Article • Visual Impairment and Blindness in People with Intellectual Disabilities: A Systematic Review

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ABSTRACT

Background: Visual impairment and blindness have a major impact on people with intellectual disabilities (ID). This review aims to provide an overview of their prevalence and issues surrounding detection.

Methods: A systematic review was conducted and included 16 studies published between 2002 and 2017 on the prevalence of visual impairment and blindness in people with ID.

Results: Reported prevalence of visual impairment ranged from 7%-67%; prevalence of blindness ranged from 0.4%-25%. Age, the level of ID, and the presence of Down syndrome all increased the prevalence of visual impairment.

Conclusions: The prevalence of visual impairment and blindness is higher in people with ID compared to the general population. Additionally, all evidence suggests that visual impairment often goes undetected in people with ID. It is therefore important that a more structural approach is adopted to detect visual impairment and blindness in all people with ID.

Keywords: blindness, intellectual disability, visual impairment

Introduction

People with a presenting binocular visual acuity (VA) of <0.3 are considered to have a moderate or severe visual impairment (VI) or to be blind.[1] Visual impairments have a major impact on the ability to perform activities of daily living and to participate in society, thereby negatively influencing the quality of life.[2-4] This influence is even larger for people with intellectual disabilities (ID), because they have less capacity to compensate for their (visual) problems.[5-7] Therefore, it is important to detect VI in people with ID so that proper treatment and/or rehabilitation can be provided and their quality of life can be enhanced. This is especially important since the prevalence of VI and blindness in people with ID is higher than in the general population,[8,9] largely due to the presence of brain damage as a result of injury to the developing brain and/or genetic anomalies.[10,11] However, visual impairments are often not recognized, as not all people with ID are capable of communicating their visual problems,[12-14] and family members and support staff often do not recognize symptoms of visual problems.[15-18]

To our knowledge, the most recent systematic review on the prevalence of VI and blindness in people with ID dates from 2001[9] and was limited to adults with ID. Recently, research has suggested that risk factors such as age,[9,16,19-21] level of ID,[4,9,15,16,22,23] and the presence of Down syndrome[16,23,24] may increase the risk for VI in people with ID. Therefore, we aim to provide an up-to-date overview of risk factors for and prevalence of VI and blindness in people with ID, as well as background information on testing of VI and blindness in people with ID.

Materials and Methods

The results presented in this paper were obtained as part of a larger research project in which a Dutch

Table 1. Inclusion and Exclusion Criteria

Inclusion criteria
The publication concerns people with ID and/or Down syndrome
The study is conducted in a country that is a member of the Convention on the Organisation for Economic Co-operation and Development (OECD)
The publication concerns either:
• The prevalence of visual disorders or ophthalmological conditions that can or almost always lead to visual impairments, examined in a study with a sample of at least 20 people (without selection criteria based on the presence or absence of a VI); • Factors related to the occurrence of visual disorders or ophthalmological conditions that can or almost always lead to visual impairments (including severity of ID and presence of specific syndromes), examined in a study with a sample of at least 20 people (without selection criteria based on the presence or absence of a VI); • Underdiagnosis of visual disorders or ophthalmological conditions
The publication is written in Dutch, English, or German.
Exclusion criteria
The publication is an abstract, editorial, book, dissertation, commentary, or non-systematic review.

multidisciplinary guideline on visual impairments in people with ID was developed.

Search strategy

A systematic search was performed in conjunction with a biomedical information specialist. Embase, Medline, Web of Science, PsycINFO, Cochrane Central, CINAHL, and Google Scholar (first 200 hits) were searched from January 2002 to July 2017. A variety of search terms was used, including intellectual disability, visual impairments, blindness, prevalence, and detection (search available upon request from corresponding author). The hits of all searches were entered into Endnote X9 software (Clarivate Analytics, Philadelphia, USA), and duplicates were removed.

Study selection

Inclusion and exclusion criteria can be found in Table 1. The title and abstract of the first 100 references were screened independently by two reviewers (92% agreement; Cohen's kappa 0.77). Disagreements were discussed, and the remaining publications were screened by a single reviewer. All potentially relevant articles were obtained as full-text. The first 20 articles were screened by two reviewers (95% agreement; Cohen's kappa 0.89) and the remaining articles by one reviewer. During the process, whenever in doubt, a second reviewer screened the article, and disagreements were discussed until consensus was reached.

