outcome per group versus comparator	Results and effect size per group versus comparator
Kim (2003, USA, 2-arm RCT)[54]	Pre-test vs. post-test for a) intervention social students b) intervention social teachers c) intervention assertiveness students d) intervention cognitive distortion e) intervention assertiveness observers f) control social students g) control social teachers h) control assertiveness students i) control cognitive distortion j) control assertiveness observers	a) improvement (ES: -0.143) b) improvement (ES: -0.210) c) improvement (ES: -0.012) d) improvement (ES: 0.139) e) improvement (ES: -0.333) f) improvement (ES: -0.379) g) improvement (ES: -0.105) h) deterioration (ES: 0.505) i) improvement (ES: 0.220) j) improvement (ES: -0.389)	Intervention vs. control at a) gain social skills students b) gain social skills teachers c) gain assertiveness students d) gain cognitive distortion e) gain assertiveness observers	a) control gained more (NS; ES: 0.160) b) intervention gained more (NS; ES: 0.088) c) intervention gained more (NS; ES: 0.488) d) intervention gained more (NS; ES: -0.044) e) no difference (ES: 0.000)
McConnell (1994, USA, 2-arm RCT)[43]	Pre-test vs. post-test for a) intervention parent communication b) intervention adolescent communication c) control parent communication d) control adolescent communication	a) no difference (ES: 0.016) b) no difference (ES: 0.099) c) no difference (ES: 0.035) d) deterioration (ES: 0.359)	Intervention vs. control at a) gain parent communication b) gain adolescent communication	a) intervention deteriorated less (ES: 0.027) b) intervention deteriorated less (ES: 0.291)

Sacks & Gaylord-Ross (1989, USA, 3-arm RCT)[45]	Pre-test vs. post-tests for a) peer-mediated intervention social skills b) peer-mediated intervention social validation c) teacher-directed intervention social skills d) teacher-directed intervention social validation e) control social skills f) control social validation	a) significant improvement 5/7 behaviours T1, 7/7 behaviours T2, 6/7 behaviours T3 b) significant improvement 3/7 peer items, 7/8 teacher items c) significant improvement 7/7 behaviours T1, 1/7 behaviours T3 d) significant improvement 2/7 peer items, 2/8 teacher items e) significant improvement 2/7 behaviours T2 f) no significant difference peers and teacher items	Intervention vs. control at a) gain peer-mediated vs. control social competence b) gain teacher-directed vs. control social competence c) gain peer-mediated vs. teacher directed social competence	a) peer-mediated gained significantly more b) teacher-directed gained significantly more c) peer-mediated gained more (NS)
Uysal & Düger (2012, Turkey, 2-arm RCT)[47]	Pre-test vs. post-test for a) intervention social skills b) intervention activity performance c) control social skills d) control activity performance	a) significant improvement (ES: -0.681) b) significant improvement (ES: 1.229) c) significant improvement (ES: -0.443) d) significant improvement (ES: 1.076)	Intervention vs. control at a) gain social skills b) gain activity performance	a) intervention gained more (ES: 0.024) b) control gained more (ES: -0.134)
Yildiz & Duy (2013, Turkey, 2-arm RCT)[49]	Pre-test vs. post-test for a) intervention empathic skills b) intervention communication skills c) control empathic skills d) control communication skills	a) significant improvement b) significant improvement c) significant improvement d) significant improvement	Intervention vs. control at a) gain empathic skills b) gain communication skills	a) intervention gained significantly more b) intervention gained significantly more

Table 4. Cont'd

Author (year, country)	Outcome per group baseline versus follow-up	Results and effect size baseline versus follow-up	Outcome per group versus comparator	Results and effect size per group versus comparator
Boonstra et al. (2012, The Netherlands, 2-arm RCT)[31]	Pre-test vs. post-test for a) viewing behavior LH chart near vision test single b) viewing behavior LH chart near vision line c) duration of observation	a) significant improvement (ES: 0.685) b) significant improvement (ES: 0.663) c) significant improvement	Intervention vs. control at a) gain viewing behaviour LH chart near vision test single b) gain viewing behaviour LH chart near vision line c) gain duration of observation	a) no difference b) no difference c) no difference
7. Viewing behaviour				
Cox et al. (2009, The Netherlands, 2-arm non-RCT)[64]	Pre-test vs. post-test for a) intervention number of trails followed b) control number of trails followed c) pooled number of trails followed	a) improvement (ES: -0.975) b) improvement (ES: -1.670) c) significant improvement (ES: 2.608)	Intervention vs. control at gain proportion of trails followed correct	Intervention gained significantly more

Nyquist et al. (2016, USA, 3-arm RCT)[44]	Pre-test vs. post-test for a) AVG intervention foveal b) AVG intervention single c) AVG intervention multi d) AVG intervention crowding e) AVG intervention search f) MAT intervention foveal g) MAT intervention single h) MAT intervention multi i) MAT intervention crowding j) MAT intervention search k) control foveal l) control single m) control multi n) control crowding o) control search	a) no significant difference b) significant improvement c) non-significant improvement d) significant improvement e) significant improvement f) no significant difference g) significant improvement h) significant improvement i) significant improvement j) significant improvement k) no significant difference l) no significant difference m) no significant difference n) no significant difference o) significant improvement	Intervention vs. control at a) gain AVG vs. control foveal b) gain AVG vs. control single c) gain AVG vs. control multi d) gain AVG vs. control crowding e) gain AVG vs. control search f) gain MAT vs. control foveal g) gain MAT vs. control single h) gain MAT vs. control multi i) gain MAT vs. control crowding j) gain MAT vs. control search k) gain MAT vs. AVG foveal l) gain MAT vs. AVG single m) gain MAT vs. AVG multi n) gain MAT vs. AVG crowding o) gain MAT vs. AVG search	a) no difference b) AVG gained more (NS) c) AVG gained more (NS) d) AVG gained significantly more e) AVG gained more (NS) f) no difference g) MAT gained significantly more h) MAT gained more (NS) i) MAT gained more (NS) j) MAT gained more (NS) k) no difference l) MAT gained more (NS) m) MAT gained more (NS) n) MAT gained more (NS) o) MAT gained more (NS)
Ritchie et al. (1989, India, 1-arm BA)[85]	Pre-test vs. post-test for visual functioning	50% of the children improved		
8. Mobility skills				
Ungar et al. (1997, UK, 1-arm BA)[88]	Pre-test vs. post-test for performance in estimating distances	Improvement	N/A	N/A
Wood (1978, USA, 3-arm RCT)[48]	N/A	N/A	Intervention vs. control at gain PMS	Intervention gained significantly more

AVG: Action Video Game; BOT: Bruininks-Oseretsky Test of Motor Proficiency Short Form; CMI: Cornell Medical Index; DUSO: Developing Understanding of Self and Others; EIT: Emotional Intelligence Training; ES: Effect size; HDP: Human Development Programme; LCT: Locus of Control Training; LVP-FVQ: LV Prasad-Functional Vision Questionnaire; MABC: Movement Assessment Battery for Children; ManuVis: manual skills test for children (6-12 years) with visual impairment; MAT: Modified Attentional Tracking; Movement ABC: movement assessment for children; N/A: Not applicable; NS: Not significant; OHE: oral hygiene education; PACER: Progressive Aerobic Cardiovascular Endurance Run; PMS: Peabody Mobility Scale

Discussion of the results

Summary of the results

This systematic review thoroughly assesses the effectiveness of all interventions published aimed at increasing functioning, participation and quality of life, or skills and behaviours that determine these constructs, in children with visual impairment. The main finding of this review is that the number of high-quality studies is limited. Of the 441 articles that were of potential interest, only 66 met our inclusion criteria.

Most of the included studies were aimed at investigating the effectiveness of interventions on physical performance (n=17), oral health (n=10) or psychological outcomes (n=9). Fewer studies focused on reading performance (n=8), functioning and development (n=8) or social skills (n=8). Only a few studies investigated the effects on viewing behaviour (n=4) or mobility (n=2), even though mobility is often mentioned as an important factor impacting functioning, participation and quality of life in children.[3,96-99] Only one study investigated the effect of an intervention, amongst other outcomes, specifically on general quality of life of the participants.[62] In addition, two studies used the LVP-FVQ to assess functional vision,[78,79] one study used the IVI_C to assess impact of visual impairment,[55] and several studies used measures on areas that belong to the concept of quality of life, that is to assess development, child functioning and activities of daily living,[30,60,83,90] although often not specifically developed for children with visual impairment.

