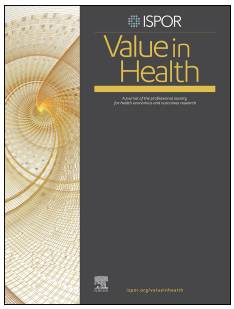

Development, use and psychometric properties of vision and hearing bolt-ons for EQ-5D-3L and EQ-5D-5L: a systematic review

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Title: Development, use and psychometric properties of vision and hearing bolt-ons for EQ-5D-3L and EQ-5D-5L: a systematic review

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Precis: This study presents evidence from studies that developed, used or assessed the psychometric properties of vision or hearing bolt-ons for EQ-5D-3L and EQ-5D-5L

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Not applicable.

Development, use and psychometric properties of vision and hearing bolt-ons for EQ-5D-3L and EQ-5D-5L: a systematic review

Abstract

Objectives

We aimed to systematically review studies that had developed, used, or assessed the psychometric properties of vision or hearing bolt-ons for EQ-5D-3L and EQ-5D-5L.

Methods

A systematic review was conducted up to 17 March 2025, in Embase, PubMed, and Web of Science following the PRISMA 2020 guideline. Findings for EQ-5D-3L and EQ-5D-5L with vision and hearing bolt-ons, including the number of different bolt-on wordings and psychometric performance, were summarised narratively.

Results

The review included 21 and eight publications for vision and hearing bolt-ons, respectively. More differentiated bolt-ons were developed for the EQ-5D-5L than for the EQ-5D-3L (vision: 9 vs. 1; hearing: 20 vs. 1). Among them, four vision and 13 hearing bolt-ons for EQ-5D-5L originated from two separate qualitative development studies. Six studies (vision: 3; hearing: 3) used qualitative research during item development. Across general-population and patient-population studies, both vision and hearing bolt-ons reduced the ceiling effects (vision: 4.3%-38.1%; hearing: 1.65%-18.8%) and showed good convergent validity with relevant external measures (e.g. HUI-3, Cat-PROM5). However, convergent validity was weaker for some clinical measures, including visual acuity and hearing thresholds. Known-group validity based on relevant clinical characteristics (e.g. visual acuity, unilateral vs. bilateral hearing loss) was reported. Responsiveness, test-retest reliability and patient-proxy agreement evidence was limited.

Conclusion

Although psychometric properties were generally favourable, the evidence base remains partial and heterogeneous. This review informs future development of bolt-ons that should prioritise identifying the most appropriate item wordings, and exploring psychometric properties using both qualitative and quantitative approaches in relevant patient populations.

Keywords: Bolt-on; health-related quality of life; vision; hearing; psychometric properties

Highlights

1. This study is the first comprehensive synthesis of evidence from studies that have developed, used or assessed the psychometric properties of vision or hearing bolt-ons for EQ-5D-3L and EQ-5D-5L.
2. Substantial heterogeneity in bolt-on development and wording was observed. Overall, studies demonstrated reduced ceiling effects and satisfactory divergent validity with EQ-5D dimensions. Evidence on convergent and known-group validity was heterogeneous depending on the population, version (3L vs 5L), external measures or known-groups used, with most studies demonstrating at least satisfactory performance.
3. Future research should prioritise consensus on appropriate dimension wording, incorporate qualitative methods to strengthen content validity, and undertake psychometric testing studies to fill evidence gaps in responsiveness, test-retest reliability, and patient-proxy agreement.

Introduction

EQ-5D is one of the most widely used generic instruments for measuring and valuing health-related quality of life (HRQoL), due to its simplicity, brevity, and inclusion of key health dimensions relevant across diverse populations and interventions [1, 2]. The descriptive system of EQ-5D includes five health dimensions: mobility (MO), self-care (SC), usual activities (UA), pain/discomfort (PD) and anxiety/depression (AD). It is commonly used to describe health status and calculate quality-adjusted life-years (QALYs) in cost-utility analyses [3, 4], allowing comparisons across different health conditions and interventions.

Despite being a widely applicable generic instrument, evidence suggests that the EQ-5D may not capture some important HRQoL dimensions, including fatigue, cognition, itching, and sensory functioning [5-8]. To address this, adding health dimensions to supplement the EQ-5D descriptive system, also known as "bolt-ons", has been proposed [9, 10], aiming to capture aspects of HRQoL not covered by the five core dimensions. Accumulating studies have explored the development and application of bolt-ons to improve the EQ-5D's content validity, discriminatory power, and responsiveness to change. In a 2021 review, Geraerds and colleagues identified 26 different bolt-ons proposed for the EQ-5D [9], with vision and hearing among the most frequently studied after cognition. The review focused on the methodological aspects and did not synthesise the empirical evidence on psychometric performance in detail.

Vision and hearing are essential components of sensory and perceptual function. Sensory impairments can significantly influence HRQoL across a wide range of patient populations, including age-related macular degeneration, glaucoma, cataracts, diabetes, and hearing loss, as well as in the older adult population [11-14]. Impairments in these domains can impact daily activities [15], social participation [16], cognitive decline [17], and mental health

conditions [18]. This highlights the importance of incorporating vision and hearing into comprehensive HRQoL assessments in some populations.

Some preference-accompanied instruments, such as the Health Utilities Index (HUI) and 15D [19, 20], already include dimensions addressing vision and hearing. Unlike these instruments, the EQ-5D does not include specific dimensions for vision or hearing. The high prevalence of sensory impairments and their substantial impact on HRQoL have led to a growing interest in developing bolt-ons for these dimensions [6]. This approach allows to extend the EQ-5D descriptive system, while retaining its framework for estimating QALY in economic evaluation. Additionally, incorporating bolt-ons is more concise than including condition-specific measures in a study.