Additional step

Only publications selected for the guideline development that concerned the prevalence of blindness or VI (i.e., VA <0.3) were included in the current review. Subsequently, the reference lists of these articles were screened to identify additional publications.

Data synthesis and analysis

Data was extracted by two reviewers. General characteristics of the study, study population, methodology, definitions and prevalence of VI and blindness (stratified by age and/or level of ID where possible), and information on testing of VI were extracted.

Quality assessment

The methodological quality of included publications was evaluated using the Joanna Briggs Institute Critical Appraisal Checklist for Studies Reporting Prevalence Data.[25] The appraisal tool does not provide cut-off scores for 'high quality' studies. For the purpose of this review, a study was considered high quality if it scored positive on two important items (sample size and representativeness of the target population) and at least 60% overall. All articles were independently scored by two reviewers. Disagreements were discussed until consensus was reached.

Results

Study characteristics

Sixteen studies were included in the review (Figure 1). Included studies were from the Netherlands,[4,16,26,27] the United Kingdom,[17,28-30] Denmark,[11,31] the United States,[32,33] Austria,[34] Finland,[35] Germany,[21] and Spain.[36] Sample sizes ranged from n=42[32] to n=6220.[27]

Ten studies reported data for people with ID,[4,11,17,26,27,29-32,34] four included only people with Down syndrome,[28,33,35,36] and two studies included both groups.[16,21] Most studies included people with all levels of ID.[4,11,16,21,27,29,33,35] Others included people with moderate to profound ID,[34] severe ID,[31] and severe or profound ID.[26] Five studies did not report

