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RESEARCH ARTICLE

Prevalence and impact of combined vision and hearing (dual sensory) impairment: A scoping review

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Abstract

Hearing and vision impairments are common globally. They are often considered separately in research, and in planning and delivering services. However, they can occur concurrently, termed dual sensory impairment (DSI). The prevalence and impact of hearing and vision impairment have been well-examined, but there has been much less consideration of DSI. The aim of this scoping review was to determine the nature and extent of the evidence on prevalence and impact of DSI. Three databases were searched: MEDLINE, Embase and Global Health (April 2022). We included primary studies and systematic reviews reporting the prevalence or impact of DSI. No limits were placed on age, publication dates, or country. Only studies where the full text was available in English were included. Two reviewers independently screened titles, abstract, full texts. Data were charted by two reviewers independently using a pre-piloted form. The review identified 183 reports of 153 unique primary studies and 14 review articles. Most evidence came from high-income countries (86% of reports). Prevalence varied across reports, as did age groups of participants and definitions used. The prevalence of DSI increased with age. Impact was examined across three broad groups of outcomes—psychosocial, participation, and physical health. There was a strong trend towards poorer outcomes for people with DSI across all categories compared to

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people with one or neither impairment, including activities of daily living (worse for people with DSI in 78% of reports) and depression (68%). This scoping review highlights that DSI is a relatively common condition with substantial impact, particularly among older adults. There is a gap in evidence from low and middle-income countries. There is a pressing need for a consensus position on the definition(s) of DSI and standardisation of reporting age groups to enable reliable estimates to be ascertained and compared and responsive services developed.

Introduction

Hearing and vision impairments are common globally [1, 2]. These two sensory impairments are often considered separately in research as well as in planning and delivering services. However, they can occur concurrently, which is commonly termed dual sensory impairment (DSI), dual sensory loss, combined/concurrent vision and hearing impairment, deafblindness or multi-sensory impairment [3]. In this review we use the term DSI. The global prevalence of DSI has not been fully examined, however it is thought to be more common in older people, as the prevalence of both vision and hearing impairment increase with age [4]. A report by the World Federation for the Deafblind estimated that 0.2% of the global population are living with deafblindness, which excludes those with milder forms of DSI who may still experience barriers to participation. In the context of the global ageing population, the prevalence of DSI is expected to increase [5]. This has implications for the wellbeing and quality of life for people with, or at risk of, DSI, as well as for delivering effective health services to maximise their health and functional ability.

People can develop DSI at different points in their life and the impact of DSI may depend on when it occurs in their life course. Some people have DSI from birth (congenital), some develop DSI during early childhood or have one impairment from childhood and develop the other later (acquired), but most people with DSI acquire vision and hearing impairment later in life (age-related deafblindness) [6]. There are internationally agreed World Health Organization (WHO) definitions of hearing and vision impairment separately, and some agreement on within the deafblindness field through the Nordic definition of deafblindness for rehabilitation and service delivery [7]. However, there is currently no consensus on how to measure and define DSI, particularly in terms of the severity of the underlying impairments when they co-exist, and whether a definition should rely on behaviously measurable observations (e.g. acuity, audiogram) or functional impairment (subjectively reported).

The independent impact of either vision loss or hearing loss on quality of life, wellbeing, participation, and mental health has been well explored [8–16], along with the benefits of correcting these impairments [13, 17, 18]. Less is known about the impact of DSI on people's lives, though a small number of literature reviews and systematic reviews have examined quality of life [19], mental health [20], independence [21] and the range of impacts [22] among older people with DSI, as well as vulnerability [6], and participation [5, 23]. Many studies and reviews focus on people who develop DSI later in life, high-income contexts and report only one specific outcome. There is a need to examine the evidence on the prevalence of DSI more broadly, and to explore the potential wide-reaching and multitude of effects on people's lives. This type of evidence can inform interventions to improve health and quality of life for people with DSI. Furthermore, there is a need to examine how DSI has been defined in the literature and work towards a standardised definition.

We undertook a scoping review to identify and map the available evidence on these themes, and anticipated heterogenous evidence [24, 25]. The aim of this scoping review was to determine the nature and extent of the evidence on DSI relating to:

1. The definitions of DSI used in the literature;
2. The prevalence of DSI globally and across regions for all age groups; and
3. The impact of DSI on people's lives (e.g. quality of life, mental health, mortality).

Methods and analysis

Ethics statement

As this study only included published data, ethics approval was not sought.

This scoping review was undertaken as part of the *Lancet Global Health* Commission on Global Eye Health [26]. The methods and results are reported according to the relevant items of the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) checklist [24, 27]. This protocol was registered on Open Science Framework (OSF) (DOI: 10.17605/OSF.IO/MGYFV). We decided to undertake a scoping review rather than a systematic review in order to identify and map the available evidence on these themes, and expected the results to be heterogenous [24, 25].

Eligibility criteria

Study type. We included primary studies and systematic reviews. No time limit was placed on publication dates. We excluded studies not reported in English, editorials, interviews, case reports, and comments and studies where the full text was not available. We excluded reviews that were not systematic (e.g. narrative reviews that did not demonstrate a systematic search in the methodology). We included systematic reviews to understand which aspects of DSI have received the most attention by researchers synthesising the evidence.

Participants. Only studies involving human participants were included. There were no age restrictions. All types of combined hearing and vision impairment were included, whether measured via self-report, clinical tools, or through registries. Studies that focussed on syndromes (e.g. Usher's syndrome) were included if results for people with DSI were disaggregated in the study.

We excluded. Studies that focussed on causes of DSI among a restricted population subgroup (e.g. pre-term infants) unless they reported impact outcomes, because findings in these studies would not be applicable to people with DSI generally; studies that only considered hearing and vision impairment separately; and studies that reported on the prevalence (not impact) of DSI amongst children from schools for the deaf or blind, as these would not be representative of DSI prevalence in the general population.

Context. No limits were placed on country of study. We excluded studies that focussed on service provision (e.g. screening techniques) for people with DSI because we aimed to scope only studies reporting prevalence and/or impact.

Outcomes. Studies that reported the prevalence or the impact of DSI, were included. No restrictions were placed on types of impact outcome measures. We anticipated outcomes related to health and well-being such as mental health, mortality, quality of life, participation, falls, trauma or education [6, 19–21, 23, 28]. We considered impact as a consequence of DSI, rather than a cause.

Search strategy and information sources

Three databases were searched from inception to April 2022 (MEDLINE, Embase and Global Health) using rigorous search strategies that were developed and run by an experienced Cochrane Information Specialist (IG). The search strategy can be found in the supplementary material. Reference lists of included articles were examined to identify any further eligible articles (snowballing).

Study selection

Two reviewers independently screened titles and abstracts of identified studies using Covidence systematic review management software (Veritas Health Innovation, Melbourne, Australia. Available at www.covidence.org). We selected all reports for full text screening where DSI (or equivalent terms) were mentioned in the title or abstract of the report. Full text articles were obtained and reviewed independently by two reviewers for relevance. Any discrepancies between the reviewers were solved by a discussion with a third reviewer. A PRISMA flow chart was compiled to display the study selection process (Fig 1).

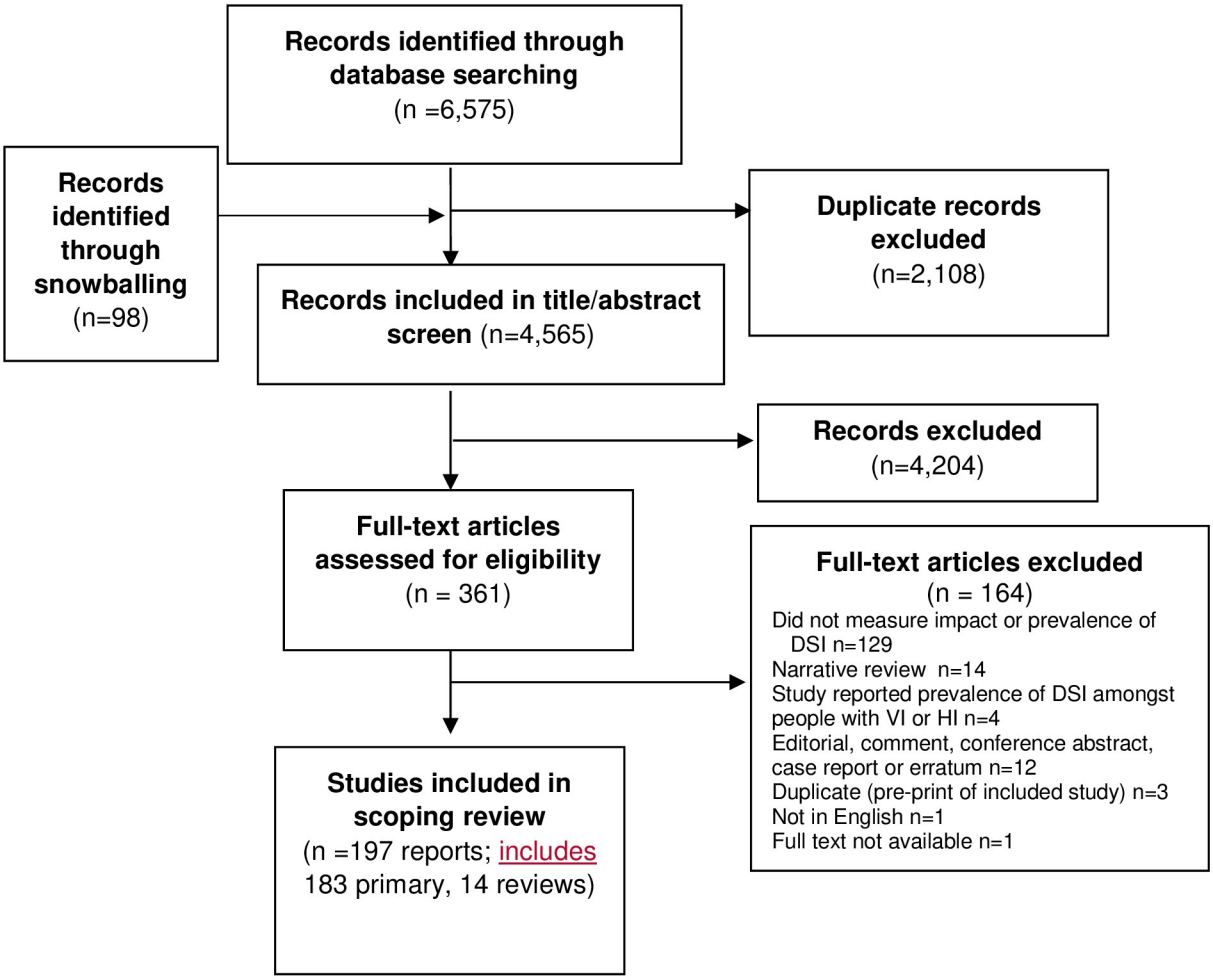

Fig 1. PRISMA flow chart. DSI: Dual sensory impairment, HI: Hearing impairment, VI: Vision impairment].