Previous systematic reviews on bolt-ons covered cognition and identified over 180 studies [21, 22]. Following evidence from previous systematic reviews showing that the EQ-5D performs sub-optimally in vision/hearing-related conditions [23], a growing number of studies have explored the development, application or psychometric properties of vision and/or hearing bolt-ons for EQ-5D. However, no publication has yet synthesised the results. Therefore, we aimed to conduct a systematic literature review and summarise the most up-to-date evidence from studies that developed, used or tested the psychometric properties of vision or hearing bolt-ons in adult populations.

Methods

Study design

The systematic review was performed following the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) 2020 guideline [24]. The protocol for this systematic review was registered with PROSPERO (registration number: CRD42024533965).

Identification and selection of studies

A systematic literature search was conducted in Embase, PubMed and Web of Science. The search strategies were developed based on earlier reviews of bolt-on publications [9, 21, 22], with keywords related to EQ-5D and bolt-on items (see Appendix 1). Search strategies were developed in English, but relevant non-English publications could be identified through indexed English titles, abstracts, and keywords; no language restrictions were applied in the database searches. To supplement these databases, we searched EuroQol conference proceedings. Forward and backward reference searching was also performed for the included literature to further retrieve articles related to the topic.

The search in databases was conducted on 17 March 2025, after which the retrieved references were exported to EndNote and duplicates were removed. One reviewer (ZM) first filtered out and excluded the records that did not relate to EQ-5D bolt-ons. Titles and abstracts of the remaining records were screened again to further filter the records according to inclusion and exclusion criteria. The second reviewer (YF) independently screened ten percent of randomly selected records to validate the results. Any disagreements were resolved by discussion between the two reviewers, with a third independent reviewer consulted if consensus could not be reached. After the abstract screening, full texts of the remaining records were assessed for eligibility by one reviewer (ZM).

Inclusion and exclusion criteria

Original research studies, including original articles, published study protocols, conference papers and published working articles or research reports were included in this review. We only included studies that used EQ-5D-3L or EQ-5D-5L with vision or hearing bolt-on(s). Specifically, we included studies that:

1. Developed vision or hearing bolt-on(s) for the EQ-5D;
2. Qualitatively or quantitatively investigated the psychometric properties of vision or hearing bolt-on(s) for the EQ-5D;
3. Used any vision or hearing bolt-on for the EQ-5D to measure HRQoL or valued health states.

Studies were excluded if they met any of the following criteria: (1) they were reviews, editorials, or conference abstracts; (2) they included solely populations < 16 years; (3) they identified hearing or vision as missing from the EQ-5D but did not develop or use a bolt-on; (4) they used other instruments' items as a vision or hearing bolt-on without adapting them to the EQ-5D format (i.e. inconsistent with the dimension title format and response levels of EQ-5D); (5) they were cost-utility analyses that used utilities based on an EQ-5D vision or hearing bolt-on but referenced utilities from other publications; and (6) the EQ-5D was not administered alongside the bolt-on or not all 5 core dimensions were used (this criterion was applied to studies that had used, tested or valued bolt-ons).

Data extraction and strategy for data synthesis

Data extraction was primarily performed by one reviewer (ZM), using a standardised extraction table, developed following the earlier reviews of bolt-on publications. The extracted data were subsequently reviewed by a second researcher experienced in bolt-on systematic reviews, and any concerns were discussed and resolved. The following data were extracted:

1. Publication details: author(s), year of publication, publication language, funding organization;
2. Study characteristics: study design, sample size, country, language;

3. Characteristics of the study population, including age and diagnosis. Patient populations were categorised using the International Classification of Diseases 11th Revision (ICD-11) [25];
4. Mode of administration: onsite (face-to-face), online, email, mail, or telephone;
5. Completion: self-completed vs interviewer-administered. Reporting method: self-report vs proxy;
6. Characteristics of the vision/hearing bolt-on;
7. Any qualitative methods used for bolt-on development;
8. Psychometric properties assessed;
9. Any valuation methods used to value health states.

The findings from the included studies for vision and hearing bolt-ons were summarised using descriptive statistics narratively. Vision and hearing bolt-ons were analysed and reported separately. Where available, psychometric properties of each bolt-on item were extracted and descriptively summarised.

Results

The PRISMA flow diagram illustrating the identification and screening process can be found in Appendix 2.

The literature search yielded 21 publications for vision bolt-ons and eight publications for hearing bolt-ons (Appendix Table 1). Among the identified publications, one developed a composite item for vision and hearing [26], four publications included both vision and hearing bolt-ons [23, 27-29], and two vision publications had data collected in the same study [30, 31].

Overall characteristics of included publications

The sample sizes of the included publications ranged from 11 to 14597 in vision bolt-on publications, and from 43 to 1587 in hearing bolt-on publications. Over 60% of the vision publications and the hearing publications included 400 or more respondents (Table 1). The majority of studies (61.9% for vision and 75% for hearing) used a 5L bolt-on. All but one vision [32] and one hearing [33] publications developed or used only a single bolt-on item. Additionally, nine vision publications and six hearing publications used other non-sensory bolt-ons in their studies, with sleep, tiredness/energy and social relationships being the most common.

A total of 14 vision publications [6, 23, 26-29, 34-41] and seven hearing publications [23, 26-29, 42, 43] assessed at least one psychometric property. Four vision publications (no hearing publications) had the main aim of using bolt-ons to measure HRQoL [41, 44-46], while five vision [6, 23, 30, 31, 47] and two hearing publications [23, 42] valued EQ-5D plus bolt-on health states (multiple aims within the same study are possible).