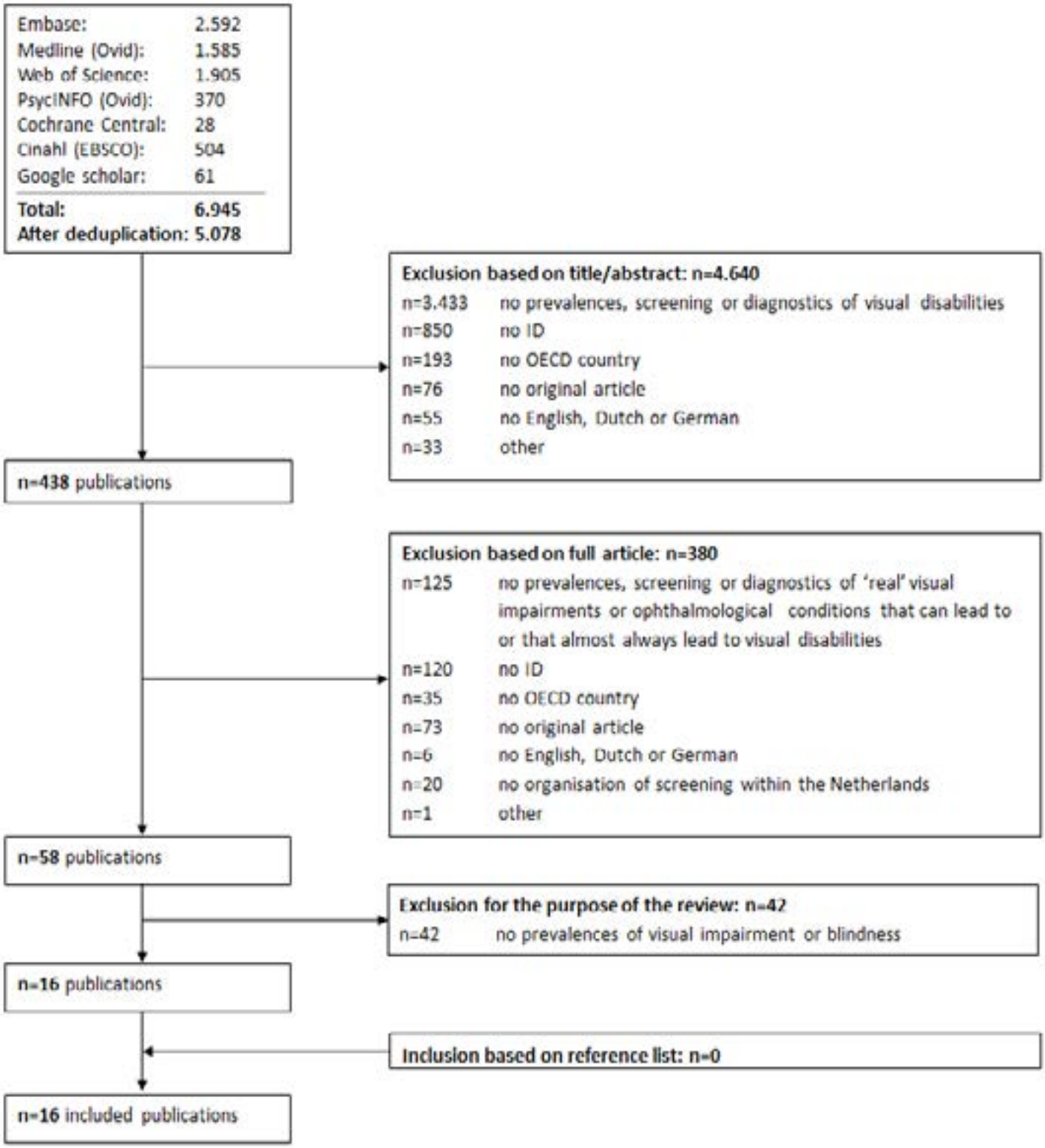

Figure 7. *Flowchart of the search and selection process*

the level of ID.[17,28,30,32,36] Five studies were limited to children,[11,17,28,31,32] five to adults,[4,16,21,33,36] and the remaining studies included all ages.[26,27,29,30,34,35]

Studies recruited participants from special-needs schools,[17,31,32] residential facilities,[26,34] hospital records,[29,35] a workshop,[21] among Special Olympics athletes,[30] through data provided by a visual advisory centre,[27] from multiple facilities,[4,27] and two were population-based.[11,16] Three studies did not describe their recruitment process.[28,33,36]

Visual acuity (VA) was measured using the Cardiff acuity cards,[4,11,16,17,26,27,29,34] Teller acuity cards,[4,11,16,26,27,31,32,34] Lea pictures and symbols,[21,27,30-32] Stycar cards,[4,16,17,27,29] Snellen chart,[4,16,17,27] Burghardt's children's chart,[4,16] Keeler gratings,[17,29] Broken Wheel test,[36] EH optotypes,[34] Kay pictures,[17] Oesterberg Pictorial Sight-Test Chart for Little Children,[31] Sheridan

Gardner/Glasgow acuity cards,[29] and the uncrowded logMAR.[17] Half of the studies reported assessing both near and distant VA,[11,17,21,27,30-32,36] while the other half did not specify this.[4,16,26,28,29,33-35] Five studies reported best-corrected VA (VA achieved by subjects tested with pinhole or refraction, i.e. with eyeglasses or contact lenses),[16,17,21,31,36] and four studies reported presenting VA (VA obtained with currently available refractive correction, if any).[4,27,30,34] One study reported uncorrected VA,[32] and for six studies this was unclear[35] or not reported.[11,26,28,29,33] Visual field was measured using the confrontation method,[4,31] Stycar balls,[16,26,27] or by hand.[11]

Appendix A contains a full summary of all included publications. All data are stored at Erasmus MC University Medical Centre Rotterdam. For information and requests about the data, please contact the first author.

Twelve studies were considered to be of low quality[4,17,21,26-28,30,32-36] and four of high quality.[11, 16,29,31]

Prevalence of visual impairment

The prevalence of visual impairment (VI) was reported in nine studies, with prevalence rates ranging from 7-67%.[4,11,16,21,26,27,30,34,36] Five studies defined VI as VA between 0.3 and 0.05[4,16,21,26,27] and four as VA between 0.3 and 0.1.[11,30,34,36] Three studies reported on the VA for near vision separately.[21,30,36] Three studies included visual field in their definition of VA.[11,16,27]

Age

Two studies found increased prevalence of VI with older age. Henriksen and Degenhardt[21] reported a prevalence of 15% in people under 35 and 36% in people over 45 years old. Similarly, Van Splunder et al.[16] found a prevalence ranging from 2-29% in people under 50 and a prevalence ranging from 8-67% in people older than 50. Van den Broek et al.,[26] on the other hand, reported more severe VI in younger people. However, they noted that younger people in their study had a more severe level of ID, for which they did not correct.