The included studies showed that offering physical training[37,42,56-58,70,73-75,93,94] or sports camps[61,82,84] are likely to be effective in increasing physical performance, since the effect sizes found were moderate to large. The study of Mavrovouniotis et al. that examined the effect of Greek dances and Pilates on balance of children who are blind found the largest effect sizes.[42] In addition, the study of Mohanty et al. was rated as being least susceptible to bias among the non-RCTs and BAs.[70] Providing information alone proved not to be effective for improving physical performance.[38,86] Training in trail following tasks was effective in improving fine motor skills, irrespective of the use of visual aids.[71]

Interventions aimed at improving oral health were all effective,[34,46,50,51,53,63,72,80,91,92] and effect sizes were mostly large. Oral health interventions combining multiple elements and with long duration were more effective than those with fewer elements and shorter durations. The largest effect sizes for pre-test versus post-test results were found in those studies who had an intervention group combining several intervention elements (e.g. the multisensory group in the study of Ganapathi et al.,[34] the group who received a combination or verbal, braille and tactile oral hygiene awareness training in the study of Chowdary et al.[63] and the group who received brushing instructions, oral hygiene education and mouth rinse in the study of Arunakul et al.[51]). However, compared to the control interventions, which often entailed light interventions consisting of only one element, the results were less distinctive and effect sizes were smaller. Moreover, the study of Ganapathi et al. was rated as high risk of bias because no post-measures were conducted for the control group.[34]

Group-based programmes to improve psychological outcomes showed mixed results.[32,33,41,68,69,83] The largest effect sizes were found by Mohamed et al., in which a group-based educational programme resulted in significantly less problems in activities of daily living, anxiety, depression and self-esteem; however, this study did not use a comparison group.[83] Sports camps seemed to be effective in improving psychological outcomes,[81,87] whereas ice-skating deteriorated psychological outcomes.[77] This might suggest that the type of physical activity influences the results. However, none of these studies employed a control group.

Intensive home-based early intervention programmes did not show to be effective in improving functioning and development compared to low-intensity programmes,[30,52,60] and the effectiveness of admission to a care-unit was also limited;[90] effect sizes were mostly small. Rehabilitation at a low vision rehabilitation centre was effective, however, in particular when combined with a home-based programme with support from the community.[55] Provision of low vision devices were effective in improving functioning and development, although these studies did not use a control group.[78,79] Attention training[62] and a programme to increase creativity[59] turned out to be effective as well. Especially the study of Çalik et al. found relatively large effect sizes for the intervention group when pre- and post-test scores were compared.[62] The studies of Platje et al.[52] and Christy[55] were rated as having the least bias, and therefore the evidence resulting from these studies is rather strong.

Training for reading that was offered in the studies included in this review showed not to be effective,[35,36,39,40] which might be due to the type of training used or focus on outcomes placed in the included studies. Most studies focused on increasing reading speed, which is at the expense of reading comprehension. When offering interventions to increase reading speed in children, one should be aware that this could have negative effects on reading comprehension. Focus should be placed in order to make sure that interventions for increasing reading speed do not lead to deteriorations in comprehension. Provision of low vision devices resulted in improved reading skills, but effect sizes were mostly small.[13,65,89] As a result one can question whether using low vision aids is useful for every individual or just for some. However, none of these studies used a control group. Huurneman et al. found that uncrowded and crowded training significantly improved reading acuity and affected minimum critical print size. Training did not have an influence on maximum reading speed and acuity reserve.[67]

Studies showed that a drama workshop[76] and visual perception training[47] were effective in improving social skills, but the results of social skills/assertiveness training[45,49,54] were rather mixed. Communication training did not seem to be effective in improving social skills,[43,66] and the low susceptibility to bias of the study of Grumpelt and Rubin[66] makes the quality of the evidence rather strong. The study of Uysal and Düger showed the largest effect sizes, both for the intervention group as for the control group. However, the only difference between the intervention and the control condition was the medium with which they received training: the intervention group received visual perception training with the computer, whereas the control group received training with paper-and-pencil.[47]

Video games[44] and the provision of low vision devices[31,64,85] improved viewing behaviour with moderate to large effect sizes; however, the control group who trained without a magnifier also improved in the studies of Cox et al. and Boonstra et al.[31,64]

Although limited in number, interventions to improve mobility were likely to be effective as well.[48,88] These studies provided insufficient information to calculate effect sizes.

Limitations of the included studies

Despite the evidence for the effectiveness of certain interventions outlined above, the results must be interpreted with caution. For instance the interventions aimed at improving oral health showed to be the most effective, with generally large effect sizes. For unknown reasons these studies were all conducted in Asian countries. This raises the question whether oral health in children with visual impairment is also an issue on other continents and whether the intervention results can be generalised to those countries. Furthermore, over 40% of the included studies were older than a decade, and the investigated interventions might be outdated, especially because technology advances rapidly. In addition, follow-up periods were often short and sample sizes were small. Only three studies reported use of a power analysis to calculate the minimum number of participants necessary to detect clinically important differences,[52,55,92] and only one study conducted cost-effectiveness analyses.[30] The included studies showed large variability in age of the participants, degree of visual impairment and causes of vision loss of participants (if even reported), and duration of follow-up. This makes it difficult to compare studies and results with each other.

Many RCTs and non-RCTs did not have a control group that received no intervention, or that was put on a waiting list or received care as usual. Offering no treatment or putting controls on a waiting list has the largest likelihood of finding large effect sizes,[100] requires smaller sample sizes, and is potentially useful for interventions that have not been evaluated previously.[101] However, there might be ethical problems if there is an alternative treatment available, and it may cause participants to decline enrollment.[101] In the included studies, a light or alternative intervention was often the comparison treatment, and the researchers did not state which group was the intervention group and which group was the control group. Comparing an intervention group to a control group receiving a light intervention or alternative intervention requires very large sample sizes and often these studies were underpowered.[101,102] As such, type II error risk (rejecting a valuable intervention) increases.[101] To a degree, this also accounts for control groups receiving usual care, depending on its effectiveness.[101] Moreover, care as usual may include many sources of variation, and it is often unclear what it precisely entails.[101,103,104] In addition, we found a substantive number of BAs, which do not employ a control group. The use of a control group is of great value, because it increases confidence that the findings could be attributed to the intervention studied, and not to other factors.[12] In children, using a control group is even more valuable because of their natural development. No single control condition is perfect, and each condition has its advantages and disadvantages.[101] It is important that researchers consider the advantages and disadvantages

of the various control conditions before selecting a study design, and keep the study purpose in mind. If the control condition has to be consistent with practice, care as usual might be the best option. However, in case small sample sizes are foreseen and the intervention has not been studied before, an exploratory trial in which a control group that receives no intervention or is put on a waiting list might be the preferred method.

The number of high-quality studies was limited. The lack of high quality designs in intervention studies might be due to some methodological limitations in the study of children with visual impairment and blindness that were already described in 1977[105] and are still valid today. Amongst others these are the relatively low incidence of blindness and visual impairments and the heterogeneity of this population because of differences in age of onset, aetiology and the large number of comorbid disorders. In most RCTs, randomisation methods (i.e. random sequence generation and allocation concealment) were not reported adequately, introducing possible selection bias. As expected, blinding of participants was not possible due to the nature of the intervention, and in those studies in which it was clear who the assessors were, it was often unclear whether assessors were blinded. Several studies lacked a proper description of the intervention they were investigating, and therefore it was not clear what the intervention precisely entailed. Reporting bias was almost always unclear, because only one[52] of the included studies had a study protocol available[95] and conformity to the protocol was reported in only one study.[54] Furthermore, conducting a non-RCT or BA might induce confounding; often no correction for relevant confounders was applied. Future studies should aim to improve the standard on conducting research on the effectiveness of interventions in children with visual impairment and should adequately report on the results, preferably using one of the available reporting standards[106] and preregistering study protocols and expected outcomes.

Strengths and limitations of this systematic review

In contrast to previous systematic reviews[12,15,16], this review focuses specifically on children and included studies irrespective of study design, with the exception of single case studies or studies with less than 10 participants. We used a broad search strategy to get an overall view of all available evidence, employing multiple databases as well as searching the grey literature for relevant studies. Furthermore, we included all types of interventions aimed at increasing functioning, quality of life and/or participation, and/or skills and behaviours that determine these constructs. The broad search strategy resulted in finding a large number of studies, and 59 met the inclusion criteria. Moreover, effect sizes were calculated to investigate the relevance of the results with respect to changes within and between groups over time.

A number of limitations need to be acknowledged as well. Because of the small number of high quality studies, it is not possible to draw firm conclusions on the effectiveness of interventions to improve functioning, participation and quality of life in children with visual impairment. The large variety of intervention types and lack of uniformity in the outcome measures used (i.e. over 50 different outcome measures were reported) hinders comparison of the results. Therefore, it was

not possible to pool the results of the included studies and perform a meta-analysis. Furthermore, because of the intention to perform a meta-analysis, studies with less than 10 participants were not included, although large in number (at least 120 studies were counted performing a quick search among all excluded studies). The results of these studies are thus missing in this systematic review, and further research should indicate whether interventions investigated in these studies might be effective for improving quality of life, participation and functioning in children with visual impairment. Moreover, some articles were more experimental in nature, comparing for example two methods for visual search, and reporting on the results over time (e.g. [107,108]); however, these studies did not include information on pre-test data, and were therefore also omitted in this systematic review. In addition, studies not published in English, Dutch, French or German were excluded in this systematic review, because of the difficulties with interpretation of the results. Ten studies were excluded because of this reason: 5 from Russia, 2 from Japan and 3 from Spain (the other 24 studies in Figure 1 were not presenting original research, but for example presented research protocols, abstracts, systematic reviews, editorials or letters to the editor). Last, since we could not perform a meta-analysis, we have also not contacted the authors of the included studies to request additional information for calculating effect sizes. Hence, also risk of bias could not be always assessed and the relevance of some of the intervention effects remains uncertain.