Overall, 52% of the vision publications administered EQ-5D and bolt-ons in a patient population. A proportion of 43% of the vision publications and all hearing publications investigated the adult general population, while one hearing publication included a subsample with hearing loss [43] (Table 1). The vision publications conducted in patient populations included different health conditions. The most common ICD-11 group was “Visual system” (38%). The most prevalent diagnoses were cataract (19%), macular oedema (10%) and age-related macular degeneration (10%).

The most common study design was cross-sectional (57% for vision and 88% for hearing publications). For vision publications, longitudinal cohorts (19%) and randomised controlled trials (19%) were also applied. One vision publication [32] and one hearing publication [33]

had a qualitative research design. The primary modes of administration were face-to-face (43% for vision; 50% for hearing) and online (19% for vision; 38% for hearing). Nearly all vision and hearing publications used self-reporting, with the only exception being one which focused on valuation and did not assess participants' self-reported health [47].

In the five vision publications that valued health states, two applied time-trade-off (TTO) [6, 23], two used composite time trade-off (cTTO) [30, 31], while one conducted standard gamble [47]. In the two publications that assessed the impact of a hearing bolt-on on health state values, one performed TTO [23] and the other used discrete choice experiment [42]. Among these, one publication developed a full EQ-5D-5L+vision value set [6], which was subsequently applied in five publications [34, 36, 37, 44, 45].

Development of vision and hearing bolt-ons

Six vision publications and six hearing publications proposed new bolt-on wordings and of these (Appendix Table 2), three vision publications and three hearing studies employed qualitative techniques in the development of the bolt-on items. Two vision publications used focus groups (one with the general population [28], the other with patients and carers [32]), while one performed "expert discussions" as well as interviews with patients, caregivers and representatives of relevant patient associations [38]. Similarly, all three hearing studies used focus groups [28, 33, 42], while one supplemented these with semi-structured interviews [33].

Across the vision bolt-ons, one wording was developed for the three-level version (3L) and nine for the five-level version (5L), with six of the 5L versions benefiting from qualitative input and four of these originated from the same publication [32] (Appendix Table 2). The 3L and two of the 5L wordings referenced the use of vision aids in the dimension title (e.g., using glasses or contact lenses if needed). One 5L wording included examples of vision

problems (e.g., near vision, depth perception, seeing colours). Four wordings used only "Vision" as the dimension title, one used "Visual acuity", and another used "Vision-related activities". The most common response level formats followed a problem-framing structure, which was used in the 3L wording and five of the 5L wordings, while two 5L wordings used difficulty-based response levels and two used frequency-based response levels.

For the hearing bolt-ons, one wording was developed for the 3L and twenty for the 5L, with seventeen of the 5L versions informed by qualitative methods and 13 of these originated from a single qualitative development study (Appendix Table 2). The 3L wording and three of the 5L versions referenced the use of hearing aids in the dimension title (using equipment if needed, e.g. hearing aids). Two 5L wordings included examples of hearing issues (e.g., sound clarity, localisation, and effort), six described specific surroundings or situations (e.g., in your current environment or in social situations), and nine used only 'Hearing' as the dimension title. The 3L and thirteen 5L hearing bolt-on wordings employed a problem-framing approach for the response levels, while seven used a difficulty scale.

In addition, a composite vision-and-hearing bolt-on was developed based on a review of existing health-utility instruments and general health status questionnaires without qualitative input (Appendix Table 2).

The psychometric performance of vision and hearing bolt-ons

Ceiling and floor

Adding vision and hearing bolt-ons reduced the ceiling (Table 2), as demonstrated in both patient populations and adult general populations. Specifically, three publications using 3L vision bolt-on and six using 5L vision bolt-ons reported reduced ceiling: for 3L, a reduction of 11.6% in a general population sample and reductions ranging from 11.1% to 38.1% in

patient populations were observed; for 5L, reductions ranged from 5% to 19.8% in the general populations and reductions ranged from 4.3% to 31.7% in patient populations. Three publications using 5L hearing bolt-ons (reductions of 1.65%-18.8%) and one publication using a composite vision-and-hearing bolt-on (reduction of 4.7% in a general population sample) also observed decreased ceiling. No evidence on ceiling was reported for the 3L hearing bolt-on.

The distribution of responses for 3L and 5L vision and hearing bolt-ons is shown in Appendix Table 3.

Informativity

Two vision publications and one hearing publication assessed absolute and relative informativity (Table 2). In general, Shannon's H' and Shannon's J' were always higher in the EQ-5D plus bolt-ons than in EQ-5D-3L or EQ-5D-5L alone.

Divergent and convergent validity

Table 3 presents the divergent and convergent validity of 3L and 5L vision and hearing bolt-ons. Correlations between bolt-ons and EQ-5D dimensions were assessed for divergent validity. One publication identified a very weak to weak correlation between a 3L vision bolt-on and the five core dimensions, ranging between 0.19 (with MO) and 0.26 (with PD) [40]. Four publications showed very weak to weak correlations (<0.4) between 5L vision bolt-ons and the core dimensions [29, 38-40], with one exception where a moderate correlation was observed between vision and UA (0.43) [39]. Similarly, two studies on 5L hearing bolt-ons found weak correlations with the core dimensions [29, 43]. A significant, negative, weak correlation between EQ VAS and bolt-ons was found in two vision bolt-on publications [29, 38] and one hearing bolt-on publication [29].