Level of ID

Four studies found an increase in the prevalence of VI with more severe levels of ID. Evenhuis et al.[4] found that prevalence ranged from 0% in people with mild ID to 43-45% in people with severe and profound ID. Nielsen et al.[11] reported a prevalence of 3% in children with mild ID and 13% in children with moderate to profound ID. Van Splunder et al.[16] found a prevalence ranging from 2-20% in people with mild ID to 29-67% in people with profound ID. Van den Broek et al.[26] noted that vision was significantly more impaired in persons with profound ID.

Down syndrome

Three studies reported on the prevalence of VI in people with Down syndrome.[16,21,36] Reported prevalence ranged from 20-52%. In the two studies that reported the prevalence of VI in both people with ID and people with Down syndrome,[16,21] prevalence was higher in people with Down syndrome.

Prevalence of blindness

Eleven studies reported on the prevalence of blindness in people with ID, ranging from 0.4-25%.[4,11,16,21,26,27,29-31,33,34] Studies defined blindness as VA <0.05,[4,16,21,26,27] VA <0.1,[11,30,34] and 'legal blindness.'[29,31,33] Three studies included visual field in their definition.[11,16,27]

Age

Van Splunder et al.[16] reported a prevalence of blindness ranging from 0% (mild ID) to 39% (profound ID) in people younger than 50 and from 0% (mild ID) to 18% (profound ID) in people older than 50.

Level of ID

Evenhuis et al.[4] reported a prevalence of blindness ranging from 0% in people with mild ID to 14% in people with profound ID. Nielsen et al.[11] reported a prevalence of 0.5% in children with mild ID and of 9% in children with moderate to profound ID. Van Splunder et al.[16] reported a prevalence ranging from 0-3% in people with mild ID and from 18-39% in people with profound ID. Krinsky-McHale et al.[33] found that those who were blind were more likely to have profound ID.

Down syndrome

Two studies reported the prevalence of blindness in people with Down syndrome, ranging from 4-8%.[16,33] One study reported the prevalence of blindness to be 4% in people with Down syndrome and 6% in people with ID.[16]

Combined prevalence of VI and blindness

Two studies reported the combined prevalence of VI and blindness (VA<0.3) in people with ID.[17,32] Eight studies reported VI and blindness separately, and the research team calculated the combined prevalence.[4,11,16,21,26,27,30,34] The combined prevalence of VI and blindness ranged from 11-92%.

Two studies reported on the combined prevalence of VI and blindness in the population of people with Down syndrome,[28,35] and for another study, the combined prevalence was calculated.[16] The combined prevalence in people with Down syndrome ranged from 23-51%.

Detection of visual impairment

Success rate of visual acuity assessments

Half of the included studies reported the success rates of VA assessments, ranging from 71-97%.[16,17,21,26,27,32,34,36] Two studies reported success rates specifically for near VA (87% resp. 51%) and distant VA (97% resp. 82%).[21,36]

New diagnoses of VI and blindness

Four studies reported the percentage of newly detected cases of VI or blindness. Van den Broek et al.[26] found that 62% of the participants who were diagnosed with VI or blindness had not previously been diagnosed as such. Van Splunder et al.[37] reported that VI was newly detected in 43% of people and blindness in 36%. Fellinger et al.[34] found that 69% of all detected cases of VI were newly found, as were 29% of all detected cases of blindness. Welinder and Baggesen[31] reported that 20% of cases were newly detected.

New prescriptions

Seven publications reported prescribing new lenses or spectacles.[17,21,26,30-32,36] Four studies reported on the improvement in VA following new prescriptions, with VA improving for 40-91%[21,30,32,36] of participants. In addition, Henriksen and Degenhardt[21] reported that 3% of participants who were visually impaired before were no longer impaired after receiving a prescription update. Woodhouse et al.[30] reported that for 86% of all participants, VA improved from below to above 0.3.