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Data charting and synthesis of results

A data extraction form was developed in Google Forms. This form was piloted on three studies by three reviewers, and amendments made as necessary. Data were extracted by two reviewers independently to ensure accuracy. Any discrepancies between the reviewers were solved by a discussion with a third reviewer.

Items for data extraction included:

All studies:

- Publication characteristics: title, year of publication, countries of study and source of funding, World Bank country income group (at time of publication)

For primary studies:

- Characteristics of study: year(s) of data collection, design, sample size (total and DSI), study setting, recruitment characteristics, age group of the study population, method of impairment measurement and definition of individual and dual impairments
- Outcome measures: prevalence (including confidence interval if reported) and impact outcomes
- The type of syndrome: for primary studies that focussed on syndromes

For systematic reviews:

- Number of included studies
- Types of included studies
- Scope of the research (e.g. research questions)
- Review conclusions

Extracted data were coded in Excel and imported into Stata v15.0 for descriptive analysis. Where confidence intervals were not reported around prevalence estimates, these were calculated in Stata using the *cii proportion* command. Prevalence data were graphed using forest plots in Stata. Data were summarised using a narrative synthesis. The study findings were grouped according to the outcomes measured with three key themes–definitions of DSI, prevalence of DSI and impact outcomes. The types of impact outcomes were mapped in terms of what has been measured, and the resulting impact. Outcomes were classified into broad themes to allow summaries to be made. Each outcome type was classified in terms of whether the outcome among people with DSI was "worse", "better" or "the same" compared to a relevant comparison group. These outcomes were judged based on statistical significance (e.g. p values, or confidence intervals). If studies measured multiple outcomes (e.g., mental health and quality of life), studies were classified as "worse", "the same", or "better" if all outcomes showed the same relationship. Impact data summary outcomes were summarised in bar charts created in Excel. Studies were classified as "varied" if results for a study were worse in one outcome of interest or and the same or better in another. We planned to present impact results overall as well as for each Global Burden of Disease super-region, however due to insufficient data from some regions of the world this was not done.

Patient and public involvement statement

This scoping review was developed with input from the Commissioners of the Lancet Global Health Commission on Global Eye Health, which includes people with lived experience of

vision impairment, policy makers, academics, clinicians, government eye health programme leaders and advocacy specialists.

Results

Description of included studies

Overall, 6,575 articles were identified through database searching, and an additional 98 through snowballing. After duplicates were removed, titles and abstracts of 4,565 articles were screened and 361 selected for full text review. Following this, 197 reports were included based on the inclusion/exclusion criteria (Fig 1) [29].

Of the included reports, 14 were reviews and the 183 primary reports came from 153 unique primary studies (i.e. multiple publications per study). As different outcomes were included in individual reports we present results by report, indicating when findings come from the same study as appropriate. Table 1 summarises the characteristics of included reports of primary studies. Regionally, approximately two-thirds of reports came from either North America (n = 72, 39%) or Western Europe (n = 49, 27%); none were from sub-Saharan Africa. Studies were conducted in 35 countries, with nearly 9 in 10 reports coming from high-income countries (n = 158, 86%). More than three-quarters of reports were from studies conducted since 2010 (n = 142, 78%).

Studies from over half of reports used cross-sectional designs (n = 106; 58%). Cohort studies were also common– 31% of reports were from prospective and 6% were retrospective cohorts. A small number of qualitative reports were included (n = 5, 3%). Most reports recruited participants from the population (n = 123, 67%) or were clinic-based (n = 20, 11%). Other locations included care homes and registers of people with disability. The majority of reports (n = 122, 67%) included older adults only (≥40 years); very few reports included only children (n = 4, 2%).

Many reports included more than one outcome—66% (n = 121) presented prevalence of DSI and 85% (n = 156) presented impact outcomes, including psychosocial health, participation, and physical health. Within each of these broad categories a range of outcomes and measures were used, and these are discussed further below.

Definition and measurement of DSI

A range of methods were used to measure, and thus define DSI across reports. Hearing impairment (HI) was most commonly measured via self- or proxy-report alone (n = 95, 52%), followed by pure-tone audiometry (n = 58, 32% and a further four studies used both pure-tone audiometry and self-report) (Table 2). Vision impairment (VI) was most commonly assessed via self- or proxy-reported measures (alone) (n = 88, 48%), or a visual acuity (VA) chart (n = 70, 38%, a further two also used self-report, in combination with VA charts). Most reports defined DSI as a combination of both VI and HI according to the definitions of each single impairment.

Self-reported measures of each of HI and VI included a range of different tools/questions but commonly used a single question with a response on a Likert scale, or with binary or categorical answer (Table 2). Among the reports that used visual acuity charts to assess VI, there were more than 19 different definitions, with variation in the chart used, whether better/worse or both eyes and the visual acuity threshold (Table 2). The most common definition was bilateral / better eye VA <6/12 (n = 24, 33%) which equates to mild VI in ICD11 [30]. There were more than 23 different definitions of HI across reports, with variation by decibel cut-off, frequencies included, and focus on the better or worse ear (Table 2). The most common

Table 1. Characteristics of 183 reports of 153 primary studies reporting dual sensory impairment prevalence or impact.

Characteristic		n	% (n/183)
Region*	HIC—North America	72	39.3
	HIC—Australasia	14	7.7
	HIC—Asia Pacific	12	6.6
	HIC—Western Europe	49	26.8
	Southeast Asia, East Asia, Oceania	18	9.8
	North Africa and Middle East	2	1.1
	South Asia	6	3.3
	Latin America and the Caribbean	2	1.1
	Multiple	7	3.8
	Not specified	1	0.5
World Bank Country income group**	Low	1	0.5
	Lower middle	6	3.3
	Upper middle	17	9.3
	High	158	86.3
	Not specified	1	0.5
Decade of publication	1980	1	0.5
	1990	9	4.9
	2000	31	16.9
	2010	91	49.7
	2020 (to search date)	51	27.9
Study design	Cross sectional	106	57.9
	Prospective cohort	56	30.6
	Retrospective cohort study	11	6.0
	Qualitative	5	2.7
	Case control	2	1.1
	Secondary analysis	1	0.5
	Chart review	1	0.5
	Case series	1	0.5
Study setting	Population	123	67.2
	Clinic	20	10.9
	Register of people with disability	14	7.7
	Other	14	7.7
	Care home	11	6.0
	Not specified	1	0.5
Age group (years)^^	All ages	6	3.3
	Only children (<18)	4	2.2
	Adults ≥18	28	15.3
	Older adults ≥40***	122	66.7
	Older adults ≥70	22	12.0
	Unknown	1	0.5

(*Continued*)

Table 1. (Continued)

Characteristic		n	% (n/183)
Outcomes	Prevalence	121	66.1
	Impact (any)^	156	85.2
	Impact—Psychosocial	93	50.8
	Impact—Participation	55	30.1
	Impact—Physical	56	30.6

*GBD Super-region, with high-income country (HIC) super-region disaggregated into regions;

**At time of publication;

***includes diverse set of age groups;

^includes psychosocial, participation, and physical;

^^age group categories mutually exclusive

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definition was a pure tone average (PTA) across frequencies 500, 1000, 2000, 4000Hz of >25dB in the better ear (n = 18 reports).

Given the range of tools and approaches used to measure VI and HI individually, the resulting definitions of DSI also varied substantially across studies—we identified 75 different definitions of DSI across these 183 reports. One of our included reviews reported the range of terminology used across its included primary studies—in addition to DSI, other terms were combined functional sensory impairment, dual sensory loss, double disability, and concurrent vision and hearing impairment [27]. Another included review focused on deafblindness and reported that half of the 29 included studies did not define the condition [28]. The large variation in definitions made synthesis challenging, and this is discussed in the following sections.

Prevalence of DSI

Of 121 reports that measured prevalence of DSI, four did so for all ages, one in children (<18 years), fifteen in adults ≥18 years, and 101 amongst older adults aged ≥4 0 years. Overall, at least 15 different age cut-offs were used, making comparison difficult (Figs 2 and 3). This was exacerbated by the wide range of clinical test methods and thresholds for HI and VI described above. However, overall, there was a trend for increasing prevalence of DSI with increasing age. Studies of people aged 18+ had a median prevalence of DSI in the order of 3% and studies of people aged ≥65 years had a median prevalence over double that of approximately 7%. In one study in people over the age of 95 years, over 1 in every 3 people had DSI.

All-age prevalence. Of the four studies including people of all ages, three were population-based. The prevalence varied substantially across these studies. For the three population-based studies [31–33], a register-based study in Denmark [31] had the lowest prevalence of DSI of 0.003% (sample n = 190, VA <6/60 [eye not specified], PTA: 3 frequency average (3FA) ≥80 dB [ear not specified]) while a study in India had the highest prevalence of 1.9% (n = 3,574, VA <6/12 better eye, PTA ≥35dB children, ≥41dB adults better ear) [32]. The third population-based study, conducted in Oman had a prevalence of 0.25% (n = 11,400, VA<6/120 better eye; PTA: 3FA ≥36dB better ear) [33]. In the non-population-based study—which may not be representative—the prevalence was 0.015% in Canada (n = 564; chart review; VA ≤6/18 better eye; PTA ≥25dB PTA in better ear) [34].

Prevalence amongst children. The one study that included only children was a school-based study conducted in Sweden—among all school students in Sweden it reported a prevalence of DSI of 0.3% (n = 7,793; self-reported) [35].