Two vision 3L publications [34, 40], three vision 5L publications [38-40] and one hearing 5L publication [43] assessed convergent validity. One publication conducted index value-based analysis and found moderate correlations between EQ-5D-3L+vision and ICECAP-O score (0.5) as well as Cat-PROM5 (-0.42), but the correlation between EQ-5D-3L+vision index value and visual acuity was very weak (-0.1) [34]. Both 3L and 5L vision bolt-ons were found to be moderately correlated with the vision item from HUI-3 in the adult general population in one publication [40]. Another publication found that a 5L vision bolt-on was moderately associated with the HUI-3 vision item as well as MG-Activities of Daily Living items in myasthenia gravis patients [39]. One publication found a 5L vision bolt-on to be weakly associated with SF-12 physical composite scores, SF-12 mental composite scores, and Medical Outcome Study Social Support Survey scores [38]. One publication presented a weak association (0.322 and 0.325) between a 5L hearing bolt-on and hearing thresholds [43], but this was stronger than the associations observed for the other EQ-5D items (ranging between 0.008–0.139). External measures evaluated for convergence with vision and hearing bolt-on items and their relations are summarised in Appendix Table 4.

Known-group validity

The known-group validity of vision bolt-ons and hearing bolt-ons was assessed in multiple known groups, in seven vision publications [29, 34, 35, 37-40] and two hearing publications [29, 43] (Table 4). Significant known-group differences were observed for EQ-5D-3L+vision when comparing patients by visual acuity [34], severity of visual impairment [37] and presence of visual functioning problems [37] and for EQ-5D-5L+vision [29]. EQ-5D-5L+vision was also able to discriminate between different age groups, the presence of eye disorders, and overall health subgroups [29]. In addition, 3L vision bolt-ons were found to be significantly associated with visual acuity and age-related macular degeneration diagnosis, as

demonstrated by regression analysis [35]. On the other hand, no significant known-group differences were reported for either EQ-5D-3L or EQ-5D-5L+vision when comparing individuals by number of chronic conditions or by caregiver support needs, in a general population sample [40]. Similarly, in one publication [34], EQ-5D-3L+vision did not distinguish between individuals with and without cataract surgery, or between those with and without ocular comorbidities.

EQ-5D-5L+hearing demonstrated significant known-group differences when comparing individuals with and without hearing problems [29], those with non-disabling hearing loss in both ears versus at least one disabling ear [43], and by better-ear performance [43].

Responsiveness

Two publications assessed responsiveness (Table 5). One publication evaluated change after cataract surgery and found that the EQ-5D+vision was more responsive than the standard EQ-5D in detecting statistically significant changes over time, for both the 3L and 5L versions [36]. Similarly, another study applied the Pareto classification of health change in an adult general population and reported improved responsiveness with both 3L and 5L EQ-5D plus bolt-ons [40]. Responsiveness was not assessed in hearing publications, due to the cross-sectional nature of studies.

Other psychometric properties

One publication examined the structural validity of the EQ-5D-5L plus both vision and hearing bolt-ons (Appendix Table 5), using principal component analysis and confirmatory factor analysis with external measures including PROMIS-29+2, SF-6D, PROMIS Global Health, and Satisfaction with Life Scale [29]. Both bolt-ons loaded onto a single factor

labelled “other physical symptoms”, whereas none of the EQ-5D-5L dimensions loaded on this factor.

Two 5L vision bolt-on publications examined the explained variance of EQ VAS using EQ-5D+vision (Appendix Table 6) [29, 38]. Both showed that including a vision bolt-on item improved explanatory power, although the increase in adjusted R-squared was minimal (0.033 and 0.001).

A summary of evidence on psychometric properties is presented in Table 6. Test-retest reliability and patient-proxy agreement were not assessed in any of the included publications.

Discussion

This systematic review summarised available evidence from studies that developed, used or tested the psychometric performance of vision and hearing bolt-ons for the EQ-5D.

Although some studies incorporated qualitative input when identifying and developing bolt-ons [28, 38, 42], most did not. Instead, they relied on reviews of existing HRQoL instruments or adopted previously developed bolt-ons [23]. Furthermore, the vision and hearing bolt-on items developed by Yang et al. [23], which were created originally for 3L and subsequently adapted for the 5L, were the most commonly applied bolt-on items, for both 3L [34-37, 40, 47] and 5L [29, 36, 39, 40, 44, 45] studies. This shows that the current evidence base is influenced by a limited number of studies and highlights the need for broader and more diverse research efforts, including the involvement of patients in the development phases.

In general, the evidence base is more developed for vision bolt-ons than for hearing bolt-ons, and psychometric evaluations have been reported more frequently for 5L versions than for 3L versions. Where data were available, the bolt-ons show potential to improve sensitivity, with reduced ceiling and enhanced absolute and relative informativity. They also showed

satisfactory divergent validity with the core EQ-5D dimensions and better convergent validity with relevant external measures, compared to the standard EQ-5D. Known-group validity was established for several relevant groups, including visual acuity, severity of visual impairment, presence of visual functioning problems and hearing problems. Where assessed, vision bolt-ons also appeared to strengthen the responsiveness, improve explanatory power for EQ VAS scores and support structural validity. However, some findings remain mixed. For example, one study reported a weak association between EQ-5D-3L+vision index value and visual acuity [34], which may reflect differences between patient-reported impact and clinical measurements. Evidence also remained limited for both vision and hearing bolt-ons regarding test-retest reliability or patient-proxy agreement.