Ophthalmological referrals

Creavin and Brown[28] reported that 40% of clients for whom follow-up was recommended did not receive it. Clients who did receive follow-up received it on average 47 weeks later than requested.

Discussion

This review demonstrates a high prevalence of VI and blindness in people with ID, which is in line with a previous review from 2001.[9] Included studies reported a broad range of prevalence for VI (7-67%) and blindness (0.4-25%) in people with ID. A key explanation for this seems to be the presence or absence of risk factors. The three major risk factors suggested in the literature – higher age, more severe level of ID, and the presence of Down syndrome[11,16,26,33] – are all supported by our review for VI. The influence of these risk factors on blindness was less clear. While our findings support a positive relationship between the prevalence of blindness and higher levels of ID, we could not determine the effects of age and the presence of Down syndrome, since this was only reported in one study.[16]

Another explanation for the broad range of prevalence for VI and blindness may be the variety of definitions used. VI was defined as VA between 0.3 and 0.05[4,16,21,26,27] and between 0.3 and 0.1,[11,30,34,36] and blindness as VA <0.05,[4,21,26,27,37] VA <0.1,[11,30,34] and as 'legal blindness.'[29,31,33] Also, some studies included a severely reduced visual field in their definitions.

Another complicating factor for comparing the values is that different definitions of VA were used. Some studies measured presenting VA, others measured best-corrected VA. One study measured uncorrected eyes, while six studies did not report how they measured VA. To get a more detailed picture of VI and blindness in people with ID, it would be useful if studies would aim for the use of uniform definitions and uniform reporting of VA. It is known that visual field defects are present in people with ID and that a strongly reduced visual field will hamper visual functioning.[38] It therefore seems important to include an assessment of visual field in the visual assessment and the definitions of VI and blindness.

A further explanation for the broad range in prevalence numbers may be found in the different methods of recruitment: prevalence among people seen by a visual advisory centre[27] may be biased and higher than the prevalence found in a population-based study.[11]

A final observation is that some of the included studies measured both near and distant VA, whereas others did not mention the testing of near VA. However, near VA is important for daily functioning and also for people with ID who are non-literate.[21,37] For instance, Castañé et al.[36] found a significant improvement in visual quality after near-vision correction.

To improve the detection of visual impairments in this population, this review gathered information about issues surrounding the testing of VI in people with ID. Success rates for visual assessments varied from 71-97%, suggesting that testing should always be attempted. Obtaining a successful test result is often possible, as long as the methodology is adapted to the capabilities of the person with ID, the measurements are performed by an experienced researcher, and the circumstances are adapted to best fit the person.[39]

All studies reporting on the detection of new cases found a significant number of new cases of VI and even blindness.[16,26,31,34] This points to the persistent existence of diagnostic overshadowing (where symptoms are wrongly attributed to the ID

instead of the visual impairment) and unawareness of symptoms of VI by caregivers or family.[40] This calls for more awareness-raising and knowledge on the high prevalence of visual impairments in people with ID, as well as the importance of standardized regular screenings, which may help to improve the recognition of visual problems.[18] Early recognition may prevent permanent damage and result in better post-treatment outcomes,[28] especially since the most commonly found eye conditions – refractive errors, cataract, and keratoconus – are potentially treatable.[41] The vision of up to 91% of participants with an ocular disorder improved after treatment in the studies included in this review.[17,21,30,32,33,36] Even if a condition cannot be treated, there may be rehabilitation options to improve the functioning or quality of life for people with ID.

While there is a general consensus on the need for regular screening for VI in people with ID,[16,31,42,43] there seem to be barriers to adopting a standard screening program. Newsam et al. and Creavin and Brown[28,40] listed some of them, including a lack of organization; insufficient staffing, resources, and time; a lack of accountability; and insufficient knowledge of healthcare professionals. In view of these challenges, it is important that future research also focuses on the financial, practical, and organisational factors hampering the implementation of large-scale screening programs and how they can be overcome.

Limitations

In this review, meta-analysis was not possible due to the heterogeneity of the studied populations, the different definitions of VI and blindness used, the different definitions of VA, and the wide range of sample sizes and data collection methods. However, despite these differences, all studies reported an increased prevalence of VI in people with ID.