Table 2. Measurement and definition of hearing and vision impairments among 183 studies reporting dual sensory impairment.

	Hearing impairment	n	%		Vision impairment	n	%
Measurement of hearing impairment (n = 183)	Self- or proxy-reported	95	51.9	Measurement of vision impairment (n = 183)	Self- or proxy-reported	88	48.1
	Pure tone audiometry	58	31.7		Visual acuity chart	70	38.3
	Whisper voice test	5	2.7		Self-report and visual acuity chart	2	1.1
	Self-report and pure tone audiometry	4	2.2		Other	11	6.0
	Other	10	5.5		Not specified	12	6.6
	Not specified	11	6.0				
Self- or proxy-reported measures of hearing impairment (n = 99)	Single question Likert	32	32.3	Self- or proxy reported measures of vision impairment (n = 90)	Single question Likert	30	33.3
	Single question categorical	31	31.3		Single question categorical	24	26.7
	Single question binary (e.g. yes/no)	20	20.2		Single question binary (e.g. yes/no)	22	24.4
	Multiple questions	15	15.2		Multiple questions	11	12.2
	Not specified / unclear	1	1.0		Not specified / unclear	2	2.2
					Other	1	1.1
Definition of hearing impairment by pure tone audiometry (n = 62)	*PTA 500, 1000, 2000, 4000 Hz, better ear*			Definition of vision impairment by visual acuity measurement Snellen (LogMAR) (n = 72)	*Distance, better eye**		
	≥21dB	1	1.7		<3/60 (1.30)	1	1.4
	≥25dB	4	6.9		≤6/60 (1.00)	2	2.8
	>25dB	18	31.0		<6/18 (0.50)	9	12.5
	≥26dB	5	8.6		≤6/18 (0.50)	1	1.4
	≥30dB	1	1.7		<6/15 (0.40)	3	4.2
	≥35dB	3	5.2		≤6/15 (0.40)	2	2.8
	≥40dB	4	6.9		<6/12 (0.30)	24	33.3
	>40dB	8	13.8		≤6/12 (0.30)	5	6.9
	>41dB adults, >35dB children	1	1.7		<6/7.5 (0.10)	3	4.2
	≥41dB	2	3.4		*Distance, worse eye*		
	>70dB	2	3.4		<6/18 (0.50)	1	1.4
	Based on PTA but definition not clear	1	1.7		<6/12 (0.30)	2	2.8
	Three frequency average (500, 1000, 2000Hz)				*Distance, eye not specified*		
	≥26dB in better ear	1	1.7		<1/60 (1.80)	1	1.4
	>30dB worse ear	1	1.7		<6/60 (1.00)	2	2.8
	>40dB better ear	1	1.7		<6/15 (0.40)	1	1.4
	≥80dB ear not specified	2	3.4		<6/12 (0.30)	4	5.6
	Based on single frequency threshold in better ear				<6/9 (0.20)	1	1.4
	>30dB at 1k in better ear	1	1.7		≤6/9 (0.20)	1	1.4
	>40dB at 1kHz in better ear	1	1.7		*Near, better eye*		
	≥40dB at 2kHz in better ear	1	1.7		≤20/70 (0.5)	2	2.8
	>40dB at 1 or/and 2kHz in better ear	1	1.7		*Other*	7	9.7
	Other	3	5.2				

*10 of these measured binocular vision; which equates approximately to better eye vision; dB: decibels PTA: pure tone average

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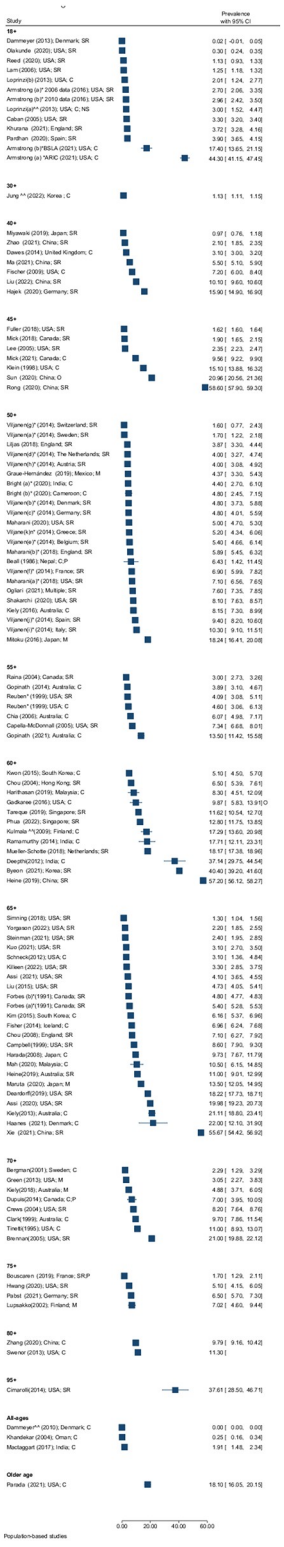

Fig 2. Prevalence (95%CI) of DSI by age, region, study setting, and measurement type in population-based studies. (SR = self-report; C = clinical (PTA or VA); M = mixed (SR and C); O = other)] ^^ measured DSI in a subpopulation, * same study, multiple countries, or multiple prevalence estimates reported.

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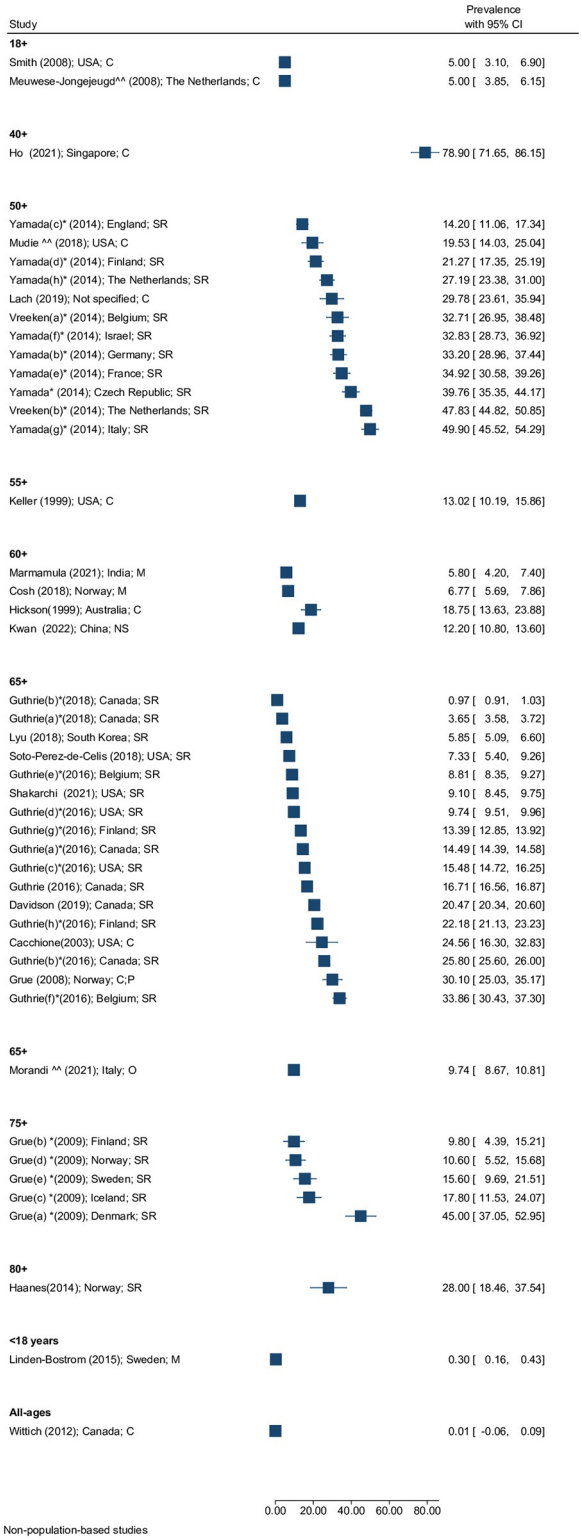

Fig 3. Prevalence (95%CI) of DSI by age, region, study setting, and measurement type in non-population-based studies (SR = self-report; C = clinical (PTA or VA); M = mixed (SR and C); O = other)] ^^ measured DSI in a subpopulation, * same study, multiple countries, or multiple prevalence estimates reported.

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Prevalence amongst adults ≥18 years. Seven of ten population-based studies conducted amongst adults ≥18 years were in the USA, reporting a prevalence of DSI between 0.3% (n = 468,303; self-reported) [36] and 44.3% (n = 963; VA >0.3; PTA > 25 dB HL) [37]. Three other population-based studies were identified from Denmark [38], England [39] and Spain [40], with estimates of 0.02% (n = 10,000; self-report), 3.7% (n = 7,546; self-report), and 3.9% (n = 23,089; self-report) respectively. Two clinic-based reports, one in the USA and one in The Netherlands reported estimates of 5.0% (n = 400; VA <6/12 better eye; PTA ≥40dB better ear) and 5.0% (n = 1,359; VA>0.3; 3FA>25) respectively [41, 42].

Prevalence amongst older adults. Amongst older adults, prevalence was reported across ten different age categories. The estimated prevalence in population-based studies was highly variable across studies, from 0.97% in Japan (n = 2,190; self-report) [43], to 58.6% in China (10,575; self-report) [44]. Variation in prevalence was observed even when the same definitions were used. For example, in people 65 years and older using clinical assessment tools (VI threshold of <6/18 in better eye and HI threshold >25dB in the better ear); the prevalence of DSI ranged from 3.1% (USA; n = 446) to 21% (Australia; n = 1,611) [45–47]. Another example, amongst four reports using self-reported measures (Likert scale) with participants aged ≥50 years, the prevalence ranged between 3.8% (England; n = 4,621) [48] and 8.1% (USA; n = 13,092) [49]. Fig 2 provides details of the prevalence range of DSI found across different reports, by age group. S1 Table provides more details of the definitions used in each report.