Conclusions

Overall, the lack of high-quality, well-designed and adequately reported studies, limits the conclusions that can be drawn for the effectiveness of interventions to increase functioning, participation or quality of life in children with visual impairment. The included studies were all susceptible to bias, and reporting of the results was often substandard. There was hardly any consensus on the most suitable methods or instruments to measure the outcomes of interventions, which hindered study comparisons. Despite these limitations, the results of this review suggest that sports camps, prescription of low vision devices and oral hygiene programmes might be effective in improving functioning or elements of participation and quality of life in children with visual impairment. In particular, sports camps were effective in improving physical performance and psychological outcomes, prescription of low vision devices in improving viewing behaviour, and to a lesser extent reading skills, and oral hygiene programmes in improving oral health. Further research is warranted in order to collect more evidence for the effectiveness of interventions to improve functioning, participation and quality of life in children with visual impairment. Moreover, for those interventions that already have been studied, it should be investigated what the underlying mechanisms for effectiveness are and whether these interventions are more effective for groups with certain demographic or clinical characteristics.

Recommendations for practice and future research

This systematic review supports the need for well-designed, high-quality studies on the effectiveness of interventions to increase functioning, participation and quality of life in children

with visual impairment. Future studies should preferably adopt an RCT design using a control condition that is appropriate to the aim of the study; however, the limitations regarding the suitability for conducting an RCT should be acknowledged (e.g. ethical issues for denying or delaying a group access to care, lack of representativeness of daily health care practice which causes limited results when effective interventions are implemented in daily health care practice, and lack of appropriate interventions to be researched using an RCT), especially for this heterogeneous population.[109] Furthermore, future studies should also ensure sufficient statistical power, proper randomisation methods, longer follow-up measurements, blinded outcome assessment, trial registration and published research protocols. We recommend that results of future studies should be reported using one of the available reporting standards,[106] including a detailed description of what the intervention entailed.

Lack of homogeneity in interventions and outcome measures hinders the comparison of results. Therefore, consensus must be sought on what constructs or even outcome measures are most relevant for measuring the effects of interventions to increase functioning, participation and quality of life. Visual functioning is not sufficient to capture the effectiveness of an intervention on children's participation and quality of life; for that purpose, patient-reported outcome measures for functional status and quality of life should be recorded as well. In contrast to the measures available for adults with visual impairment (e.g.[110-116]), there has been a paucity of effort in the development and application of such measures for children; however, several instruments have recently been developed to target this specific population and are now available for use.[117-124] If future studies would incorporate measures for functional status and/or quality of life as secondary outcome measures, in addition to their primary outcome measures, it would facilitate comparison between studies using meta-analysis.

Although this review suggests that certain interventions might be effective in improving aspects of quality of life, participation and functioning in children with visual impairment, the effectiveness of many interventions offered by, for instance, low vision rehabilitation centres is still unclear. Further research is needed in order to determine which interventions are effective and to ensure maintenance of funding for low vision rehabilitation services in children.

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Appendix 1. Full search strategy for bibliographic databases

PubMed Session Results (21 February 2018): 9614 items

Search	Query
#5	#4 NOT ("Animals"[Mesh] NOT "Humans"[Mesh])
#4	#1 AND #2 AND #3
#3	"Rehabilitation"[Mesh] OR "Sensory Aids"[Mesh] OR "Self-Help Groups"[Mesh] OR "Self-Help Devices"[Mesh] OR "Education, Special"[Mesh] OR "rehabilitation"[Subheading] OR rehabilitation[tiab] OR intervention*[tiab] OR sensory aid*[tiab] OR self-help group*[tiab] OR self-help device*[tiab] OR special education*[tiab] OR self care*[tiab] OR self-management[tiab] OR training[tiab] OR program*[tiab] OR service*[tiab]
#2	child*[tw] OR schoolchild*[tw] OR infan*[tw] OR adolescen*[tw] OR pediatri*[tw] OR paediatr*[tw] OR neonat*[tw] OR boy[tw] OR boys[tw] OR boyhood[tw] OR girl[tw] OR girls[tw] OR girlhood[tw] OR youth[tw] OR youths[tw] OR baby[tw] OR babies[tw] OR toddler*[tw] OR teen[tw] OR teens[tw] OR teenager*[tw] OR newborn*[tw] OR postneonat*[tw] OR postnat*[tw] OR perinat*[tw] OR puberty[tw] OR preschool*[tw] OR suckling*[tw] OR picu[tw] OR nicu[tw]
#1	"Visually Impaired Persons"[Mesh] OR "Vision Disorders"[Mesh:noexp] OR "Blindness"[Mesh] OR "Vision, Low"[Mesh] OR "Retinal Diseases"[Mesh:noexp] OR "Leber Congenital Amaurosis"[Mesh] OR "Eye Diseases"[Mesh:noexp] OR "Corneal Diseases"[Mesh] OR "Eye Diseases, Hereditary"[Mesh] OR "Optic Nerve Diseases"[Mesh] OR "Eye Abnormalities"[Mesh] OR "Glaucoma/congenital"[Mesh] OR "Strabismus"[Mesh] OR "Nystagmus, Congenital"[Mesh] OR "Refractive Errors"[Mesh] OR "Retinopathy of Prematurity"[Mesh] OR "Uveitis"[Mesh] OR "Amblyopia"[Mesh] OR visually impair*[tiab] OR visual impair*[tiab] OR vision impair*[tiab] OR blindness*[tiab] OR low vision*[tiab] OR reduced vision*[tiab] OR subnormal vision*[tiab] OR diminished vision*[tiab] OR vision disorder*[tiab] OR visual disorder*[tiab] OR vision disab*[tiab] OR visual disab*[tiab] OR visually disab*[tiab] OR retinal disease*[tiab] OR retina disease*[tiab] OR retinal disorder*[tiab] OR retina disorder*[tiab] OR leber[tiab] OR leber's[tiab] OR lebers[tiab] OR maculopath*[tiab] OR retinitis pigmentosa[tiab] OR Rod-Cone dystroph*[tiab] OR Cone-Rod dystroph*[tiab] OR retinal detachment*[tiab] OR retina detachment*[tiab] OR corneal disease*[tiab] OR cornea disease*[tiab] OR corneal disorder*[tiab] OR cornea disorder*[tiab] OR glaucoma*[tiab] OR optic nerve disease*[tiab] OR optic nerve disorder*[tiab] OR optic neuropath*[tiab] OR optic atroph*[tiab] OR nystagmus[tiab] OR albinism[tiab] OR aniridia[tiab] OR anophthalm*[tiab] OR microphthalm*[tiab] OR coloboma*[tiab] OR ectopia lentis[tiab] OR buphthalm*[tiab] OR hydrophthalm*[tiab] OR retinal dysplas*[tiab] OR strabismus[tiab] OR refractive error*[tiab] OR refractive disorder*[tiab] OR ametropia*[tiab] OR prematurity retinopath*[tiab] OR premature retinopath*[tiab] OR retinopathy of prematur*[tiab] OR uveiti*[tiab] OR amblyopia*[tiab] OR lazy eye*[tiab]

Cinahl Session Results (21 February 2018): 1325 items

Search	Query
S7	S6 NOT (MH "Animals" NOT MH "Human")
S6	S1 AND S4 AND S5
S5	(MH "Rehabilitation+") OR (MH "Sensory Aids") OR (MH "Support Groups") OR (MH "Assistive Technology Devices") OR (MH "Self Care") OR (MH "Education, Special") OR TI (rehabilitation OR intervention* OR "sensory aid*" OR "self-help group*" OR "self-help device*" OR "special education*" OR "self care*" OR "self-management" OR training OR program* OR service*) OR AB (rehabilitation OR intervention* OR "sensory aid*" OR "self-help group*" OR "self-help device*" OR "special education*" OR "self care*" OR "self-management" OR training OR program* OR service*)
S4	S2 OR S3
S3	Limiters - Age Groups: Infant, Newborn: birth-1 month, Infant: 1-23 months, Child, Preschool: 2-5 years, Child: 6-12 years, Adolescent: 13-18 years
S2	TI (child* OR schoolchild* OR infan* OR adolescen* OR pediatri* OR paediatr* OR neonat* OR boy OR boys OR boyhood OR girl OR girls OR girlhood OR youth OR youths OR baby OR babies OR toddler* OR teen OR teens OR teenager* OR newborn* OR postneonat* OR postnat* OR perinat* OR puberty OR preschool* OR suckling* OR picu OR nicu) OR AB (child* OR schoolchild* OR infan* OR adolescen* OR pediatri* OR paediatr* OR neonat* OR boy OR boys OR boyhood OR girl OR girls OR girlhood OR youth OR youths OR baby OR babies OR toddler* OR teen OR teens OR teenager* OR newborn* OR postneonat* OR postnat* OR perinat* OR puberty OR preschool* OR suckling* OR picu OR nicu)