Conclusion

This review found a high prevalence of VI and blindness in people with ID. The prevalence of VI increases with older age, higher level of ID, and the presence of Down syndrome. This underlines the need for a structural screening program for all people with ID, combined with treatment or rehabilitation, especially considering the potential benefits of (early) recognition and treatment.

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Author(s), year, country and quality	Study population	Data collection method(s)	Success rate	Type of impairment	ID or DS	Definition of VI	Measured with or without correction	Prevalence (%)	Prevalence (%) stratified to age (years) and/or level of ID
Castañé, Boada, Hernández, 2004[36] Spain Low quality	Study sample n=49 adults (27M, 22F), of which one was excluded due to viral conjunctivitis. Twelve patients were diagnosed with Alzheimer's disease and received medication for this. Age 40-62 (47.59) Level of ID Unknown	VA was measured both monocularly and binocularly. - Distant-vision VA assessed at 3 meters with Broken Wheel Test. - Near-vision VA assessed at 25cm with numbers.	Distant-vision VA could be measured in 40 persons (81.6%), near-vision VA could be measured in 25 persons (51%). Reasons for not completing measurements were lack of cooperation and failure to recognize numbers.	VI	DS	Distant VA <0.3-≥0.1 Near VA ≤0.4	Patients wore glasses during assessment if prescribed. After prescription update VA was assessed again. VA is reported for the best eye.	Distant- before prescription update 54% Distant-after prescription update 33% Near- before prescription update 46% Near- after prescription update 6%	-
Creavin & Brown, 2010[28] UK Low quality	Study sample n=59 children with Down syndrome who had been seen by ophthalmic services. Age 0-16 (mean age at first ophthalmologic appointment 2.5) Level of ID Not reported	Retrospective record review	Of the 59 children referred to ophthalmology, relevant notes could be obtained for 53.	VI & blind	DS	VA <0.3	Not reported	51%	-
Das, Spowart, Crossley, & Dutton, 2010[17] UK Low quality	Study sample n=183 children and adolescents attending special schools for complex needs. Age 5-19 Level of ID Not reported	A protocol-based ophthalmological assessment was performed on-site by an optometrist with pediatric experience, assisted in most cases by a member of school staff known to the child/young person. Distant VA was measured with both eyes open and if possible monocular, using one of the following tests: - Snellen chart - Uncrowded logMAR - Cardiff Acuity Cards - Keeler gratings - Kay single pictures cards. Near VA was measured binocularly with the Stycar near-card (40cm).	VA could be reliably assessed in 134 children, due to varying levels of cooperation.	VI & blind	ID	Both near and distant VA VA <0.3 and/or visual field <20° :	Children who had glasses wore those during measurements. VI was classified using VA in the better eye with best possible correction.	13%	-

Duckman, 2014[32] USA Low quality	Study sample n=42 children (23M, 19F) attending an early intervention/preschool facility. Age 2.33-5.17 (3.74) Level of ID Not reported	Comprehensive eye examination including VA. Children were tested binocularly (except in the case of strabismus) with Teller Acuity Cards in a forced choice preferential looking paradigm if they were unable to be assessed with different instruments (n=35). Children who were able to respond were tested monocularly with Lea Picture Symbol testing (n=7).	It should be noted that for twelve children (28.57%), acuity values were based on the limits of the child's attention to the task rather than on threshold value (minimal acuity).	VI & blind	DS	VA <0.3	Uncorrected	74%	-
Evenhuis, Sjoukes, Koot, & Kooijman, 2009[4] the Netherland Low quality	Study sample n=277 adults recruited from sheltered workshops, residential facilities and day care. 16.2% had Down syndrome. Only clients with a possible elevated risk were screened. Age Age 17-79 (median 46) Level of ID All levels	On-site screening of visual function by a district low vision center with expertise on people with ID. VA was assessed with at least two of the following tests: - Snellen chart - Burghardt's children's chart - Stycar single characters and matching - Cardiff Acuity Cards - Teller Acuity Cards. Visual fields were assessed with the confrontation method.	VA could be assessed in n=269 (97.1%), due to organisational problems.	VI	ID	VA <0.3->0.05	VA reported for the best eye and measured with optimal correction, if glasses were used.	35%	Level of ID mild=0; moderate=22; severe=45; profound=43
				Blind	ID	VA <0.05	VA reported for the best eye and measured with optimal correction, if glasses were used.	5%	Level of ID mild=0; moderate=2; severe=4; profound=14