Although the psychometric properties were generally favourable, the evidence base remains limited and heterogeneous in terms of wording, language versions and study populations. The heterogeneity in bolt-on wording shows the ongoing exploration in developing and applying bolt-ons in different contexts. Standardisation is desirable, given that the variability in wording limits the comparability. A standardised bolt-on could also support health technology assessment with a consistent measurement tool. The current evidence, however, does not support recommending any single bolt-on wording for vision or hearing as a preferred option. Further research on vision and hearing bolt-ons should include mixed-methods research aimed at developing and testing various items [32, 33]. Quantitative studies are also needed to compare alternative bolt-on items. Future research should aim to identify the most appropriate dimension titles and phrasing, assessing whether illustrative examples should be included in parentheses, and evaluating whether response options should capture severity, difficulty, or frequency. These priorities are consistent with the current EuroQol research agenda, which includes the development and validation of the experimental EQ-5D Bolt-on Toolbox.

Meanwhile, evidence on the valuation of vision and hearing bolt-ons remains limited and methods are diverse. As bolt-ons are intended for use in valuation and QALY estimation, EuroQol is currently working on methodological approaches for deriving EQ-5D-5L+bolt-on value sets and establishing a valuation protocol. Methodologically, key challenges remain, including selecting appropriate and feasible approaches, addressing comparability between bolt-on and core EQ-5D value sets, and the complexity associated with valuing multiple bolt-ons.

One study explored applying a single composite item for vision and hearing [26]. Composite items raise significant conceptual and empirical challenges [48, 49], and our review did not identify sufficient evidence to either support or reject their use in the context of sensory function.

This systematic review has some limitations. First, the second reviewer screened a random 10% sample of records rather than the entire set. The inter-rater agreement for this sample was high (exceeding 90%), and discrepancies were mainly because of a more inclusive approach taken by the main reviewer to retain potentially relevant records for full-text review. Second, fully independent data extraction was not undertaken, which may increase the risk of extraction errors. Furthermore, we did not formally assess the methodological quality of the included studies. Many studies had broader or different primary aims, with psychometric findings reported as secondary outcomes. While these results are highly informative, applying a formal appraisal framework could risk downscoring studies and limiting the interpretability of the overall evidence base. In addition, the included studies were highly heterogenous, covering different stages of bolt-on research (identification, development, evaluation and application), with different versions (3L vs 5L) and among various populations (general populations and patient groups with sensory disorders). We

therefore focused on narrative synthesis and did not conduct meta-analysis or quantitative evidence synthesis that would more typically require formal methodological quality appraisal. Appraisal frameworks such as COSMIN risk of bias checklist were considered but were found to be less applicable to bolt-on studies. Developing a new appraisal framework would itself require methodological justification and validation, which was beyond the scope of the present review. However, the absence of formal quality assessment limits the ability to differentiate between more and less robust evidence and should be considered when interpreting the findings. Additionally, our English-language search strategy and restricting to three databases may have led to the omission of some relevant studies. Also, unpublished data, conference abstracts, and grey literature were not systematically searched, which may introduce publication bias, although we reviewed EuroQol conference proceedings as a key source and conducted forward and backward reference searches to identify additional relevant studies. Furthermore, some bolt-ons were developed in non-English languages and later translated for publication, which may introduce some uncertainty around their exact wording. Finally, many included studies were conducted with involvement of the EuroQol Group, which may increase the risk of positive-results orientation or publication bias.

Conclusion

In most cases, bolt-ons enhanced the measurement properties of the EQ-5D across both patient and general population samples. However, evidence remained limited for some properties, including content validity, test-retest reliability, and patient-proxy agreement. Future research should incorporate both qualitative and quantitative approaches across diverse populations, languages and contexts to identify the most effective and optimal bolt-ons for HRQoL measurement.

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Table 1. Characteristics summary of the included publications*

Characteristic	Vision Publications (n= 21)		Hearing Publications (n= 8)	
Publication type				
Journal article	18	85.7%	6	75.0%
EuroQol conference paper	2	9.5%	1	12.5%
Other research reports	1	4.8%	1	12.5%
Country				
UK	9	42.9%	2	25.0%
China	3	14.3%	0	0
Singapore	2	9.5%	1	12.5%
Hungary	1	4.8%	1	12.5%
Malaysia	1	4.8%	1	12.5%
South Korea	1	4.8%	1	12.5%
Switzerland	1	4.8%	1	12.5%
Multi-country[a]	3	14.3%	1	12.5%
Language of instrument[b]				
English	15	71.4%	5	37.5%
Simplified Chinese	5	23.8%	1	12.5%
French	4	19.0%	1	12.5%
Dutch	3	14.3%	0	0
German	3	14.3%	0	0
Italian	3	14.3%	0	0
Spanish	3	14.3%	0	0
Danish	2	9.5%	0	0
Hungarian	2	9.5%	1	12.5%
Study design				
Cross-sectional	12	57.1%	7	87.5%
Longitudinal cohort	4	19.1%	0	0
Randomised controlled trial	4	19.1%	0	0
Qualitative (focus group and/or interviews)	1	4.8%	1	12.5%
Sample size				
<49	1	4.8%	1	12.5%
50-99	2	9.5%	0	0
100-199	2	9.5%	1	12.5%
200-299	1	4.8%	0	0
300-399	2	9.5%	2	12.5%
400-499	2	9.5%	1	25.0%
500-999	7	33.3%	1	12.5%
1000 and above	4	19.1%	2	25.0%
Study population[c]				
Patients	11	52.4%	0	0
General population (18+)	9	42.9%	8	100%
Students	2	9.5%	0	0
Carers	1	4.8%	0	0
Patient population (ICD-11 categorization)[d]				
09 Diseases of the visual system	8	38.1%	0	0
08 Diseases of the nervous system	1	4.8%	0	0
10 Diseases of the ear or mastoid process	0	0	1	12.5%
14 Diseases of the skin	1	4.8%	0	0
20 Developmental anomalies	1	4.8%	0	0
Not applicable	11	52.4%	7	87.5%
Most common diagnoses[e]				
Cataract	4	19.1%	0	0
Age-related macular degeneration	2	9.5%	0	0
Macular oedema	2	9.5%	0	0
Albinism	1	4.8%	0	0
Diabetic retinopathy	1	4.8%	0	0
Glaucoma	1	4.8%	0	0
Marfan syndrome	1	4.8%	0	0
Myasthenia gravis	1	4.8%	0	0
Submacular haemorrhage	1	4.8%	0	0
Hearing loss	0	0	1	12.5%
Not applicable	11	52.4%	7	87.5%
Response levels of the EQ-5D+vision bolt-on				
EQ-5D-5L + five-level bolt-on	11	52.4%	6	75.0%
EQ-5D-3L + three-level bolt-on	8	38.1%	2	25.0%
Both EQ-5D-5L + five-level bolt-on and EQ-5D-3L + three-level bolt-on	2	9.5%	0	0
Number of bolt-ons used/developed[f]				
1	20	95.2%	7	87.5%