In addition to the 121 reports of prevalence identified, three reviews also examined prevalence. Besser et al. (2018) found that the prevalence ranged between 3.1% in Australia and 18.2% in Japan [50]. Heine et al. (2015) reported that the prevalence across 42 included studies ranged between 3.3% and 64% and noted the range of criteria used [51]. Dewan et al. (2012) reported a lack of evidence on the prevalence of DSI due to congenital rubella syndrome [52].

Impact of DSI

Of the 156 reports that measured at least one impact of DSI, 93 reported psychosocial outcomes, 55 reported participation outcomes, and 56 reported a physical health outcome. Further, nine reviews included outcomes related to psychosocial health, four included participation outcomes and two examined outcomes related to physical health. These three categories of outcomes are outlined further below.

Across the 156 reports of primary studies, 141 included a comparison group, though this group varied across studies (e.g. people without DSI, people with VI only, people with HI only, people without either sensory impairment). Over two thirds of the reports with a comparison group (n = 94, 67%) found worse outcomes for people with DSI, while a quarter (n = 34, 24%) reported varied outcomes (e.g. two outcomes worse among people with DSI, one the same) and a small number reported no difference between people with DSI and the comparator group (n = 13, 9%); no reports found better outcomes for people with DSI.

Psychosocial health. Of the 86 reports measuring psychosocial outcomes that included a comparator group, 72% (n = 62) showed worse outcomes in the DSI group in comparison to a control group while no difference was found between groups in 12% (n = 10) of reports (Fig 4a). Depression (n = 40) and cognition (n = 35) were the most reported psychosocial outcomes with a comparison group and people with DSI had worse outcomes in 68% of reports (n = 27) and 71% (n = 25) or reports respectively. All other outcomes are shown in Fig 4b and outlined in the S2 Table.

Of the seven reports without a comparator group, there was a trend towards negative outcomes for people with DSI. For example, Amini and colleagues found that war veterans in Iran with DSI had poor quality of life scores, measured using the SF-36 Health Survey [53]. In

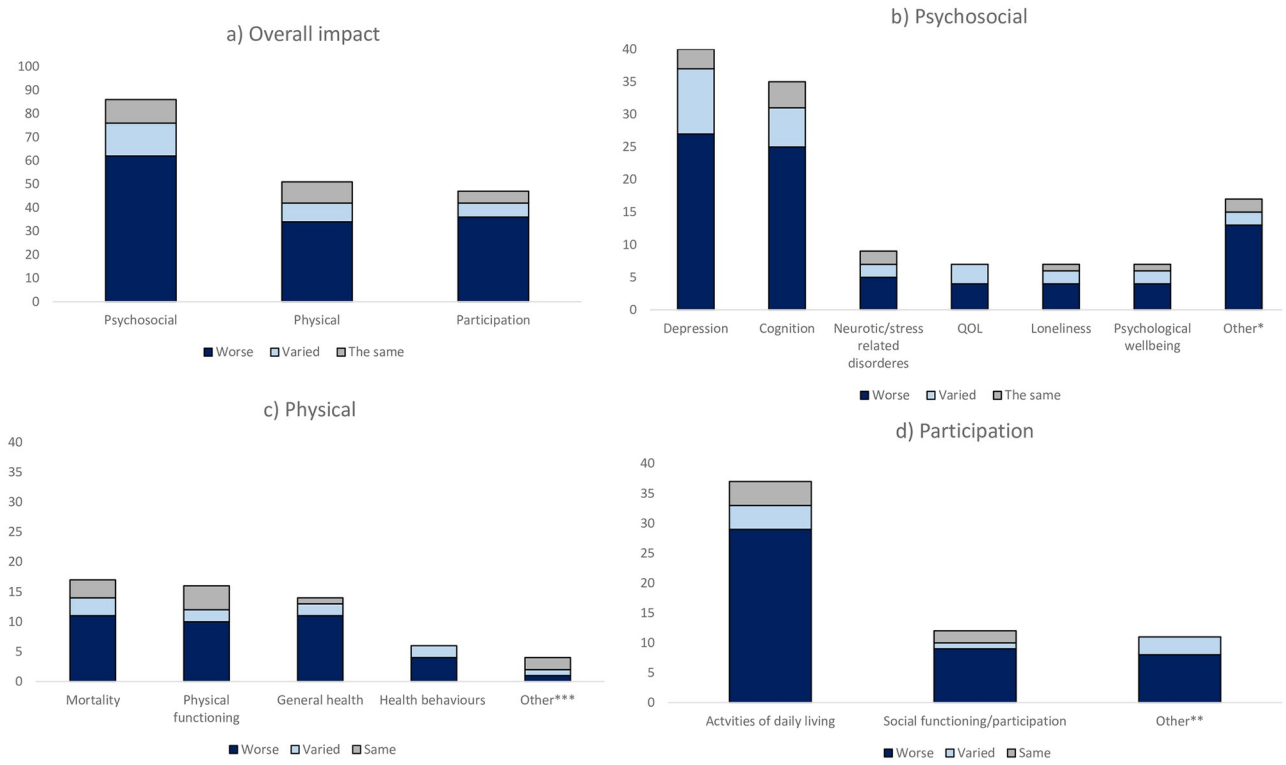

Fig 4. Impact of DSI across the domains of psychosocial, participation and physical health outcomes (*Other includes: Quality of life; self-evaluation of life; suicide ideation or attempt; episodic memory; behavioural disorder; developmental disability; acute confusion; intellectual disability. **Other includes: impendence, participation, retirement, education, wealth, self-regulation/goal pursuit, work, communication. ***Other includes: health care costs, sexual health, long term care admissions, hospitalisation)]. Studies were classified as "varied" if results for a study were worse in one outcome of interest or and the same or better in another.

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another example, Appollonio showed that people with DSI had poor scores on self-evaluation of life, depression and general mental health [54]. In-depth interviews with people with DSI in several European countries described the stigma they experienced [55].

In addition to the primary reports in this category, nine reviews were identified that considered the psychosocial impacts of DSI. The majority of reviews reported that DSI is associated with poor psychological wellbeing–including depression [20, 22, 56], cognition [22, 51, 56], coping capacity [6], resilience [6], and quality of life [19]. DSI was also found to be associated with other disorders including autism [57]. One review found that those with Usher's syndrome, a major syndromic cause of DSI, were more at risk of developing psychological disorders, but there was no evidence that this was correlated with the presence of DSI [58]. Another review looked at psychosocial health among caregivers, but only one study was identified which showed no important impact of caregiving of people living with DSI on psychosocial health of the caregivers [59]. Several reviews reported methodological limitations with included studies, or insufficient information to draw strong conclusions.

Physical health. Of the 50 reports measuring and comparing physical health, over half found worse outcomes (n = 33, 66%), 16% (n = 8) found varied outcomes, and a similar proportion (n = 9, 18%) found no difference. Physical health outcomes were varied, and comparisons were most commonly reported for general health (n = 16), physical functioning (n = 16) and mortality (n = 16). General health was worse for people with DSI in 79% of reports (n = 11/14), mortality was higher in 69% (n = 11) of reports and physical functioning was worse in 63% of reports (n = 10).

The two reviews that summarised physical health outcomes reported that people with DSI had increased mortality [22, 51], poor health [51], and reduced functional status [51].

Participation. Of the 47 reports measuring and comparing participation-related outcomes, 77% (n = 36) found worse outcomes for the DSI group, 11% (n = 5) found both better and worse outcomes, and 13% (n = 6) found no difference (Fig 4a). Outcomes relating to participation were diverse and comparisons were most commonly reported for activities of daily living (n = 37) and social participation (n = 12) (Fig 4c). In studies reporting activities of daily living, people with DSI had worse outcomes 78% of reports (n = 29/37). Likewise, in studies reporting social participation in 75% of reports (n = 9/12) found worse outcomes in comparison to another group.

In general, the four reviews reporting participation outcomes suggested that people with DSI experience difficulties in participation in key areas of life, including communication [22, 23, 51], mobility [23], activities of daily living [23, 51], independence [6, 22], employment [51], social networks [6] and social interactions [23].

Discussion

The purpose of this scoping review was to determine the nature and extent of the evidence on the prevalence and impact of DSI. Overall, 14 reviews and 183 reports of 153 unique primary studies were identified. Primary studies were mostly population-based (67%) and located in high-income countries (86%). We summarised prevalence and impact outcomes for a broad range of age groups and regions, which sets our review apart from previous reviews, which have focused on a particular age group or impact of DSI (e.g. quality of life).

Most of the research we identified was from North America or European countries, with almost no evidence from low- or middle-income countries (LMICs). There is a great need for more evidence to be generated from LMIC contexts. The magnitude and experiences of people with DSI in LMICs is likely to differ substantially to HICs. Given that the vast majority of HI and VI are experienced by people in LMICs [1, 2], there is potentially a substantial number of people experiencing DSI and its wider impacts. Evidence from LMICs on DSI could help to advocate and plan innovative service delivery models. In contexts with scarce human resources for both sensory impairments, integrated ear and eye care services may help to address the huge unmet need for diagnosis, treatment, rehabilitation, and policies for inclusive environments.

Differences in definition

There was striking heterogeneity in the definitions used for DSI; with at least 75 alternative definitions used across the included reports. Despite the differences across studies, there were some commonalities. For example, the majority of studies included people with residual vision and/or hearing in their definitions, rather than only focusing on people with profound hearing loss or blindness. Broadly, DSI was measured using either self-report or clinical tools across studies, using a range of tools and thresholds.

Within the field of deafblindness, there are differing perspectives on whether it is best measured and defined using clinical tools (medical approach), or the resulting functional disability (functioning-based approach), or using the medical aetiology of DSI (e.g. CHARGE) [60]. Ask Larsen and colleagues discussed some of the reasons for different definitions in a review of deafblindness [60]. Another challenge with definitions of DSI, is that individuals cannot be easily categorised in to deafblind or not deafblind–the interaction between the impairments creates complexity that needs to be accommodated across a spectrum. Using definitions based on the medical approach will result in different numbers of people identified with DSI than if using functioning-based approach. This has been examined in the field of disability by

Mactaggart and colleagues, who found that using tools to assess functional limitation to measure the prevalence of disability would under-estimate the number of people with underlying clinical impairments [61]. The lack of consensus on a definition and assessment criteria for DSI makes it difficult to gather data that are comparable between studies, settings and over time. This is a key area for action to inform responsive services for people with DSI.