S1	(MH "Vision Disorders") OR (MH "Blindness+") OR (MH "Vision, Subnormal") OR (MH "Rehabilitation of Vision Impaired") OR (MH "Retinal Diseases") OR (MH "Cone-Rod Dystrophies") OR (MH "Leber's Congenital Amaurosis") OR (MH "Retinal Detachment") OR (MH "Retinitis Pigmentosa+") OR (MH "Eye Diseases") OR (MH "Corneal Diseases+") OR (MH "Eye Diseases, Hereditary+") OR (MH "Optic Nerve Diseases+") OR (MH "Eye Abnormalities+") OR (MH "Glaucoma+") OR (MH "Strabismus") OR (MH "Nystagmus, Congenital") OR (MH "Refractive Errors+") OR (MH "Retinopathy of Prematurity") OR (MH "Uveitis+") OR (MH "Amblyopia") OR TI ("visually impair*" OR "visual impair*" OR blindness* OR "low vision*" OR "reduced vision*" OR "subnormal vision*" OR "diminished vision*" OR "visual disorder*" OR "visually disab*" OR leber OR "leber s" OR lebers OR maculopath* OR "retinitis pigmentosa" OR "Rod-Cone dystroph*" OR "Cone-Rod dystroph*" OR "retinal detachment*" OR "retina detachment*" OR glaucoma* OR "optic neuropath*" OR "optic atroph*" OR nystagmus OR albinism OR aniridia OR anophthalm* OR microphthalm* OR coloboma* OR "ectopia lentis" OR buphthalm* OR hydrophthalm* OR "retinal dysplas*" OR strabismus OR "refractive error*" OR "refractive disorder*" OR ametropia* OR uveiti* OR amblyopia* OR "lazy eye*" OR (vision N3 impair*) OR (vision N3 disorder*) OR (vision N3 disab*) OR (visual N3 disab*) OR (retina* N3 disease*) OR (retina* N3 disorder*) OR ("optic nerve*" N3 disease*) OR ("optic nerve*" N3 disorder*) OR (cornea* N3 disease*) OR (cornea* N3 disorder*) OR (prematur* N3 retinopath*)) OR AB ("visually impair*" OR "visual impair*" OR blindness* OR "low vision*" OR "reduced vision*" OR "subnormal vision*" OR "diminished vision*" OR "visual disorder*" OR "visually disab*" OR leber OR "leber s" OR lebers OR maculopath* OR "retinitis pigmentosa" OR "Rod-Cone dystroph*" OR "Cone-Rod dystroph*" OR "retinal detachment*" OR "retina detachment*" OR glaucoma* OR "optic neuropath*" OR "optic atroph*" OR nystagmus OR albinism OR aniridia OR anophthalm* OR microphthalm* OR coloboma* OR "ectopia lentis" OR buphthalm* OR hydrophthalm* OR "retinal dysplas*" OR strabismus OR "refractive error*" OR "refractive disorder*" OR ametropia* OR uveiti* OR amblyopia* OR "lazy eye*" OR (vision N3 impair*) OR (vision N3 disorder*) OR (vision N3 disab*) OR (visual N3 disab*) OR (retina* N3 disease*) OR (retina* N3 disorder*) OR ("optic nerve*" N3 disease*) OR ("optic nerve*" N3 disorder*) OR (cornea* N3 disease*) OR (cornea* N3 disorder*) OR (prematur* N3 retinopath*))

Cochrane Library Session Results (21 February 2018): 845 items

Search	Query
#4	#1 and #2 and #3
#3	(rehabilitation or intervention* or "sensory aid*" or "self-help group*" or "self-help device*" or "special education*" or "self care*" or "self-management" or training or program* or service*):ab,ti,kw
#2	(child* or schoolchild* or infan* or adolescen* or pediatri* or paediatr* or neonat* or boy or boys or boyhood or girl or girls or girlhood or youth or youths or baby or babies or toddler* or teen or teens or teenager* or newborn* or postneonat* or postnat* or perinat* or puberty or preschool* or suckling* or picu or nicu):ab,ti,kw
#1	("visually impair*" or "visual impair*" or blindness* or "low vision*" or "reduced vision*" or "subnormal vision*" or "diminished vision*" or "visual disorder*" or "visually disab*" or leber or "leber s" or lebers or maculopath* or "retinitis pigmentosa" or "rod-cone dystroph*" or "cone-rod dystroph*" or "retinal detachment*" or "retina detachment*" or glaucoma* or "optic neuropath*" or "optic atroph*" or (vision near/3 impair*) or (vision near/3 disorder*) or (vision near/3 disab*) or (visual near/3 disab*) or (retina* near/3 disease*) or (retina* near/3 disorder*) or ("optic nerve*" near/3 disease*) or ("optic nerve*" near/3 disorder*) or (cornea* near/3 disease*) or (cornea* near/3 disorder*) or nystagmus or albinism or aniridia or anophthalm* or microphthalm* or coloboma* or "ectopia lentis" or buphthalm* or hydrophthalm* or "retinal dysplas*" or strabismus or "refractive error*" or "refractive disorder*" or ametropia* or (prematur* near/3 retinopath*) or uveiti* or amblyopia* or "lazy eye*"):ab,ti,kw

PsycINFO Session Results (21 February 2018): 2115 items

Search	Query
S7	S6 NOT (PO Animal NOT PO Human)
S6	S1 AND S4 AND S5
S5	DE "Rehabilitation" OR DE "Optical Aids" OR DE "Self-Help Techniques" OR DE "Self-Management" OR DE "Self-Care Skills" OR DE "Support Groups" OR DE "Special Education" OR TI (rehabilitation OR intervention* OR "sensory aid*" OR "self-help group*" OR "self-help device*" OR "special education*" OR "self care*" OR "self-management" OR training OR program* OR service*) OR AB (rehabilitation OR

	intervention* OR "sensory aid*" OR "self-help group*" OR "self-help device*" OR "special education*" OR "self care*" OR "self-management" OR training OR program* OR service*)
S4	S2 OR S3
S3	Limiters - Age Groups: Childhood (birth-12 yrs), Adolescence (13-17 yrs)
S2	TI (child* OR schoolchild* OR infan* OR adolescen* OR pediatri* OR paediatr* OR neonat* OR boy OR boys OR boyhood OR girl OR girls OR girlhood OR youth OR youths OR baby OR babies OR toddler* OR teen OR teens OR teenager* OR newborn* OR postneonat* OR postnat* OR perinat* OR puberty OR preschool* OR suckling* OR picu OR nicu) OR AB (child* OR schoolchild* OR infan* OR adolescen* OR pediatri* OR paediatr* OR neonat* OR boy OR boys OR boyhood OR girl OR girls OR girlhood OR youth OR youths OR baby OR babies OR toddler* OR teen OR teens OR teenager* OR newborn* OR postneonat* OR postnat* OR perinat* OR puberty OR preschool* OR suckling* OR picu OR nicu)
S1	DE "Vision Disorders" OR DE "Blind" OR DE "Partially Sighted" OR DE "Retina" OR DE "Eye Disorders" OR DE "Cornea" OR DE "Optic Nerve" OR DE "Glaucoma" OR DE "Strabismus" OR DE "Nystagmus" OR DE "Amblyopia" OR TI ("visually impair*" OR "visual impair*" OR blindness* OR "low vision*" OR "reduced vision*" OR "subnormal vision*" OR "diminished vision*" OR "visual disorder*" OR "visually disab*" OR leber OR "leber s" OR lebers OR maculopath* OR "retinitis pigmentosa" OR "Rod-Cone dystroph*" OR "Cone-Rod dystroph*" OR "retinal detachment*" OR "retina detachment*" OR glaucoma* OR "optic neuropath*" OR "optic atroph*" OR nystagmus OR albinism OR aniridia OR anophthalm* OR microphthalm* OR coloboma* OR "ectopia lentis" OR buphthalm* OR hydrophthalm* OR "retinal dysplas*" OR strabismus OR "refractive error*" OR "refractive disorder*" OR ametropia* OR uveiti* OR amblyopia* OR "lazy eye*" OR (vision N3 impair*) OR (vision N3 disorder*) OR (vision N3 disab*) OR (visual N3 disab*) OR (retina* N3 disease*) OR (retina* N3 disorder*) OR ("optic nerve*" N3 disease*) OR ("optic nerve*" N3 disorder*) OR (cornea* N3 disease*) OR (cornea* N3 disorder*) OR (prematur* N3 retinopath*)) OR AB ("visually impair*" OR "visual impair*" OR blindness* OR "low vision*" OR "reduced vision*" OR "subnormal vision*" OR "diminished vision*" OR "visual disorder*" OR "visually disab*" OR leber OR "leber s" OR lebers OR maculopath* OR "retinitis pigmentosa" OR "Rod-Cone dystroph*" OR "Cone-Rod dystroph*" OR "retinal detachment*" OR "retina detachment*" OR glaucoma* OR "optic neuropath*" OR "optic atroph*" OR nystagmus OR albinism OR aniridia OR anophthalm* OR microphthalm* OR coloboma* OR "ectopia lentis" OR buphthalm* OR hydrophthalm* OR "retinal dysplas*" OR strabismus OR "refractive error*" OR "refractive disorder*" OR ametropia* OR uveiti* OR amblyopia* OR "lazy eye*" OR (vision N3 impair*) OR (vision N3 disorder*) OR (vision N3 disab*) OR (visual N3 disab*) OR (retina* N3 disease*) OR (retina* N3 disorder*) OR ("optic nerve*" N3 disease*) OR ("optic nerve*" N3 disorder*) OR (cornea* N3 disease*) OR (cornea* N3 disorder*) OR (prematur* N3 retinopath*))