Characteristic	Vision Publications (n= 21)		Hearing Publications (n= 8)	
	n	%	n	%
4	1	4.8%	0	0
13				
Administration				
Face to face	9	42.9%	4	50%
Online	4	19.0%	3	37.5%
Mail/postal	2	9.5%	1	12.5%
Telephone	1	4.8%	0	0
Not known	4	19.1%	0	0
Not applicable (valuation study and not reporting their own health)	1	4.8%	0	0
Self/proxy reporting				
Self-report	20	95.2%	8	100%
Not applicable (valuation study and not reporting their own health)	1	4.8%	0	0

Note:

*One publication developed a composite item for vision and hearing (Perneger 2011). Four publications included both vision and hearing bolt-ons (Yang et al. 2015, Kim et al. 2017; Thakumar et al. 2017.; Rencz and Janssen 2024). Two vision publications were with data collected in the same study (Yang 2023, Yang 2024).

[a]One publication collected data in Austria, Belgium, Bulgaria, Denmark, France, Germany, Hungary, Ireland, Italy, Luxemburg, the Netherlands, Poland, Portugal, Slovenia, Spain, Switzerland and the UK (Jackson 2022); one collected in Belgium, Canada, Denmark, France, Germany, Italy, Japan, Spain, the UK and the US (Dewilde 2024); one collected in the Belgium, Canada, Germany, Italy, the Netherlands, Spain (Dewilde 2025).

[b]A study may use more than one instrument language. Languages with one study each: Austrian, Bulgarian, Irish, Japanese, Korean, Malay, Polish, Portuguese, Slovenian. A hearing publication also used Korean.

[c]One vision publication (Luo 2015) recruited both general population and patients.

[d]One publication recruited patients with both Developmental anomalies and Skin diseases (Xu 2025).

[e]One publication recruited patients on multiple diseases, including cataract, glaucoma, diabetic retinopathy, or age-related macular degeneration (Luo 2015); one study recruited patients on multiple diseases, including albinism and Marfan syndrome (Xu 2025).

[f]A qualitative paper developed 13 vision bolt-on alternatives (Sampson 2022); a qualitative paper developed 4 hearing bolt-on alternatives (Hodgson 2025).

Table 2. Ceiling, floor and informativity of the EQ-5D-3L(+bolt-on) and E

Bolt-on	Version	Wording code	Publication	Study population*	Sample size	Reporting	Ceiling		Floor		Absolute informativity (H')		Relative informativity (J')	
							EQ-5D	EQ-5D+vision	EQ-5D	EQ-5D+vision	EQ-5D	EQ-5D+vision	EQ-5D	EQ-5D+vision
Vision	3L	A-3L-VI-01	Breheny et al. 2020	cataract surgery patients 50+	300	Self-report	27.13%	8.72%	-	0%	-	-	-	-
Vision	3L	A-3L-VI-01	Gandhi et al. 2020	cataract surgery patients (71% were 60+)	63	Self-report	Pre-operative: 47.6% Post-operative: 61.9%	Pre-operative: 9.5% Post-operative: 50.8%	-	-	-	-	-	-
Vision	3L	A-3L-VI-01	Dewilde et al. 2025	adult general population 18+	14597	Self-report	45.4%	33.8%	0.13%	0.11%	3.24	4.22	0.41	0.44
Vision	5L	A-5L-VI-01	Kim et al. 2017	adult general population 18+	600	Self-report	60.83%	55.83%	-	-	-	-	-	-
Vision	5L	A-5L-VI-02	Gandhi et al. 2020	cataract surgery patients	63	Self-report	Pre-operative: 49.2% Post-operative: 66.7%	Pre-operative: 17.5% Post-operative: 52.4%	-	-	-	-	-	-
Vision	5L	A-5L-VI-02	Rencz and Janssen 2024	adult general population 18+	1587	Self-report	Whole sample: 40.5%	Whole sample: 20.7%	-	-	-	-	-	-
Vision	5L	A-5L-VI-02	Rencz and Janssen 2024	adult patients with eye or visual disorders 18+	267	Self-report	19.9%	1.5%	-	-	-	-	-	-
Vision	5L	A-5L-VI-02	Dewilde et al. 2025	adult general population 18+	14597	Self-report	32.3%	19.7%	0.06%	0.05%	4.89	6.51	0.42	0.47
Vision	5L	A-5L-VI-02	Dewilde et al. 2024	myasthenia gravis patients 18+	1510	Self-report	14.1%	9.8%	-	-	1.77	1.79	0.76	0.77
Vision	5L	A-5L-VI-03	Xu et al 2025	Albinism and Marfan syndrome patients 15+	976	Self-report	ALB: 18.8% MFS: 10.6%	ALB: 4.3% MFS: 5.1%	-	-	-	-	-	-
							EQ-5D	**EQ-5D+hearing**	**EQ-5D**	**EQ-5D+hearing**	**EQ-5D**	**EQ-5D+hearing**	**EQ-5D**	**EQ-5D+hearing**
Hearing	5L	A-5L-HE-01	Kim et al. 2017	adult general population 18+	600	Self-report	60.83%	59.17%	-	-	-	-	-	-
Hearing	5L	A-5L-HE-02	Wang et al. 2022	Community-dwelling adults receiving hearing evaluation	418	Self-report	Whole sample: 70.41% Both ear disabling: 70.3% At least one disabling: 70.5%	Whole sample: 57.76% Both ear disabling: 63.7% At least one disabling: 51.7%	-	-	2.81	3.14	0.61	0.64
Hearing	5L	A-5L-HE-03	Rencz and Janssen 2024	adult general population 18+	1587	Self-report	Whole sample: 40.5%	Whole sample: 34.7%	-	-	-	-	-	-
Hearing	5L	A-5L-HE-03	Rencz and Janssen 2024	adult patients with hearing problems 18+	93	Self-report	17.2%	1.1%	-	-	-	-	-	-
							EQ-5D	**EQ-5D+V/H**	**EQ-5D**	**EQ-5D+V/H**	**EQ-5D**	**EQ-5D+V/H**	**EQ-5D**	**EQ-5D+V/H**
Composite	3L	A-3L-VH-01*	Perneger et al. 2011	adult general population 18+	349	Self-report	40.2%	35.5%	-	-	-	-	-	-