Prevalence of DSI

The prevalence of DSI was reported for at least 15 different age groups, and a broad range of DSI definitions were used. The age included in the prevalence estimates has implications for service planning and delivery, which will be different for children, working age adults, and the elderly. Future studies should align age categories with those recommended by WHO (e.g., older adults are aged 60 years and older), and present data in a clear and standardised format [62, 63]. A number of studies in this review did not use population-based samples, instead reporting prevalence based on data from clinics, highlighting the lack of large-scale studies of DSI in the general population. The majority of the literature came from high-income countries, so any differences in prevalence rate between low- and high-income countries could not be examined in depth. This warrants further investigation, as the prevalence may be higher in LMICs due to factors such as poor access to services. Despite the lack of comparable data, the findings of our review suggest that the prevalence of DSI increases with age, with population-based studies of people aged $\geq$50 years reporting rates between 1.6% and 18.2% [48, 64–73]. The World Federation for the Deafblind report, which analysed 22 population-based surveys conducted in LMICs that measured DSI using self-report, found a pooled prevalence of 0.2%. Although our review only included 3 all age population-based studies, the prevalence in these ranged between 0.003% and 1.91% consistent with the low pooled prevalence found in the report [5]. The relatively high prevalence highlights that DSI should be considered in the delivery of stand-alone HI and VI services, particularly for older age groups. For example, providers could make accommodations for people with DSI within audiology clinics, via communicative support [56]. There is also an opportunity to screen for HI within vision services, or vice versa. Further, population-based surveys of single impairments (vision or hearing) should consider the potential overlap between the two conditions. In addition, the rehabilitation strategies that are suitable for people with single impairment may not be always suitable for people with DSI. For example, people with DSI may require support in the development of tactile communication techniques to supplement assistive devices (such as glasses or hearing aids) or visual sign language [56].

Impact of DSI

Many of the identified reports examined the impact of DSI on people's physical and psychological health and on their ability to participate in key life areas. These provide, across a wide range of domains and indicators, a clear picture of the adverse impact of DSI, with two thirds reporting worse outcomes for all domains considered, and a further quarter reporting worse outcomes for some of the domains considered (varied outcome). The diverse range of indicators used across studies examining impact makes direct comparisons difficult, however the trends observed were clear—people with DSI may experience poorer general health, increased morbidity and mortality, and decreased participation in everyday activities. In particular, the review identified that people with DSI experienced more depression [45, 48, 74–89] and greater difficulties with performing activities of daily living [70, 76, 81, 83, 84, 87, 88, 90–111] than people without sensory impairments. In addition, there was an indication in a small number of studies that these outcomes were worse for people with DSI than for people with single impairments [74, 81, 87, 88, 97].

The findings of this scoping review concur with previous reviews focussing on either HI or VI [8–16]. For example, a recent review found hearing loss was associated with greater odds of depression in older adults across 35 studies [112]. Similarly, VI was found to be consistently associated with depression in a 2015 systematic review [113]. There is also evidence that HI [114] and VI are independently associated with increased mortality [115]. It is not clear from this scoping review whether the combined effects of both HI and VI result in increased risk of poorer health and wellbeing. This is an area that warrants further attention. The findings of grey literature sources such as the 2018 report by the World Federation of the Deafblind also agree with the findings of our review–people with deafblindness may have poorer levels of health, and poorer levels of participation in work and education [5].

Further, given the tendency for worse outcomes among people with DSI, healthcare professionals working in the field of eye care or hearing care have an opportunity to identify, and intervene early to help alleviate some of the negative consequences on physical and psychological health, as well as in participation in society. In particular, this review has identified a high need for mental health services for people with DSI. Evidence from high-income settings suggests that despite the high need for these services, there are substantial barriers to access, such as lack of qualified interpreters [116, 117].

Limitations

Our findings must be interpreted in the context of several limitations. First, scoping reviews do not assess the risk of bias of included studies, thus the studies included in this review are likely to be of varying quality. Second, we excluded reports not in English, so we may have missed some evidence, including from LMICs. Third, by including review articles and primary reports in the review we may have introduced some duplication of studies; we attempted to counter this by presenting review findings separately to primary studies. Fourth, we only conducted electronic searches and did not handsearch journals. It is possible that we may have missed articles that were not properly indexed on the electronic databases, or where indexing was delayed–for example, a potentially relevant review on the prevalence of DSI [118] published in January 2022 was not indexed by the time of our searches in April 2022. However, the findings are consistent with the findings of our scoping review–that prevalence increases by age, and the findings across studies were often not comparable. Finally, when constructing the search strategy, we defined search terms for potential impact outcomes based on preliminary searches of the literature (e.g. mortality, independence, participation, vulnerability, quality of life, mental health) which may have led us to miss some studies reporting other impacts. We did, however, identify a wide variety across our three impact domains.

Conclusion

This scoping review indicates that DSI is a relatively common condition, particularly among older adults. Moreover, the combination of HI and VI has a major impact on the physical, psychosocial, and participation experiences in the lives of affected people and is worthy of much more attention than it is currently receiving. In particular, people with DSI experience depression and decreased participation in everyday life. The magnitude of DSI is likely to increase with population ageing, and therefore research focused on this group is increasingly important. There is a gap in evidence from LMICs on the prevalence and impact of DSI. There is a pressing need for a consensus position on the definition(s) of DSI and standardisation of reporting age groups, to enable reliable estimates to be developed. Further there is an urgent need for research to identify the most effective strategies to improve access to health and wellbeing services for people with DSI. These findings are important for policy and practice when

trying to address the additional needs of people experiencing DSI, beyond the impairments alone.

Supporting information

S1 Checklist. Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) checklist.
(DOCX)

S1 Text. Search strategy.
(DOCX)

S1 Table. Studies reporting prevalence of dual sensory impairment (DSI) by age group.
(DOCX)

S2 Table. Reports measuring psychosocial health outcomes for people with dual sensory impairment (DSI).
(DOCX)

S3 Table. Reports measuring participation outcomes for people with dual sensory impairment (DSI).
(DOCX)

S4 Table. Reports measuring physical health outcomes.
(DOCX)

S5 Table. Included systematic reviews.
(DOCX)

S6 Table. Included studies (n = 197).
(DOCX)

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References

1. Bourne RR, Flaxman SR, Braithwaite T, Cicinelli MV, Das A, Jonas JB, et al. Magnitude, temporal trends, and projections of the global prevalence of blindness and distance and near vision impairment: a systematic review and meta-analysis. The Lancet Global Health. 2017; 5(9):e888–e97. https://doi.org/10.1016/S2214-109X(17)30293-0 PMID: 28779882
2. Stevens G, Flaxman S, Brunskill E, Mascarenhas M, Mathers CD, Finucane M. Global and regional hearing impairment prevalence: an analysis of 42 studies in 29 countries. The European Journal of Public Health. 2013; 23(1):146–52. https://doi.org/10.1093/eurpub/ckr176 PMID: 22197756
3. Wittich W, Southall K, Sikora L, Watanabe DH, Gagné J-P. What's in a name: Dual sensory impairment or deafblindness? British Journal of Visual Impairment. 2013; 31(3):198–207.
4. Saunders GH, Echt KV. An overview of dual sensory impairment in older adults: perspectives for rehabilitation. Trends in amplification. 2007; 11(4):243–58. https://doi.org/10.1177/1084713807308365 PMID: 18003868
5. World Federation of The Deafblind. At risk of exclusion from CRPD and SDGs implementation: Inequality and Persons with Deafblindness 2018 [cited 2023 23/03]. https://www.wfdb.eu/wp-content/uploads/2019/06/WFDB_complete_Final.pdf.
6. Simcock P. One of society's most vulnerable groups? A systematically conducted literature review exploring the vulnerability of deafblind people. Health & social care in the community. 2017; 25 (3):813–39. https://doi.org/10.1111/hsc.12317 PMID: 26733322
7. Issues NCfWaS. The Nordic definition of deafblindness [cited 2023 27/03]. https://kuurosokeat.fi/wp-content/uploads/2019/07/The-Nordic-definition-of-deafblindness.pdf.
8. Ford AH, Hankey GJ, Yeap BB, Golledge J, Flicker L, Almeida OP. Hearing loss and the risk of dementia in later life. Maturitas. 2018; 112:1–11. https://doi.org/10.1016/j.maturitas.2018.03.004 PMID: 29704910
9. Dalton DS, Cruickshanks KJ, Klein BEK, Klein R, Wiley TL, Nondahl DM. The Impact of Hearing Loss on Quality of Life in Older Adults. The Gerontologist. 2003; 43(5):661–8. https://doi.org/10.1093/geront/43.5.661 PMID: 14570962
10. Shoham N, Lewis G, Favarato G, Cooper C. Prevalence of anxiety disorders and symptoms in people with hearing impairment: a systematic review. Social Psychiatry and Psychiatric Epidemiology. 2019; 54(6):649–60. https://doi.org/10.1007/s00127-018-1638-3 PMID: 30547211
11. Adigun O. Depression and Individuals with Hearing Loss: A Systematic Review. Journal of Psychology & Psychotherapy. 2017; 07. https://doi.org/10.4172/2161-0487.1000323
12. Roland L, Fischer C, Tran K, Rachakonda T, Kallogjeri D, Lieu JE. Quality of life in children with hearing impairment: systematic review and meta-analysis. Otolaryngology–Head and Neck Surgery. 2016; 155(2):208–19. https://doi.org/10.1177/0194599816640485 PMID: 27118820
13. Danquah L, Kuper H, Eusebio C, Rashid MA, Bowen L, Foster A, et al. The long term impact of cataract surgery on quality of life, activities and poverty: results from a six year longitudinal study in Bangladesh and the Philippines. PLoS One. 2014; 9(4):e94140. Epub 2014/04/22. https://doi.org/10.1371/journal.pone.0094140 PMID: 24747192.
14. Mathew RS, Delbaere K, Lord SR, Beaumont P, Vaegan, Madigan MC. Depressive symptoms and quality of life in people with age- related macular degeneration. Ophthalmic and Physiological Optics. 2011; 31(4):375–80. https://doi.org/10.1111/j.1475-1313.2011.00848.x PMID: 21679317
15. Renaud J, Bédard E. Depression in the elderly with visual impairment and its association with quality of life. Clin Interv Aging. 2013; 8:931–43. Epub 2013/07/19. https://doi.org/10.2147/CIA.S27717 PMID: 23888110.
16. Renaud J, Levasseur M, Gresset J, Overbury O, Wanet-Defalque M-C, Dubois M-F, et al. Health-related and subjective quality of life of older adults with visual impairment. Disability and Rehabilitation. 2010; 32(11):899–907. https://doi.org/10.3109/09638280903349545 PMID: 19860601
17. Kuper H, Polack S, Mathenge W, Eusebio C, Wadud Z, Rashid M, et al. Does cataract surgery alleviate poverty? Evidence from a multi-centre intervention study conducted in Kenya, the Philippines and Bangladesh. PLoS One. 2010; 5(11):e15431. Epub 2010/11/19. https://doi.org/10.1371/journal.pone.0015431 PMID: 21085697.
18. Spreckley MJ. The impact of hearing impairment and the provision of hearing aids on poverty, mental health, quality of life and activity participation in Guatemala: London School of Hygiene & Tropical Medicine; 2018.
19. Tseng YC, Liu SH, Lou MF, Huang GS. Quality of life in older adults with sensory impairments: a systematic review. Qual Life Res. 2018; 27(8):1957–71. Epub 2018/02/07. https://doi.org/10.1007/s11136-018-1799-2 PMID: 29404924.