Henriksen & Degenhardt, 2009[21] Germany Low quality	Study sample n=241 adults recruited from a sheltered workshop, 31 of whom had Down syndrome. Age Age unknown Level of ID All levels	On-site visual screening by a low vision specialist. Distant VA was tested binocularly with Lea numbers, symbols, or gratings (3m). Near VA was tested binocularly with Lea line symbols (40cm). Classification was made based on binocular distance VA or distance VA of the better eye.	Distant VA could be measured in 234 adults (97.1%), near VA could be measured for 209 adults (86.7%). Reasons were anxiety or aggression in participants.	VI	ID + DS	Both near and distant vision	VA reported for the best eye and measured with optimal correction, if glasses were used.	Distant VA 19% Near VA 15%	Age ≤35=15; 36-45=20; >45=36
				VI	DS (n=31)	VA <0.3-0.05	VA reported for the best eye and measured with optimal correction, if glasses were used.	Distant VA 52%	-
				Blind	ID + DS	VA <0.05	VA reported for the best eye and measured with optimal correction, if glasses were used.	3%	-
				VI & Blind	ID + DS	VA <0.3	Persons with glasses wore those during assessment, except when they did not bring them. VA was measured again for those with a new correction.	Distant VA before correction 22% Distant VA after correction 19%	-
Kerr et al., 2003[29] UK High quality	Study sample n=589 people due for early community placement. 27 persons had Down syndrome. Schizophrenia was recorded in 65 persons, other psychological disorders were reported in 106 persons. 96% were currently prescribed two or more medications. Age Males 14-84 (49) Females 22-92 (49) Level of ID All levels	On-site vision assessments by optometrists and optometry students using: - Cardiff cards - Sheridan Gardner/ Glasgow acuity cards - Stycar field assessment set - Keeler acuity cards - Tracking of eye movements, visual interest, and reaching for/pushing away objects for the least able participants.	Vision tests could be completed for 506 persons (85.9%), because several people missed the screening due to moves between wards, admissions, discharges, deaths and the inability to cooperate.	Blind	ID	Blindness	Not reported	4%	-
Krinsky-McHale, Jenkins, Zigman, & Silverman, 2012[33] USA Low quality	Study sample n=455 adults (139M, 316F) Age 30->80 (50.93) Level of ID All levels	Medical record review that included report(s) on the examination of specific ophthalmic disorders.	-	Blind	DS	Legal blindness	Not reported	8%	-

Määttä, Kaski, Taanila, Keinänen-Kiukaanniemi, & Livanainen, 2006[35] Finland Low quality	Study sample n=129 persons with Down syndrome (76M, 53F). 116 case files of people (at some point) seen by a hospital providing physical and mental health care were analysed. Age 0.1-66.7 (31.4) Level of ID All levels	Retrospective record review	-	VI & blind	DS	VA <0.3	VI was defined as VA of the better eye with or without correction.	23%	-
Nielsen, Skov, & Jensen, 2007[11] Denmark High quality	Study sample n=923 children (576M, 347F), of whom 900 underwent VA assessment. Age Age 4-15 (10.1) Level of ID All levels	Depending on the ability of the children, VA was measured by the author or a trained paediatric ophthalmologist, using: - optotypes (6m) - picture optotypes (3m) - Cardiff cards (1m) - Teller acuity cards (84cm) - visual field assessment by hand.	-	VI	ID	VA <0.3-0.1 or visual field <20°	Not reported	7%	Level of ID mild=3; moderate to profound=13
				Blind	ID	VA ≤0.1, or visual field <20° in combination with VA ≤0.3	Not reported	4%	Level of ID mild=0.5; moderate to profound=9
Van Isterdael, Stilma, Bezemer, & Tijmes, 2006[27] the Netherlands Low quality	Study sample n=6220 persons (3275M, 2942F), 20.8% of whom had Down syndrome. All clients were referred for visual assessment. Age 0.2-92.2 (38.5) Level of ID All levels	Medical record review that included report(s) on the examination of specific ophthalmic disorders.	Visual performance could be determined for 6030 clients (96.9%), due to unspecified reasons.	VI	ID	VA <0.3-≥0.05 and/or visual field 30-10° and/or left-sided or right-sided hemianopia.	VA in the best eye using currently available correction.	30%	-
				Blind	ID	Light perception to VA <0.05, and/or visual field ≤10, or no light perception.	VA in the best eye using currently available correction.	14%	-