Embase.com Session Results (21 February 2018): 12,039 items

Search	Query
#5	#4 NOT ([animals]/lim NOT [humans]/lim)
#4	#1 AND #2 AND #3
#3	'rehabilitation'/exp OR 'sensory aid'/exp OR 'self help'/exp OR 'self help device'/exp OR 'special education'/exp OR rehabilitation:ab,ti,kw OR intervention*:ab,ti,kw OR 'sensory aid*':ab,ti,kw OR 'self-help group*':ab,ti,kw OR 'self-help device*':ab,ti,kw OR 'special education*':ab,ti,kw OR 'self care*':ab,ti,kw OR 'self-management':ab,ti,kw OR training:ab,ti,kw OR program*:ab,ti,kw OR service*:ab,ti,kw
#2	'child'/exp OR 'adolescent'/exp OR 'pediatrics'/exp OR child*:ab,ti,kw OR schoolchild*:ab,ti,kw OR infan*:ab,ti,kw OR adolescen*:ab,ti,kw OR pediatri*:ab,ti,kw OR paediatr*:ab,ti,kw OR neonat*:ab,ti,kw OR boy:ab,ti,kw OR boys:ab,ti,kw OR boyhood:ab,ti,kw OR girl:ab,ti,kw OR girls:ab,ti,kw OR girlhood:ab,ti,kw OR youth:ab,ti,kw OR youths:ab,ti,kw OR baby:ab,ti,kw OR babies:ab,ti,kw OR toddler*:ab,ti,kw OR teen:ab,ti,kw OR teens:ab,ti,kw OR teenager*:ab,ti,kw OR newborn*:ab,ti,kw OR postneonat*:ab,ti,kw OR postnat*:ab,ti,kw OR perinat*:ab,ti,kw OR puberty:ab,ti,kw OR preschool*:ab,ti,kw OR suckling*:ab,ti,kw OR picu:ab,ti,kw OR nicu:ab,ti,kw
#1	'visually impaired person'/exp OR 'visual disorder'/de OR 'visual impairment'/exp OR 'retina disease'/de OR 'eye disease'/de OR 'cornea disease'/exp OR 'glaucoma'/exp OR 'optic nerve disease'/exp OR 'eye malformation'/exp OR 'strabismus'/exp OR 'congenital nystagmus'/exp OR 'refraction error'/exp OR 'retrolental fibroplasia'/exp OR 'uveitis'/exp OR 'amblyopia'/exp OR 'visually impair*':ab,ti,kw OR 'visual impair*':ab,ti,kw OR blindness*:ab,ti,kw OR 'low vision*':ab,ti,kw OR 'reduced vision*':ab,ti,kw OR 'subnormal vision*':ab,ti,kw OR 'diminished vision*':ab,ti,kw OR 'visual disorder*':ab,ti,kw OR 'visually

	disab*':ab,ti,kw OR leber:ab,ti,kw OR 'leber s':ab,ti,kw OR lebers:ab,ti,kw OR maculopath*:ab,ti,kw OR 'retinitis pigmentosa':ab,ti,kw OR 'rod-cone dystroph*':ab,ti,kw OR 'cone-rod dystroph*':ab,ti,kw OR 'retinal detachment*':ab,ti,kw OR 'retina detachment*':ab,ti,kw OR glaucoma*:ab,ti,kw OR 'optic neuropath*':ab,ti,kw OR 'optic atroph*':ab,ti,kw OR (vision NEAR/3 impair*):ab,ti,kw OR (vision NEAR/3 disorder*):ab,ti,kw OR (vision NEAR/3 disab*):ab,ti,kw OR (visual NEAR/3 disab*):ab,ti,kw OR (retina* NEAR/3 disease*):ab,ti,kw OR (retina* NEAR/3 disorder*):ab,ti,kw OR ('optic nerve*' NEAR/3 disease*):ab,ti,kw OR ('optic nerve*' NEAR/3 disorder*):ab,ti,kw OR (cornea* NEAR/3 disease*):ab,ti,kw OR (cornea* NEAR/3 disorder*):ab,ti,kw OR nystagmus:ab,ti,kw OR albinism:ab,ti,kw OR aniridia:ab,ti,kw OR anophthalm*:ab,ti,kw OR microphthalm*:ab,ti,kw OR coloboma*:ab,ti,kw OR 'ectopia lentis':ab,ti,kw OR buphthalm*:ab,ti,kw OR hydrophthalm*:ab,ti,kw OR 'retinal dysplas*':ab,ti,kw OR strabismus:ab,ti,kw OR 'refractive error*':ab,ti,kw OR 'refractive disorder*':ab,ti,kw OR ametropia*:ab,ti,kw OR (prematur* NEAR/3 retinopath*):ab,ti,kw OR uveiti*:ab,ti,kw OR amblyopia*:ab,ti,kw OR 'lazy eye*':ab,ti,kw

ERIC Session Results (21 February 2018): 1816 items

Search	Query
S5	S4 NOT (PO Animal NOT PO Human)
S4	S1 AND S2 AND S3
S3	DE "Rehabilitation" OR DE "Assistive Technology" OR DE "Sensory Aids" OR DE "Self Help Programs" OR DE "Self Management" OR DE "Social Support Groups" OR DE "Special Education" OR TI (rehabilitation OR intervention* OR "sensory aid*" OR "self-help group*" OR "self-help device*" OR "special education*" OR "self care*" OR "self-management" OR training OR program* OR service*) OR AB (rehabilitation OR intervention* OR "sensory aid*" OR "self-help group*" OR "self-help device*" OR "special education*" OR "self care*" OR "self-management" OR training OR program* OR service*)
S2	TI (child* OR schoolchild* OR infan* OR adolescen* OR pediatri* OR paediatr* OR neonat* OR boy OR boys OR boyhood OR girl OR girls OR girlhood OR youth OR youths OR baby OR babies OR toddler* OR teen OR teens OR teenager* OR newborn* OR postneonat* OR postnat* OR perinat* OR puberty OR preschool* OR suckling* OR picu OR nicu) OR AB (child* OR schoolchild* OR infan* OR adolescen* OR pediatri* OR paediatr* OR neonat* OR boy OR boys OR boyhood OR girl OR girls OR girlhood OR youth OR youths OR baby OR babies OR toddler* OR teen OR teens OR teenager* OR newborn* OR postneonat* OR postnat* OR perinat* OR puberty OR preschool* OR suckling* OR picu OR nicu)
S1	DE "Visual Impairments" OR DE "Blindness" OR DE "Partial Vision" OR TI ("visually impair*" OR "visual impair*" OR blindness* OR "low vision*" OR "reduced vision*" OR "subnormal vision*" OR "diminished vision*" OR "visual disorder*" OR "visually disab*" OR leber OR "leber s" OR lebers OR maculopath* OR "retinitis pigmentosa" OR "Rod-Cone dystroph*" OR "Cone-Rod dystroph*" OR "retinal detachment*" OR "retina detachment*" OR glaucoma* OR "optic neuropath*" OR "optic atroph*" OR nystagmus OR albinism OR aniridia OR anophthalm* OR microphthalm* OR coloboma* OR "ectopia lentis" OR buphthalm* OR hydrophthalm* OR "retinal dysplas*" OR strabismus OR "refractive error*" OR "refractive disorder*" OR ametropia* OR uveiti* OR amblyopia* OR "lazy eye*" OR (vision N3 impair*) OR (vision N3 disorder*) OR (vision N3 disab*) OR (visual N3 disab*) OR (retina* N3 disease*) OR (retina* N3 disorder*) OR ("optic nerve*" N3 disease*) OR ("optic nerve*" N3 disorder*) OR (cornea* N3 disease*) OR (cornea* N3 disorder*) OR (prematur* N3 retinopath*)) OR AB ("visually impair*" OR "visual impair*" OR blindness* OR "low vision*" OR "reduced vision*" OR "subnormal vision*" OR "diminished vision*" OR "visual disorder*" OR "visually disab*" OR leber OR "leber s" OR lebers OR maculopath* OR "retinitis pigmentosa" OR "Rod-Cone dystroph*" OR "Cone-Rod dystroph*" OR "retinal detachment*" OR "retina detachment*" OR glaucoma* OR "optic neuropath*" OR "optic atroph*" OR nystagmus OR albinism OR aniridia OR anophthalm* OR microphthalm* OR coloboma* OR "ectopia lentis" OR buphthalm* OR hydrophthalm* OR "retinal dysplas*" OR strabismus OR "refractive error*" OR "refractive disorder*" OR ametropia* OR uveiti* OR amblyopia* OR "lazy eye*" OR (vision N3 impair*) OR (vision N3 disorder*) OR (vision N3 disab*) OR (visual N3 disab*) OR (retina* N3 disease*) OR (retina* N3 disorder*) OR ("optic nerve*" N3 disease*) OR ("optic nerve*" N3 disorder*) OR (cornea* N3 disease*) OR (cornea* N3 disorder*) OR (prematur* N3 retinopath*))