20. Heine C, Browning CJ. Mental health and dual sensory loss in older adults: a systematic review. Front Aging Neurosci. 2014; 6:83. Epub 2014/05/27. https://doi.org/10.3389/fnagi.2014.00083 PMID: 24860496.

21. Tiwana R, Benbow SM, Kingston P. Late life acquired dual-sensory impairment: A systematic review of its impact on everyday competence. British Journal of Visual Impairment. 2016; 34(3):203–13. https://doi.org/10.1177/0264619616648727

22. Schneider JM, Gopinath B, McMahon CM, Leeder SR, Mitchell P, Wang JJ. Dual sensory impairment in older age. Journal of aging and health. 2011; 23(8):1309–24. https://doi.org/10.1177/0898264311408418 PMID: 21596997

23. Jaiswal A, Aldersey H, Wittich W, Mirza M, Finlayson M. Participation experiences of people with deafblindness or dual sensory loss: A scoping review of global deafblind literature. PLoS One. 2018; 13(9): e0203772. Epub 2018/09/14. https://doi.org/10.1371/journal.pone.0203772 PMID: 30212504.

24. Peters MDJ, Godfrey CM, Baldini Soares C, Khalil H, Parker D. Joanna Briggs Institute Reviewer's Manual: The Joanna Briggs Institute; 2017 [cited 2020 13/03]. https://reviewersmanual.joannabriggs.org/

25. Munn Z, Peters MDJ, Stern C, Tufanaru C, McArthur A, Aromataris E. Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. BMC Medical Research Methodology. 2018; 18(1):143. https://doi.org/10.1186/s12874-018-0611-x PMID: 30453902

26. Burton MJ, Faal HB, Ramke J, Ravilla T, Holland P, Wang N, et al. Announcing The Lancet Global Health Commission on Global Eye Health. The Lancet Global Health. 2019; 7(12):e1612–e3. https://doi.org/10.1016/S2214-109X(19)30450-4 PMID: 31606327

27. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. Annals of Internal Medicine. 2018; 169(7):467–73. https://doi.org/10.7326/M18-0850 PMID: 30178033

28. Lam BL, Lee DJ, Gómez-Marín O, Zheng DD, Caban AJ. Concurrent Visual and Hearing Impairment and Risk of Mortality: The National Health Interview Survey. Archives of Ophthalmology. 2006; 124 (1):95–101. https://doi.org/10.1001/archopht.124.1.95 PMID: 16401790

29. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021; 372:n71. https://doi.org/10.1136/bmj.n71 PMID: 33782057

30. International classification of disease 11 vision impairment including blindness, 2018 2018 [cited 2020]. https://icd.who.int/browse11/l-m/en#/http%3a%2f%2fid.who.int%2ficd%2fentity%2f30317704

31. Dammeyer JM. Prevalence and aetiology of congenitally deafblind people in Denmark. International journal of audiology. 2010; 49(2):76–82. https://doi.org/10.3109/14992020903311388 PMID: 20151880

32. Mactaggart I, Polack S, Murthy G, Kuper H. A population-based survey of visual impairment and its correlates in Mahabubnagar district, Telangana State, India. Ophthalmic epidemiology. 2018; 25 (3):238–45. https://doi.org/10.1080/09286586.2017.1418386 PMID: 29281342

33. Khandekar R, Al Khabori M. Double disability: the hearing-impaired blind in the Sultanate of Oman. International journal of audiology. 2004; 43(3):172–6. https://doi.org/10.1080/14992020400050024 PMID: 15198382

34. Wittich W, Watanabe DH, Gagne J-P. Sensory and demographic characteristics of deafblindness rehabilitation clients in Montreal, Canada. Ophthalmic & physiological optics: the journal of the British College of Ophthalmic Opticians (Optometrists). 2012; 32(3):242–51. https://doi.org/10.1111/j.1475-1313.2012.00897.x PMID: 22348651

35. Linden-Bostrom M, Persson C. Disparities in mental health among adolescents with and without impairments. Scandinavian journal of public health. 2015; 43(7):728–35. https://doi.org/10.1177/1403494815589219 PMID: 26229072

36. Reed NS, Assi L, Pedersen E, Alshabasy Y, Deemer A, Deal JA, et al. Accompaniment to healthcare visits: the impact of sensory impairment. BMC health services research. 2020; 20(1):990. https://doi.org/10.1186/s12913-020-05829-8 PMID: 33121483

37. Armstrong NM, Wang H, E J-Y, Lin FR, Abraham AG, Ramulu P, et al. Patterns of Prevalence of Multiple Sensory Impairments among Community-Dwelling Older Adults. The journals of gerontology Series A, Biological sciences and medical sciences. 2021;(cba, 9502837). https://doi.org/10.1093/gerona/glab294 PMID: 34608938

38. Dammeyer J. Characteristics of a Danish population of adults with acquired deafblindness receiving rehabilitation services. British Journal of Visual Impairment. 2013; 31(3):189–97. https://doi.org/10.1177/0264619613490518

39. Khurana M, Shoham N, Cooper C, Pitman AL. Association between sensory impairment and suicidal ideation and attempt: a cross-sectional analysis of nationally representative English household data. BMJ open. 2021; 11(2):e043179. https://doi.org/10.1136/bmjopen-2020-043179 PMID: 33593780

40. Pardhan S, Smith L, Bourne R, Davis A, Leveziel N, Jacob L, et al. Combined Vision and Hearing Difficulties Results in Higher Levels of Depression and Chronic Anxiety: Data From a Large Sample of Spanish Adults. Frontiers in psychology. 2020; 11(101550902):627980. https://doi.org/10.3389/fpsyg.2020.627980 PMID: 33536989

41. Smith SL, Bennett LW, Wilson RH. Prevalence and characteristics of dual sensory impairment (hearing and vision) in a veteran population. Journal of rehabilitation research and development. 2008; 45 (4):597–609. https://doi.org/10.1682/jrrd.2007.02.0023 PMID: 18712645

42. Meuwese-Jongejeugd A, van Splunder J, Vink M, Stilma JS, van Zanten B, Verschuure H, et al. Combined sensory impairment (deaf-blindness) in five percent of adults with intellectual disabilities. American journal of mental retardation: AJMR. 2008; 113(4):254–62. https://doi.org/10.1352/0895-8017(2008)113[254:CSIDIF]2.0.CO;2 PMID: 18564886

43. Miyawaki A, Kobayashi Y, Kawachi I. Self-Reported Hearing/Visual Loss and Mortality in Middle-Aged and Older Adults: Findings From the Komo-Ise Cohort, Japan. Journal of epidemiology. 2020; 30 (2):67–73. https://doi.org/10.2188/jea.JE20180198 PMID: 30662042

44. Rong H, Lai X, Jing R, Wang X, Fang H, Mahmoudi E. Association of Sensory Impairments With Cognitive Decline and Depression Among Older Adults in China. JAMA network open. 2020; 3(9): e2014186. https://doi.org/10.1001/jamanetworkopen.2020.14186 PMID: 32990739

45. Kiely KM, Anstey KJ, Luszcz MA. Dual sensory loss and depressive symptoms: the importance of hearing, daily functioning, and activity engagement. Frontiers in human neuroscience. 2013; 7 (101477954):837. https://doi.org/10.3389/fnhum.2013.00837 PMID: 24379769

46. Schneck ME, Lott LA, Haegerstrom-Portnoy G, Brabyn JA. Association between hearing and vision impairments in older adults. Ophthalmic & physiological optics: the journal of the British College of Ophthalmic Opticians (Optometrists). 2012; 32(1):45–52. https://doi.org/10.1111/j.1475-1313.2011.00876.x PMID: 21999724

47. Kim Y, Kwak Y, Kim J-S. The association between suicide ideation and sensory impairment among elderly Koreans. Aging & mental health. 2015; 19(7):658–65. https://doi.org/10.1080/13607863.2014.989812 PMID: 25495960

48. Liljas AEM, Walters K, de Oliveira C, Wannamethee SG, Ramsay SE, Carvalho LA. Self-Reported Sensory Impairments and Changes in Cognitive Performance: A Longitudinal 6-Year Follow-Up Study of English Community-Dwelling Adults Aged 50 Years. Journal of aging and health. 2018;(afs, 8912686):898264318815391. https://doi.org/10.1177/0898264318815391 PMID: 30522390

49. Maharani A, Dawes P, Nazroo J, Tampubolon G, Pendleton N, Sense-Cog WPg. Visual and hearing impairments are associated with cognitive decline in older people. Age and ageing. 2018; 47(4):575–81. https://doi.org/10.1093/ageing/afy061 PMID: 29697748

50. Besser J, Stropahl M, Urry E, Launer S. Comorbidities of hearing loss and the implications of multimorbidity for audiological care. Hearing research. 2018; 369(hck, 7900445):3–14. https://doi.org/10.1016/j.heares.2018.06.008 PMID: 29941312