Van Splunder, Stilma, Bernsen, & Evenhuis, 2006[16] the Netherlands High quality	Study sample n=1539 adults Age 20.2-88.7 (45.7) (age range and average age of the entire population with ID and Down syndrome combined) Level of ID All levels	On-site protocolised assessment of visual functioning by specially trained investigators. Preferably two of the following VA tests were used: - Snellen chart - Burghardt's children's chart - Stycar single characters and matching - Cardiff acuity cards - Teller acuity cards. Assessment of the visual field was performed with the Stycar graded balls confrontational method. All outcomes were expressed in Snellen equivalents.	Reproducible and complete determination of visual function was possible in 1358 cases (88.2%).	VI	ID (n=996)	VA <0.3-0.05 and/or visual field <30°	Best-corrected VA (with new correction if necessary and accepted by the participant).	11%	Age and level of ID mild <50=2; mild ≥50=8; mod <50=4; mod ≥50=11; severe <50=19; severe ≥50=23; profound <50=29; profound ≥50=39
				VI	DS (n=362)	VA <0.3-0.05 and/or visual field <30°	Best corrected VA (with new correction if necessary and accepted by the participant).	20%	Age and level of ID mild <50=5; mild ≥50=20; mod <50=6; mod ≥50=25; severe <50=23; se-vere ≥50=36; profound <50=29; profound ≥50=67
				Blind	ID (n=996)	VA <0.05 and/or visual field <10°	Best-corrected VA (with new correction if necessary and accepted by the participant).	6%	Age and level of ID mild <50=0.7; mild ≥50=3; moderate <50=2; moderate ≥50=3; severe <50=4; severe ≥50=7; profound <50=39; profound ≥50=18
				Blind	DS (n=362)	VA <0.05 and/or visual field <10°	Best-corrected VA (with new correction if necessary and accepted by the participant).	4%	Age and level of ID mild <50=0; mild ≥50=0; Moderate <50=0; moderate ≥50=3; severe <50=4; severe ≥50=14; profound <50=29; profound ≥50=17

Welinder & Baggesen, 2012 (31) Denmark High quality	Study sample n=545 children receiving special needs education. Age 6-8 Level of ID Severe	VA was examined binocularly using the following instruments: - Oesterberg Pictorial Sight-Test Chart for Little Children, or Lea symbols (6m and 30cm) - Teller Acuity Cards for nonverbal children (55cm). Visual field was tested by confrontation. Screening was performed on-site by the authors. All children with VA ≤0.5 were referred for ophthalmological testing.	Visual data was available for 502 students (92.1%), of whom 442 (81.1%) were screened. For the remaining 60 children, recent visual data from the tertiary care system was used.	Blind	ID	Legal blindness	Optimal VA after follow-up testing by an in-office optometrist and ophthalmologist.	3%	-
Woodhouse, Adler, & Duignan, 2004 (30) UK Low quality	Study sample n=543 athletes participating in the Special Olympics (313M, 191F). Age 9-69 (median 27) Level of ID Not reported	On-site VA screening using Lea symbols, carried out by volunteer optometrists, optometry students and non-optometric volunteers. Near VA was measured binocularly, distant VA was measured monocularly. Persons unable to reach a predetermined standard were referred to a qualified optometrist.	Due to non-cooperation and time constraints, screening could be completed for 518 persons. Another 13 persons were excluded because they were not from the UK, meaning that data for 505 persons was analyzed (93%).	VI	ID	Both near and distant vision VA <0.3-0.1	Uncorrected VA in the better eye. Only 47.1% of participants who reported wearing glasses were screened while wearing those.	Distant VA 14% Near VA 14%	-
				Blind	ID	Both near and distant vision VA <0.1	Uncorrected VA in the better eye. Only 47.1% of participants that reported wearing glasses were screened while wearing those.	Distant VA 0.4% Near VA 0.8%	-