Appendix 2. Quality assessment based on 1) the Cochrane Collaboration Risk of Bias Tool (CCRBT) for RCTs (low, high or unclear risk), and 2a) the Risk Of Bias In Non-randomised Studies - of Interventions Tool (ROBINS-I) for non-RCTs and 2b) BAs (low, moderate, serious, critical or unclear risk)

Author (year, country)	Random sequence generation: selection bias	Allocation concealment: selection bias	Blinding of participants and personnel: performance bias	Blinding of outcome assessment: detection bias	Incomplete outcome data: attrition bias	Selective reporting: reporting bias	Other sources of bias
1. Cochrane Collaboration Risk of Bias Tool (low, high or unclear risk) – Randomised controlled trials							
Arunakul et al. (2015, Thailand)[3]	Unclear: not reported	Unclear: not reported	High: blinding impossible due to the nature of the intervention	Unclear: unclear if assessor was blinded	Low: no drop-out	Unclear: protocol not available	Low: baseline differences in outcome and demographics were not statistically significant
Behl et al. (1993, USA)[7]	Low: computer generated randomisation	Unclear: not reported	High: blinding impossible due to the nature of the intervention	Low: assessors were blinded	Low: drop-out was 31%, but not related to treatment allocation (White, 1988)	Unclear: protocol not available	Low: small baseline imbalances, adjusted for baseline differences
Boonstra et al. (2012, The Netherlands)[13]	Unclear: not reported	Unclear: not reported	High: blinding impossible due to the nature of the intervention	Low: assessor was blinded	Unclear: drop-out was 36% (due to quality of recording), but unclear in which group drop-out occurred	Unclear: protocol not available	Unclear: unclear if baseline differences were statistically significant, matching occurred on age an visual acuity
Caliskan et al. (2011, Turkey)[16]	Unclear: not reported	Unclear: not reported	High: blinding impossible due to the nature of the intervention	Unclear: unclear if assessor was blinded	Low: no drop-out	Unclear: protocol not available	Low: baseline differences in outcome and demographics were not statistically significant
Chen & Lin (2011, Taiwan)[19]	Unclear: not reported	Unclear: not reported	High: blinding impossible due to the nature of the intervention	Unclear: unclear if assessor was blinded	Low: no drop-out	Unclear: protocol not available	Unclear: unclear if baseline differences were statistically significant

Christy (2012, India)[21]	Low: randomised block design	Low: sealed envelopes	High: blinding impossible due to the nature of the intervention	Unclear: unclear if assessor was blinded	Low: low drop-out (7.9%), unclear in which group drop-out occurred	Low: trail registration	Unclear: no information on baseline imbalances provided
Eniola & Adebiyi (2007, Nigeria)[33]	Unclear: not reported	Unclear: not reported	High: blinding impossible due to the nature of the intervention	Unclear: unclear if assessor was blinded	Low: no drop-out	Unclear: protocol not available	Unclear: no information on baseline imbalances provided except for sex
Eniola & Ajobiewe (2013, Nigeria)[32]	Unclear: not reported	Unclear: not reported	High: blinding impossible due to the nature of the intervention	Unclear: unclear if assessor was blinded	Low: no drop-out	Unclear: protocol not available	Unclear: no information on baseline imbalances provided
Ganapathi et al. (2015, India)[39]	Unclear: simple random sampling, unclear how randomisation was performed	Unclear: not reported	High: blinding impossible due to the nature of the intervention	Low: assessor was blinded	Low: no drop-out	High: protocol not available, but no post-test measures taken for the control group	Unclear: no information on baseline imbalances provided
Heber et al. (1967, USA)[47]	Unclear: not reported	Unclear: not reported	High: blinding impossible due to the nature of the intervention	Low: assessors were blinded	Low: no drop-out	Unclear: protocol not available	Unclear: no information on baseline imbalances provided
Howell (1977, UK)[50]	Low: random numbers table	Unclear: not reported	High: blinding impossible due to the nature of the intervention	Unclear: unclear if assessor was blinded	Low: no drop-out	Unclear: protocol not available	Unclear: no information on baseline imbalances provided except for sex and IQ

Appendix 2. Cont'd

Author (year, country)	Random sequence generation: selection bias	Allocation concealment: selection bias	Blinding of participants and personnel: performance bias	Blinding of outcome assessment: detection bias	Incomplete outcome data: attrition bias	Selective reporting: reporting bias	Other sources of bias
Jazi et al. (2012, Iran)[54]	Unclear: not reported	Unclear: not reported	High: blinding impossible due to the nature of the intervention	Unclear: unclear if assessor was blinded	Low: no drop-out	Unclear: protocol not available	Unclear: baseline differences on outcome were not statistically significant, unclear if other baseline differences were statistically significant (age, sex)
Joseph (1984, USA)[56]	Unclear: not reported	Unclear: not reported	High: blinding impossible due to the nature of the intervention	Unclear: unclear if assessor was blinded	Low: no drop-out	Unclear: protocol not available	Unclear: unclear if baseline differences were statistically significant
Kederis et al. (1964, USA)[57]	Unclear: not reported	Unclear: not reported	High: blinding impossible due to the nature of the intervention	Unclear: unclear if assessor was blinded	Low: no drop-out	Unclear: protocol not available	Unclear: unclear if baseline differences were statistically significant, matching occurred on reading time and comprehension
Kederis et al. (1964, USA)[58]	Unclear: not reported	Unclear: not reported	High: blinding impossible due to the nature of the intervention	Unclear: unclear if assessor was blinded	Low: no drop-out	Unclear: protocol not available	Unclear: unclear if baseline differences were statistically significant, matching occurred on reading time and grade level

Kim (2003, USA)[61]	Low: coin tossing	Unclear: not reported	High: blinding impossible due to the nature of the intervention	Low: assessor was blinded	Low: low drop-out (11.5%), not related to intervention	Unclear: protocol not available	Low: baseline differences in outcome and demographics were not statistically significant
Krishnakumar et al. (2016, India)[62]	Unclear: not reported	Unclear: not reported	High: blinding impossible due to the nature of the intervention	Unclear: unclear if assessor was blinded	Low: no drop-out	Unclear: protocol not available	Unclear: no information on baseline imbalances provided
Locke & Gerler (1981, USA)[66]	Unclear: not reported	Unclear: not reported	High: blinding impossible due to the nature of the intervention	Unclear: unclear if assessor was blinded	Low: no drop-out	Unclear: protocol not available	Unclear: unclear if baseline differences were statistically significant
Mavrovouniotis et al. (2013, Greece)[69]	Unclear: not reported	Unclear: not reported	High: blinding impossible due to the nature of the intervention	Unclear: unclear if assessor was blinded	Low: drop-out was low (12.5%), participants were excluded from analysis based on a priori rules	Unclear: protocol not available	Low: baseline differences in outcome and demographics were not statistically significant
McConnell (1994, USA)[72]	Low: randomised block design	Unclear: not reported	High: blinding impossible due to the nature of the intervention	Unclear: unclear if assessor was blinded	Low: no drop-out	Unclear: protocol not available	Unclear: unclear if baseline differences were statistically significant
Nyquist et al. (2016, USA)[78]	Low: randomised block design	Unclear: not reported	High: blinding impossible due to the nature of the intervention	Low: outcomes electronically obtained	Low: no drop-out	Unclear: protocol not available	Low: small baseline imbalances, adjusted for baseline differences
Platje et al. (2018, the Netherlands)[83]	Low: computerised random number generator	Unclear: not reported	High: blinding impossible due to the nature of the intervention	Low: assessor was blinded	Low: low drop-out (10.5%), not related to intervention	Low: protocol published [79]	Low: baseline differences in outcome and demographics were not statistically significant