51. Heine C, Browning C. Dual Sensory Loss in Older Adults: A Systematic Review. The Gerontologist. 2015; 55(5):913–28. https://doi.org/10.1093/geront/gnv074 PMID: 26315316

52. Dewan P, Gupta P. Burden of Congenital Rubella Syndrome (CRS) in India: a systematic review. Indian pediatrics. 2012; 49(5):377–99. https://doi.org/10.1007/s13312-012-0087-4 PMID: 22700664

53. Amini R, Haghani H, Masoumi M. Quality of life in the Iranian Blind War Survivors in 2007: a cross-sectional study. BMC international health and human rights. 2010; 10(101088678):21. https://doi.org/10.1186/1472-698X-10-21 PMID: 20727193

54. Appollonio I, Carabellese C, Magni E, Frattola L, Trabucchi M. Sensory impairments and mortality in an elderly community population: a six-year follow-up study. Age and ageing. 1995; 24(1):30–6. https://doi.org/10.1093/ageing/24.1.30 PMID: 7762459

55. Hersh MA. Deafblind people, stigma and the use of communication and mobility assistive devices. Technology and Disability. 2013; 25(4):245–61. http://dx.doi.org/10.3233/TAD-130394

56. Dammeyer J. Deafblindness: a review of the literature. Scandinavian journal of public health. 2014; 42 (7):554–62. https://doi.org/10.1177/1403494814544399 PMID: 25114064

57. Carvill S. Sensory impairments, intellectual disability and psychiatry. Journal of intellectual disability research: JIDR. 2001; 45(Pt 6):467–83. https://doi.org/10.1046/j.1365-2788.2001.00366.x PMID: 11737534

58. Arcous M, Putois O, Dalle-Nazebi S, Kerbourch S, Cariou A, Ben Aissa I, et al. Psychosocial determinants associated with quality of life in people with usher syndrome. A scoping review. Disability and

rehabilitation. 2019;(9207179, a8i):1–12. https://doi.org/10.1080/09638288.2019.1571637 PMID: 30974979

59. Lehane CM, Dammeyer J, Elsass P. Sensory loss and its consequences for couples' psychosocial and relational wellbeing: an integrative review. Aging & mental health. 2017; 21(4):337–47. https://doi.org/10.1080/13607863.2015.1132675 PMID: 26739709

60. Ask Larsen F, Damen S. Definitions of deafblindness and congenital deafblindness. Research in developmental disabilities. 2014; 35(10):2568–76. https://doi.org/10.1016/j.ridd.2014.05.029 PMID: 25016162

61. Mactaggart I, Kuper H, Murthy GVS, Oye J, Polack S. Measuring Disability in Population Based Surveys: The Interrelationship between Clinical Impairments and Reported Functional Limitations in Cameroon and India. PLOS ONE. 2016; 11(10):e0164470. https://doi.org/10.1371/journal.pone.0164470 PMID: 27741320

62. World Health Organization. Ageing 2023 [cited 2023 23/03]. https://www.who.int/health-topics/ageing#tab=tab_1.

63. Cieza A, Causey K, Kamenov K, Hanson SW, Chatterji S, Vos T. Global estimates of the need for rehabilitation based on the Global Burden of Disease study 2019: a systematic analysis for the Global Burden of Disease Study 2019. The Lancet. 2020; 396(10267):2006–17. https://doi.org/10.1016/S0140-6736(20)32340-0 PMID: 33275908

64. Kiely KM, Mitchell P, Gopinath B, Luszcz MA, Jagger C, Anstey KJ. Estimating the Years Lived With and Without Age-Related Sensory Impairment. The journals of gerontology Series A, Biological sciences and medical sciences. 2016; 71(5):637–42. https://doi.org/10.1093/gerona/glv198 PMID: 26515257

65. Maharani A, Dawes P, Nazroo J, Tampubolon G, Pendleton N, Sense-Cog WPg. Associations between self-reported sensory impairment and risk of cognitive decline and impairment in the Health and Retirement Study (HRS) cohort. The journals of gerontology Series B, Psychological sciences and social sciences. 2019;(cbb, 9508483). https://doi.org/10.1093/geronb/gbz043 PMID: 30977823

66. Lyu J, Kim H-Y. Gender-Specific Associations of Sensory Impairments with Depression and Cognitive Impairment in Later Life. Psychiatry investigation. 2018; 15(10):926–34. https://doi.org/10.30773/pi.2018.06.28.2 PMID: 30205671

67. Mitoku K, Masaki N, Ogata Y, Okamoto K. Vision and hearing impairments, cognitive impairment and mortality among long-term care recipients: a population-based cohort study. BMC geriatrics. 2016; 16 (100968548):112. https://doi.org/10.1186/s12877-016-0286-2 PMID: 27233777

68. Viljanen A, Tormakangas T, Vestergaard S, Andersen-Ranberg K. Dual sensory loss and social participation in older Europeans. European journal of ageing. 2014; 11(2):155–67. https://doi.org/10.1007/s10433-013-0291-7 PMID: 28804323

69. Graue-Hernandez EO, Gomez-Dantes H, Romero-Martinez M, Bravo G, Arrieta-Camacho J, Jimenez-Corona A. [Self-reported hearing loss and visual impairment in adults from Central Mexico]. Salud publica de Mexico. 2019; 61(5):629–36. https://doi.org/10.21149/10086 PMID: 31661740

70. Beall CM, Goldstein MC. Age differences in sensory and cognitive function in elderly Nepalese. Journal of gerontology. 1986; 41(3):387–9. https://doi.org/10.1093/geronj/41.3.387 PMID: 3486204

71. Bright T, McCormick I, Phiri M, Mulwafu W, Burton M, Polack S, et al. Rationale and feasibility of a combined rapid assessment of avoidable blindness and hearing loss protocol. PloS one. 2020; 15(2): e0229008. https://doi.org/10.1371/journal.pone.0229008 PMID: 32053650

72. Ogliari G, Ryg J, Qureshi N, Andersen-Ranberg K, Scheel-Hincke LL, Masud T. Subjective vision and hearing impairment and falls among community-dwelling adults: a prospective study in the Survey of Health, Ageing and Retirement in Europe (SHARE). European geriatric medicine. 2021; 12(5):1031–43. https://doi.org/10.1007/s41999-021-00505-4 PMID: 34003480

73. Shakarchi AF, Assi L, Ehrlich JR, Deal JA, Reed NS, Swenor BK. Dual Sensory Impairment and Perceived Everyday Discrimination in the United States. JAMA ophthalmology. 2020; 138(12):1227–33. https://doi.org/10.1001/jamaophthalmol.2020.3982 PMID: 33034632

74. Capella-McDonnall ME. The effects of single and dual sensory loss on symptoms of depression in the elderly. International journal of geriatric psychiatry. 2005; 20(9):855–61. https://doi.org/10.1002/gps.1368 PMID: 16116571

75. Chou K-L. Combined effect of vision and hearing impairment on depression in older adults: evidence from the English Longitudinal Study of Ageing. Journal of affective disorders. 2008; 106(1–2):191–6. https://doi.org/10.1016/j.jad.2007.05.028 PMID: 17602753

76. Cimarolli VR, Jopp DS, Boerner K, Minahan J. Depressive symptoms in the oldest-old: The role of sensory impairments. Archives of gerontology and geriatrics. 2018; 78(8214379, 7ax):249–54. https://doi.org/10.1016/j.archger.2018.07.009 PMID: 30032074

77. Cosh S, von Hanno T, Helmer C, Bertelsen G, Delcourt C, Schirmer H, et al. The association amongst visual, hearing, and dual sensory loss with depression and anxiety over 6 years: The Tromso Study. International journal of geriatric psychiatry. 2018; 33(4):598–605. https://doi.org/10.1002/gps.4827 PMID: 29193338

78. Davidson JGS, Guthrie DM. Older Adults With a Combination of Vision and Hearing Impairment Experience Higher Rates of Cognitive Impairment, Functional Dependence, and Worse Outcomes Across a Set of Quality Indicators. Journal of aging and health. 2019; 31(1):85–108. https://doi.org/10.1177/0898264317723407 PMID: 28805100

79. Guthrie DM, Thériault ÉR, Davidson JGS. Self-rated health, cognition, and dual sensory impairment are important predictors of depression among home care clients in Ontario. Home Health Care Management & Practice. 2016; 28(1):35–43.

80. Han JH, Lee HJ, Jung J, Park EC. Effects of self-reported hearing or vision impairment on depressive symptoms: a population-based longitudinal study. Epidemiology and psychiatric sciences. 2019; 28 (3):343–55. https://doi.org/10.1017/S2045796018000045 PMID: 29415786

81. Harada S, Nishiwaki Y, Michikawa T, Kikuchi Y, Iwasawa S, Nakano M, et al. Gender difference in the relationships between vision and hearing impairments and negative well-being. Preventive medicine. 2008; 47(4):433–7. https://doi.org/10.1016/j.ypmed.2008.06.011 PMID: 18619483

82. Loprinzi PD, Smit E, Pariser G. Association among depression, physical functioning, and hearing and vision impairment in adults with diabetes. Diabetes Spectrum. 2013; 26(1):6–15. http://dx.doi.org/10.2337/diaspect.26.1.6

83. Heine C, Gong CH, Browning C. Dual Sensory Loss, Mental Health, and Wellbeing of Older Adults Living in China. Frontiers in public health. 2019; 7(101616579):92. https://doi.org/10.3389/fpubh.2019.00092 PMID: 31069206

84. Heine C, Gong CH, Feldman S, Browning C. Older Women in Australia: Facing the Challenges of Dual Sensory Loss. International journal of environmental research and public health. 2019; 17(1). https://doi.org/10.3390/ijerph17010263 PMID: 31905935

85. McDonnall MC. Physical status as a moderator of depressive symptoms among older adults with dual sensory loss. Rehabilitation psychology. 2011; 56(1):67–76. https://doi.org/10.1037/a0022696 PMID: 21401288

86. McDonnall MC. The Effect of Productive Activities on Depressive Symptoms Among Older Adults With Dual Sensory Loss. Research on aging. 2011; 33(3):234–55. https://doi.org/10.1177/0164027511399106 PMID: 21686087