*This is a composite item: seeing and hearing.

Table 3 Convergent and divergent validity of EQ-5D-3L and EQ-5D-5L vi

Version	Wording code	Publication	Study population	EQ-5D Reporting	Comparator	Type of correlation	Dimension-level analysis	Level sum score (LSS) or index value-based analysis
Correlations with EQ-5D dimensions								
3L	A-3L-VI-01	Dewilde et al 2025	adult general population 18+	Self-report	EQ-5D	Spearman's	Correlations between vision bolt-on and EQ-5D dimensions (p= NR): 3L: MO 0.190 SC 0.198 UA 0.213 PD 0.257 AD 0.243	
5L	A-5L-VI-02	Dewilde et al 2025	adult general population 18+	Self-report	EQ-5D	Spearman's	Correlations between vision bolt-on and EQ-5D dimensions (p= NR): 5L: MO 0.229 SC 0.203 UA 0.232 PD 0.298 AD 0.259	-
5L	A-5L-VI-02	Dewilde et al 2024	myasthenia gravis patients 18+	Self-report	EQ-5D	Not specified	Correlations between vision bolt-on and EQ-5D dimensions (p= NR): MO 0.35 SC 0.34 UA 0.43 PD 0.36 AD 0.30	-
5L	A-5L-VI-03	Xu et al 2025	albinism and Marfan syndrome patients 15+	Self-report	EQ-5D	Spearman's	Correlations between vision bolt-on and EQ-5D dimensions (p<0.05 for all) ALB+MFS: 0.34 ,0.18, 0.36, 0.17, 0.21 (p<0.05 for all) ALB: 0.36, 0.20, 0.28, 0.31, 0.29 (p<0.05 for all) MFS: 0.36, 0.20, 0.37, 0.24, 0.23 (p<0.05 for all)	-
5L	A-5L-VI-02	Rencz and Janssen 2024	adult general population 18+	Self-report	EQ-5D	Spearman's	MO:0.27; SC: 0.20; UA: 0.26; PD: 0.22; AD: 0.21 (p<0.01 for all):	-
5L	A-5L-HE-02	Wang et al. 2022	community-dwelling adults receiving hearing evaluation	Self-report	EQ-5D	Spearman's	MO: 0.16 (p<0.01), SC: 0.082, UA: 0.102 (p<0.05), PD: 0.079, AD: 0.055 (p>0.05 for SC, PD and AD)	-
5L	A-5L-HE-03	Rencz and Janssen 2024	the adult general population 18+	Self-report	EQ-5D	Spearman's	MO:0.26; SC: 0.25; UA: 0.22; PD: 0.19; AD: 0.09 (p<0.01 for all)	-
Correlations with EQ VAS								
5L	A-5L-VI-02	Rencz and Janssen 2024	adult general population 18+	Self-report	EQ-5D	Spearman's	Vision bolt-on: -0.27 (p<0.01)	-
5L	A-5L-VI-03	Xu et al 2025	albinism and Marfan syndrome patients 15+	Self-report	EQ-5D	Spearman's	Vision bolt-on (p<0.001): ALB+MFS: -0.21 ALB: -0.31 MFS: -0.24	-
5L	A-5L-HE-03	Rencz and Janssen 2024	adult general population 18+	Self-report	EQ-5D	Spearman's	Hearing bolt-on: -0.21 (p<0.01)	-
Correlations with external measures								
3L	A-3L-VI-01	Breheny et al. 2020	cataract surgery patients 50+	Self-report	ICECAP-O, Cat-PROM5, Visual acuity (measured using a LogMAR chart)	Spearman's		Correlations between EQ-5D+vision bolt-on index value and ICECAP-O score: 0.50 (p<0.01); Correlations between EQ-5D+vision bolt-on index value and Cat-PROM5: −0.42 (p<0.01); Correlations between EQ-5D+vision bolt-on index value and Visual acuity: −0.10 (p>0.05)
3L	A-3L-VI-01	Dewilde et al 2025	adult general population 18+	Self-report	HUI-3	Spearman's	Correlation with the vision item from the HUI-3: 0.37 (p=NR)	
5L	A-5L-VI-02	Dewilde et al 2025	adult general population 18+	Self-report	HUI-3	Spearman's	Correlation with the vision item from the HUI-3: 0.37 (p=NR)	
5L	A-5L-VI-02	Dewilde et al 2024	myasthenia gravis patients18+	Self-report	HUI-3, MG-ADL, MG-QOL	Spearman's	Correlations with the vision item from HUI-3: 0.47 Double vision (MGADL6): 0.61 Eyelid droop (MGADL7): 0.41 I have trouble with my eyes (double vision) (MGQOL2): 0.56	
5L	A-5L-VI-03	Xu et al 2025	albinism and Marfan syndrome patients 15+	Self-report	SF-12, MOS-SSS	Spearman's	Correlations with SF-12 PCS: ALB+MFS: -0.24 (p<0.001) ALB: -0.41 (p<0.001) MFS: -0.26 (p<0.001) Correlation with SF-12 MCS ALB+MFS: -0.24 (p<0.001) ALB: -0.41(p<0.001) MFS: -0.32 (p<0.001) Correlation with MOS-SSS ALB+MFS: -0.11 (p<0.001) ALB: -0.14 (p>0.05) MFS: -0.10 (p<0.01)	
5L	A-5L-HE-02	Wang et al. 2022	community-dwelling adults receiving hearing evaluation	Self-report	Decibel hearing level	Spearman's	Correlations with hearing thresholds of better ear 0.322 (p<0.01); Correlations with hearing thresholds of worse ear: 0.325 (p<0.01)	