Appendix 2. Cont'd

Author (year, country)	Random sequence generation: selection bias	Allocation concealment: selection bias	Blinding of participants and personnel: performance bias	Blinding of outcome assessment: detection bias	Incomplete outcome data: attrition bias	Selective reporting: reporting bias	Other sources of bias
Qureshi et al. (2017, Pakistan)[85]	Low: random numbers table	Low: sequentially numbered, opaque sealed envelopes	High: blinding impossible due to the nature of the intervention	Low: assessor was blinded	Low: no drop-out	Unclear: protocol not available	Low: baseline differences in outcome and demographics were not statistically significant
Sacks & Gaylord-Ross (1989, USA)[93]	Unclear: not reported	Unclear: not reported	High: blinding impossible due to the nature of the intervention	High: assessment made by unmasked recorder	Low: no drop-out	Unclear: protocol not available	Unclear: unclear when assessments took place and if baseline differences were statistically significant
Smutkeeree et al. (2011, Thailand)[98]	Low: coin tossing	Unclear: not reported	High: blinding impossible due to the nature of the intervention	Unclear: unclear if assessor was blinded	Low: drop-out was low (5%) and not related to the outcome	Unclear: protocol not available	Unclear: no information on baseline imbalances provided
Uysal & Düger (2012, Turkey)[114]	Low: random numbers table	Unclear: sequentially numbered, no information on concealment	High: blinding impossible due to the nature of the intervention	Unclear: unclear if assessor was blinded	Low: no drop-out	Unclear: protocol not available	Unclear: unclear if baseline differences were statistically significant
Wood (1978, USA)[124]	Unclear: not reported	Unclear: not reported	High: blinding impossible due to the nature of the intervention	Unclear: unclear if assessor was blinded	Low: low drop-out (14.3%), unclear in which group drop-out occurred	Unclear: protocol not available	Unclear: no information on baseline imbalances provided
Yildiz & Duy (2013, Turkey)[127]	Unclear: not reported	Unclear: not reported	High: blinding impossible due to the nature of the intervention	Unclear: unclear if assessor was blinded	Low: no drop-out	Unclear: protocol not available	Unclear: no information on baseline imbalances provided

2a. ROBINS-I Tool (low, moderate, serious or critical risk, or no information) – Non-randomised controlled trials

Author (year, country)	Bias due to confounding	Bias in selection of participants	Bias in classification of interventions	Bias due to deviations from intended interventions	Bias due to missing data	Bias in measurement of outcomes	Bias in selection of reported results	Overall risk of bias
Aki et al. (2007, Turkey)[1]	Serious: no confounders controlled for	Low: all eligible participants were included, intervention start coincided	Low: intervention status well defined	Low: no deviations from intended intervention	Low: no drop-out	No information: unclear who the assessors were	Moderate: no indication of selective reporting or subgroup analysis	Serious
Al-Dababneh et al. (2015, Jordan)[2]	Serious: only controlled for gender, not for other confounders such as age	Low: all eligible participants were included, intervention start coincided	Low: intervention status well defined	Low: no deviations from intended intervention	Low: no drop-out	Serious: interview format, outcome is subjective	Moderate: no indication of selective reporting or subgroup analysis	Serious
Beelmann & Brambring (1998, Germany)[6]	Moderate: groups were matched on sociodemographic family characteristics and child characteristics, controlled for age and pre- or full-term children	Moderate: all eligible participants were included, the intervention and follow-up did not coincide for all participants, but the ratio for effect probably remains constant over time	Low: intervention status well defined	Low: no deviations from intended intervention	Low: no drop-out	Serious: there seem to be different time-points of measurement for both groups, unclear who assessors were	Moderate: no indication of selective reporting or subgroup analysis	Serious

Appendix 2. Cont'd

Author (year, country)	Bias due to confounding	Bias in selection of participants	Bias in classification of interventions	Bias due to deviations from intended interventions	Bias due to missing data	Bias in measurement of outcomes	Bias in selection of reported results	Overall risk of bias
Black (1983, USA)[11]	Serious: only pre-test scores are corrected for in the analyses	Low: all eligible participants were included, intervention start coincided	Low: intervention status well defined	Low: no deviations from intended intervention	Low: no drop-out	Serious: different time-points of measurement for both groups, assessors were not blinded, minimal influence on outcome	Moderate: no indication of selective reporting or subgroup analysis	Serious
Çalik et al. (2012, Turkey)[15]	Serious: no variables controlled for gender and IQ	Moderate: only 51% of those eligible volunteered to participate, intervention start coincided	Low: intervention status well defined	Low: no deviations from intended intervention	Low: no drop-out	Serious: based on self-report, outcome is subjective	Moderate: no indication of selective reporting or subgroup analysis	Serious
Chowdary et al. (2016, India)[20]	Serious: no confounders controlled for	Low: all eligible participants were included, intervention start coincided	Low: intervention status well defined	Low: no deviations from intended intervention	Low: no drop-out	Moderate: unclear whether assessors were blinded, minimal influence on outcome	Moderate: no indication of selective reporting or subgroup analysis	Serious
Cox et al. (2009, The Netherlands)[27]	Serious: matching occurred only for age and visual acuity, no other confounders such as attention or IQ	Moderate: only 74% of those eligible volunteered to participate, intervention start coincided	Low: intervention status well defined	Low: no deviations from intended intervention	No information: drop-out was 21%, unclear in which group drop-out occurred	Low: assessors were blinded	Moderate: no indication of selective reporting or subgroup analysis	Serious

Farmer & Morse (2007, USA)[35]	Serious: matching occurred only for age and visual acuity, no other confounders such as gender or IQ	Low: all eligible participants were included, intervention start coincided	Low: intervention status well defined	Low: no deviations from intended intervention	Low: no drop-out	Moderate: assessors not blinded, minimal influence on outcome	Moderate: no indication of selective reporting or subgroup analysis	Serious
Grumpelt & Rubin (1968, USA)[44]	Moderate: groups were matched on IQ, age and level of comprehension on pre-test	Low: all eligible participants were included, intervention start coincided	Low: intervention status well defined	Low: no deviations from intended intervention	Low: no drop-out	Moderate: unclear whether assessors were blinded, minimal influence on outcome	Moderate: no indication of selective reporting or subgroup analysis	Moderate
Huurneman et al. (2016, The Netherlands)[51]	Serious: matching occurred only for diagnosis and age, no other confounders such as gender or IQ	Low: all eligible participants were included, intervention start coincided	Low: intervention status well defined	Low: no deviations from intended intervention	Low: no drop-out	Moderate: unclear whether assessors were blinded, minimal influence on outcome	Moderate: no indication of selective reporting or subgroup analysis	Serious
Johnson & Johnson (1991, USA)[55]	Moderate: groups were matched on age, IQ, race and sex	Low: almost all eligible participants were included, intervention start coincided	Low: intervention status well defined	Low: no deviations from intended intervention	Low: no drop-out	Serious: unclear who assessors were, outcome is subjective	Moderate: no indication of selective reporting or subgroup analysis	Serious
Levin & Rotheram-Fuller (2011, USA)[65]	Serious: no confounders controlled for	Low: almost all eligible participants were included, intervention start coincided	Low: intervention status well defined	Low: no deviations from intended intervention	Low: no drop-out	Serious: based on self-report, outcome is subjective	Moderate: no indication of selective reporting or subgroup analysis	Serious
Mohanty et al. (2015, India)[74]	Serious: no confounders controlled for	Low: all eligible participants were included, intervention start coincided	Low: intervention status well defined	Low: no deviations from intended intervention	Low: drop-out was low (3.6%)	Low: assessors were blinded	Moderate: no indication of selective reporting or subgroup analysis	Serious