87. Simning A, Fox ML, Barnett SL, Sorensen S, Conwell Y. Depressive and Anxiety Symptoms in Older Adults With Auditory, Vision, and Dual Sensory Impairment. Journal of aging and health. 2019; 31 (8):1353–75. https://doi.org/10.1177/0898264318781123 PMID: 29896982

88. Soto-Perez-de-Celis E, Sun C-L, Tew WP, Mohile SG, Gajra A, Klepin HD, et al. Association between patient-reported hearing and visual impairments and functional, psychological, and cognitive status among older adults with cancer. Cancer. 2018; 124(15):3249–56. https://doi.org/10.1002/cncr.31540 PMID: 29797664

89. Yamada Y, Vlachova M, Richter T, Finne-Soveri H, Gindin J, van der Roest H, et al. Prevalence and correlates of hearing and visual impairments in European nursing homes: results from the SHELTER study. Journal of the American Medical Directors Association. 2014; 15(10):738–43. https://doi.org/10.1016/j.jamda.2014.05.012 PMID: 24984787

90. Bouscaren N, Yildiz H, Dartois L, Vercambre MN, Boutron-Ruault MC. Decline in Instrumental Activities of Daily Living over 4-Year: The Association with Hearing, Visual and Dual Sensory Impairments among Non-Institutionalized Women. The journal of nutrition, health & aging. 2019; 23(8):687–93. https://doi.org/10.1007/s12603-019-1231-9 PMID: 31560024

91. Brennan M, Horowitz A, Su Y-P. Dual sensory loss and its impact on everyday competence. The Gerontologist. 2005; 45(3):337–46. https://doi.org/10.1093/geront/45.3.337 PMID: 15933274

92. Campbell VA, Crews JE, Moriarty DG, Zack MM, Blackman DK. Surveillance for sensory impairment, activity limitation, and health-related quality of life among older adults—United States, 1993–1997. MMWR CDC surveillance summaries: Morbidity and mortality weekly report CDC surveillance summaries. 1999; 48(8):131–56. PMID: 10634273

93. Chou K-L, Chi I. Combined effect of vision and hearing impairment on depression in elderly Chinese. International journal of geriatric psychiatry. 2004; 19(9):825–32. https://doi.org/10.1002/gps.1174 PMID: 15352139

94. Cimarolli VR, Jopp DS. Sensory impairments and their associations with functional disability in a sample of the oldest-old. Quality of life research: an international journal of quality of life aspects of treatment, care and rehabilitation. 2014; 23(7):1977–84. https://doi.org/10.1007/s11136-014-0657-0 PMID: 24682668

95. Crews JE, Campbell VA. Vision impairment and hearing loss among community-dwelling older Americans: implications for health and functioning. American journal of public health. 2004; 94(5):823–9. https://doi.org/10.2105/ajph.94.5.823 PMID: 15117707

96. Ehn M, Wahlqvist M, Danermark B, Dahlstrom O, Moller C. Health, work, social trust, and financial situation in persons with Usher syndrome type 1. Work (Reading, Mass). 2018; 60(2):209–20. https://doi.org/10.3233/WOR-182731 PMID: 29865098

97. Fuller SD, Mudie LI, Siordia C, Swenor BK, Friedman DS. Nationwide Prevalence of Self-Reported Serious Sensory Impairments and Their Associations with Self-Reported Cognitive and Functional Difficulties. Ophthalmology. 2018; 125(4):476–85. https://doi.org/10.1016/j.ophtha.2017.11.003 PMID: 29306552

98. Guthrie DM, Davidson JGS, Williams N, Campos J, Hunter K, Mick P, et al. Combined impairments in vision, hearing and cognition are associated with greater levels of functional and communication difficulties than cognitive impairment alone: Analysis of interRAI data for home care and long-term care recipients in Ontario. PloS one. 2018; 13(2):e0192971. https://doi.org/10.1371/journal.pone.0192971 PMID: 29447253

99. Heine C, Browning CJ, Gong CH. Sensory Loss in China: Prevalence, Use of Aids, and Impacts on Social Participation. Frontiers in public health. 2019; 7(101616579):5. https://doi.org/10.3389/fpubh.2019.00005 PMID: 30733938

100. Heyl V, Wahl H-W. Managing daily life with age-related sensory loss: cognitive resources gain in importance. Psychology and aging. 2012; 27(2):510–21. https://doi.org/10.1037/a0025471 PMID: 22059715

101. Keller BK, Morton JL, Thomas VS, Potter JF. The effect of visual and hearing impairments on functional status. Journal of the American Geriatrics Society. 1999; 47(11):1319–25. https://doi.org/10.1111/j.1532-5415.1999.tb07432.x PMID: 10573440

102. Kwon H-J, Kim J-S, Kim Y-J, Kwon S-J, Yu J-N. Sensory Impairment and Health-Related Quality of Life. Iranian journal of public health. 2015; 44(6):772–82.

103. Lee DJ, Lam BL, Gomez-Marin O, Zheng DD, Caban AJ. Concurrent hearing and visual impairment and morbidity in community-residing adults: the National Health Interview Survey, 1986 to 1996. Journal of aging and health. 2005; 17(5):531–46. https://doi.org/10.1177/0898264305277956 PMID: 16177449

104. Liu PL, Cohen HJ, Fillenbaum GG, Burchett BM, Whitson HE. Association of Co-Existing Impairments in Cognition and Self-Rated Vision and Hearing With Health Outcomes in Older Adults. Gerontology and Geriatric Medicine. 2016; 2((Cohen, Whitson) Durham VA Medical Center, Geriatrics Research Education and Clinical Center, Durham, NC, United States). https://doi.org/10.1177/2333721415623495 PMID: 27054148

105. Lupsakko T, Mantyjarvi M, Kautiainen H, Sulkava R. Combined hearing and visual impairment and depression in a population aged 75 years and older. International journal of geriatric psychiatry. 2002; 17(9):808–13. https://doi.org/10.1002/gps.689 PMID: 12221653

106. Maruta M, Tabira T, Sagari A, Miyata H, Yoshimitsu K, Han G, et al. Impact of sensory impairments on dementia incidence and symptoms among Japanese older adults. Psychogeriatrics: the official journal of the Japanese Psychogeriatric Society. 2019;(101230058). https://doi.org/10.1111/psyg.12494 PMID: 31799771

107. Mudie LI, Varadaraj V, Gajwani P, Munoz B, Ramulu P, Lin FR, et al. Dual sensory impairment: The association between glaucomatous vision loss and hearing impairment and function. PloS one. 2018; 13(7):e0199889. https://doi.org/10.1371/journal.pone.0199889 PMID: 29979753

108. Mueller-Schotte S, Zuithoff NPA, van der Schouw YT, Schuurmans MJ, Bleijenberg N. Trajectories of Limitations in Instrumental Activities of Daily Living in Frail Older Adults With Vision, Hearing, or Dual Sensory Loss. The journals of gerontology Series A, Biological sciences and medical sciences. 2019; 74(6):936–42. https://doi.org/10.1093/gerona/gly155 PMID: 29982391

109. Reuben DB, Mui S, Damesyn M, Moore AA, Greendale GA. The prognostic value of sensory impairment in older persons. Journal of the American Geriatrics Society. 1999; 47(8):930–5. https://doi.org/10.1111/j.1532-5415.1999.tb01286.x PMID: 10443852

110. Tareque MI, Chan A, Saito Y, Ma S, Malhotra R. The Impact of Self-Reported Vision and Hearing Impairment on Health Expectancy. Journal of the American Geriatrics Society. 2019; 67(12):2528–36. https://doi.org/10.1111/jgs.16086 PMID: 31411348

111. Teh C, Lim W, Basri R, Ismail NH. Utility of a patient-response screening question for visual impairment. Journal of the American Geriatrics Society. 2006; 54(2):370–2. https://doi.org/10.1111/j.1532-5415.2005.00592_4.x PMID: 16460398

112. Lawrence BJ, Jayakody DMP, Bennett RJ, Eikelboom RH, Gasson N, Friedland PL. Hearing Loss and Depression in Older Adults: A Systematic Review and Meta-analysis. Gerontologist. 2020; 60(3):e137–e54. Epub 2019/03/06. https://doi.org/10.1093/geront/gnz009 PMID: 30835787.

113. Ribeiro MV, Hasten-Reiter Júnior HN, Ribeiro EA, Jucá MJ, Barbosa FT, Sousa-Rodrigues CF. Association between visual impairment and depression in the elderly: a systematic review. Arq Bras Oftalmol. 2015; 78(3):197–201. Epub 2015/07/30. https://doi.org/10.5935/0004-2749.20150051 PMID: 26222114.

114. Contrera KJ, Betz J, Genther DJ, Lin FR. Association of Hearing Impairment and Mortality in the National Health and Nutrition Examination Survey. JAMA Otolaryngol Head Neck Surg. 2015; 141 (10):944–6. https://doi.org/10.1001/jamaoto.2015.1762 PMID: 26401904.

115. Ehrlich JR, Ramke J, Macleod D, Burn H, Lee CN, Zhang JH, et al. Association between vision impairment and mortality: a systematic review and meta-analysis. The Lancet Global Health. 2021; 9 (4):e418–e30. https://doi.org/10.1016/S2214-109X(20)30549-0 PMID: 33607015

116. Bodsworth SM, Clare ICH, Simblett SK. Deafblindness and mental health: Psychological distress and unmet need among adults with dual sensory impairment. British Journal of Visual Impairment. 2011; 29(1):6–26. https://doi.org/10.1177/0264619610387495

117. McDonnall MC, Crudden A, LeJeune BJ, Steverson AC. Availability of Mental Health Services for Individuals Who Are Deaf or Deaf-Blind. Journal of Social Work in Disability & Rehabilitation. 2017; 16 (1):1–13. https://doi.org/10.1080/1536710X.2017.1260515 PMID: 28187698

118. Minhas R, Jaiswal A, Chan S, Trevisan J, Paramasivam A, Spruyt-Rocks R. Prevalence of Individuals With Deafblindness and Age-Related Dual-Sensory Loss. Journal of Visual Impairment & Blindness. 2022; 116(1):36–47. https://doi.org/10.1177/0145482X211072541