Appendix 2. Cont'd

Author (year, country)	Bias due to confounding	Bias in selection of participants	Bias in classification of interventions	Bias due to deviations from intended interventions	Bias due to missing data	Bias in measurement of outcomes	Bias in selection of reported results	Overall risk of bias
Mohanty et al. (2016, India)[75]	Moderate: groups were matched on age, gender, height, weight and degree of blindness	Low: all eligible participants were included, intervention start coincided	Low: intervention status well defined	Low: no deviations from intended intervention	Low: drop-out was low (7%) and reasonably balanced between groups (2 in experimental, 4 in control)	Low: assessors were blinded	Moderate: no indication of selective reporting or subgroup analysis	Moderate
Pineio et al. (2017, Greece)[82]	Moderate: groups were matched on age, gender, degree of visual impairment, time of onset and somatometric characteristics	Low: all eligible participants were included, intervention start coincided	Low: intervention status well defined	Low: no deviations from intended intervention	Low: no drop-out	Moderate: unclear whether assessors were blinded, minimal influence on outcome	Moderate: no indication of selective reporting or subgroup analysis	Moderate
Reimer et al. (2011, The Netherlands)[89]	Serious: only age in months is corrected for in the analyses	Low: all eligible participants were included, intervention start coincided	Low: intervention status well defined	Low: no deviations from intended intervention	Low: no drop-out	Moderate: unclear whether assessors were blinded, minimal influence on outcome	Moderate: no indication of selective reporting or subgroup analysis	Serious
Shetty et al. (2013, India)[96]	Serious: no confounders controlled for	Low: all eligible participants were included, intervention start coincided	Low: intervention status well defined	Low: no deviations from intended intervention	Low: no drop-out	Serious: different time-points of measurement for both groups, unclear whether assessors were blinded, minimal influence on outcome	Moderate: no indication of selective reporting or subgroup analysis	Serious

Taskin (2016, Turkey)[105]	Serious: no confounders controlled for	Low: all eligible participants were included, intervention start coincided	Low: intervention status well defined	Low: no deviations from intended intervention	Low: no drop-out	Moderate: unclear whether assessors were blinded, minimal influence on outcome	Moderate: no indication of selective reporting or subgroup analysis	Serious
2b. ROBINS-I Tool (low, moderate, serious or critical risk, or no information) – Before-after comparisons								
Bieber-Schut (1991, Canada)[8]	Serious: no confounders controlled for	Low: all eligible participants were included, intervention start coincided	N/A	Low: no deviations from intended intervention	No information: drop-out was 25%, reasons for drop-out unclear	Serious: proxy measures by not blinded assessors, outcome is subjective	Moderate: no indication of selective reporting or subgroup analysis	Serious
Blessing et al. (1993, USA)[12]	Serious: no confounders controlled for	Low: all eligible participants were included, intervention start coincided	N/A	Low: no deviations from intended intervention	Low: no drop-out	Moderate: unclear who the assessors were, minimal influence on outcome	Moderate: no indication of selective reporting or subgroup analysis	Serious
Corn et al. (2002, USA)[26]	Serious: no confounders controlled for	Low: all eligible participants were included, intervention start coincided	N/A	Low: no deviations from intended intervention	Low: no drop-out	Moderate: unclear who the assessors were, minimal influence on outcome	Moderate: no indication of selective reporting or subgroup analysis	Serious
Debnath et al. (2017, India)[28]	Serious: no confounders controlled for	Low: all eligible participants were included, intervention start coincided	N/A	Low: no deviations from intended intervention	Low: no drop-out	Moderate: unclear who the assessors were, minimal influence on outcome	Moderate: no indication of selective reporting or subgroup analysis	Serious
Dursun et al. (2015, Turkey)[30]	Serious: no confounders controlled for	Low: all eligible participants were included, intervention start coincided	N/A	Low: no deviations from intended intervention	Low: no drop-out	Serious: interview format, outcome is subjective	Moderate: no indication of selective reporting or subgroup analysis	Serious

Appendix 2. Cont'd

Author (year, country)	Bias due to confounding	Bias in selection of participants	Bias in classification of interventions	Bias due to deviations from intended interventions	Bias due to missing data	Bias in measurement of outcomes	Bias in selection of reported results	Overall risk of bias
Ganesh et al. (2013, India)[40]	Serious: no confounders controlled for	Moderate: only 38% of those eligible could participate, intervention start coincided	N/A	Low: no deviations from intended intervention	Low: no drop-out	Serious: interview format, outcome is subjective	Moderate: no indication of selective reporting or subgroup analysis	Serious
Gothwal et al. (2015, India)[43]	Serious: no confounders controlled for	Moderate: only 28% of those eligible could participate, intervention start coincided	N/A	Low: no deviations from intended intervention	Low: drop-out was 54%, those who dropped-out were not statistically different from those who completed	Serious: assessors were blinded to baseline results, interview format, outcome is subjective	Serious: effects of characteristics on the likelihood of change in scores were explored	Serious
Hebbal & Ankola (2012, India)[46]	Serious: no confounders controlled for	Low: almost all eligible participants were included, intervention start coincided	N/A	Low: no deviations from intended intervention	Low: drop-out was 12.7%, but drop-out was not related to intervention	Moderate: assessors not blinded, minimal influence on outcome	Moderate: no indication of selective reporting or subgroup analysis	Serious
McMahon (2013, USA)[70]	Serious: no confounders controlled for	Low: all eligible participants were included, intervention start coincided	N/A	Low: no deviations from intended intervention	Low: no drop-out	Serious: interview format, outcome is subjective	Moderate: no indication of selective reporting or subgroup analysis	Serious
McMahon (2013, USA)[71]	Serious: no confounders controlled for	Low: all eligible participants were included, intervention start coincided	N/A	Low: no deviations from intended intervention	Low: no drop-out	Moderate: unclear whether assessors were blinded, minimal influence on outcome	Moderate: no indication of selective reporting or subgroup analysis	Serious

Mohamed et al. (2011, Egypt)[73]	Serious: no confounders controlled for	Low: all eligible participants were included, intervention start coincided	N/A	Low: no deviations from intended intervention	Low: no drop-out	Serious: interview format, outcome is subjective	Moderate: no indication of selective reporting or subgroup analysis	Serious
Ponchillia et al. (2005, USA)[84]	Serious: no confounders controlled for	Low: all eligible participants were included, intervention start coincided	N/A	Low: no deviations from intended intervention	Low: no drop-out	Serious: unclear whether assessors were blinded, outcome is subjective	Moderate: no indication of selective reporting or subgroup analysis	Serious
Ritchie et al. (1989, India)[90]	Serious: no confounders controlled for	Low: all eligible participants were included, intervention start coincided	N/A	Low: no deviations from intended intervention	No information: drop-out was 37.5%, reasons for drop-out unclear	Moderate: unclear who the assessors were, minimal influence on outcome	Moderate: no indication of selective reporting or subgroup analysis	Serious
Robinson & Lieberman (2008, USA)[91]	Serious: no confounders controlled for	Moderate: only 29% of those eligible volunteered to participate, intervention start coincided	N/A	Low: no deviations from intended intervention	Low: no drop-out	Serious: based on self-report, outcome is subjective	Moderate: no indication of selective reporting or subgroup analysis	Serious
Shapiro et al. (2005, USA)[95]	Serious: only controlled for age, not for other confounders such as gender	Low: all eligible participants were included, intervention start coincided	N/A	Low: no deviations from intended intervention	Low: no drop-out	Serious: based on self-report or interview format, outcome is subjective	Moderate: no indication of selective reporting or subgroup analysis	Serious

Appendix 2. Cont'd

Author (year, country)	Bias due to confounding	Bias in selection of participants	Bias in classification of interventions	Bias due to deviations from intended interventions	Bias due to missing data	Bias in measurement of outcomes	Bias in selection of reported results	Overall risk of bias
Shindo et al. (1987, Japan)[97]	Serious: no confounders controlled for	Low: all eligible participants were included, intervention start coincided	N/A	Low: no deviations from intended intervention	Low: no drop-out	Moderate: unclear who the assessors were, minimal influence on outcome	Moderate: no indication of selective reporting or subgroup analysis	Serious
Ungar et al. (1997, UK)[111]	Serious: only controlled for age and degree of visual impairment, no other confounders such as IQ	Low: all eligible participants were included, intervention start coincided	N/A	Low: no deviations from intended intervention	Low: no drop-out	Moderate: unclear who the assessors were, minimal influence on outcome	Moderate: no indication of selective reporting or subgroup analysis	Serious
Uysal & Düger (2012, Turkey)[113]	Serious: no confounders controlled for	Low: all eligible participants were included, intervention start coincided	N/A	Low: no deviations from intended intervention	Low: no drop-out	Moderate: unclear who the assessors were, minimal influence on outcome	Moderate: no indication of selective reporting or subgroup analysis	Serious
Williams (1985, UK)[122]	Serious: no confounders controlled for	Low: all eligible participants were included, intervention start coincided	N/A	Low: no deviations from intended intervention	No information: drop-out was 48%, reasons for drop-out unclear	Serious: assessors not blinded, outcome is subjective	Moderate: no indication of selective reporting or subgroup analysis	Serious
Yalcinkaya & Atalay (2006, Turkey)[126]	Serious: no confounders controlled for	Low: all eligible participants were included, intervention start coincided	N/A	Low: no deviations from intended intervention	Low: no drop-out	Moderate: unclear who the assessors were, minimal influence on outcome	Moderate: no indication of selective reporting or subgroup analysis	Serious

N/A: not applicable