Abbr. NR= not reported; p= p-value. MO= Mobility; SC= Self-care; UA= Usual activities; PD= Pain/discomfort; AD= Anxiety/depression. ALB= Albinism; MFS= Marfan syndrome; PCS=Physical Composite Score; MCS=Mental Composite Score; MOS-SSS=Medical Outcome Study Social Support Survey; MG-ADL=MG-Activities of Daily Living; MG-QoL=MG-Quality of Life.

Table 4 Known-group validity of EQ-5D-3L and EQ-5D-5L bolt-ons

Known-groups	Vision bolt-on			EQ-5D+vision bolt-on			Where statistically significant, more problems were reported by
	3L	5L	Total	3L	5L	Total	
Disease/condition, or multimorbidity	*2+*	*0*	*2+*	*18+/3-*	*12+/1-*	*33*	
Visual acuity (good vs poor)				1+			Poor visual acuity
With ocular comorbidities vs without				1-			
Visual impairment severity (no vs mild vs moderate vs severe)				4+			More severe group
Visual acuity in the better eye (BEVA)	1+	0	*1*				Poor visual acuity
Age-related macular degeneration (AMD) classification	1+	0	*1*				Not specified
With eye disorder vs healthy				1-	1+		With eye or visual disorders
Visual functioning problems*				12+			With visual functioning problems
Number of chronic diseases				1-	1-		
With diabetes vs healthy				1+			With diabetes
Whether had specific symptoms**					11+		With symptoms
Caregiving				*0+/1-*	*0+/1-*	*2*	
Whether needing help from a caregiver				1-	1-		
Overall health				*0+/0-*	*3+/0-*	*3*	
PROMIS health (poor, fair, good, very good, excellent)					1+		Poor health
PROMIS quality of life (poor, fair, good, very good, excellent)					1+		Poor quality of life
PROMIS physical health (poor, fair, good, very good, excellent)					1+		Poor physical health
Socioeconomic characteristics				*1+/0-*	*0+/0-*	*1*	
Age				1+			Older age group
Treatment/intervention				*0+/1-*	*0+/0-*	*1*	
Whether had cataract surgery				1-			
TOTAL	*2+/0-*	*0+/0-*	*2*	*19+/4-*	*15+/2-*	*40*	

Known-groups*	Hearing bolt-on			EQ-5D+hearing bolt-on			Where statistically significant, more problems were reported by
	3L	5L	Total	3L	5L	Total	
Disease/condition, or multimorbidity	*0*	*0*	*0*	*0+/0-*	*3+/0-*	*3*	
With hearing problems vs healthy					1+		With hearing problems
Ear disability (both ears not disabling and at least one ear disabling)					1+		At least one ear disabling
Better ear performance (normal, mild vs moderate or severe)					1+		Moderate or severe
TOTAL	*0+/0-*	*0+/0-*	0	*0+/0-*	*3+/0-*	3	

Note. '+' indicates statistically significant outcomes ($p<0.05$, $p<0.01$ or $p<0.001$), whereas '-' indicates insignificant outcomes.

* Luo et al (2015) defined 12 pairs of known groups using self-reported vision problems. These vision problems included reading small print, reading newspapers, reading large print, recognizing people, seeing steps, reading traffic signs, doing handwork, filling forms, playing games, taking part in sports, cooking, and watching TV.

** Xu et al (2025) defined specific symptoms including immunocompromised, exostosis and joint laxity, pectus carinatum or funnel chest, scoliosis, pneumothorax, ectopia lentis, heart valve problem, flat feet, high-arched palate, spondylolisthesis, wrist (walker–murdoch) and thumb (steinberg) signs.

Table 5. Responsiveness of EQ-5D-3L and EQ-5D-5L vision bolt-ons

Version	Wording code	Publication	Study population	Reporting	Level of analysis	Analysis methods	Anchor	Findings
Responsiveness								
3L	A-3L-VI-01	Gandhi et al 2020	cataract surgery patients	Self-report	Descriptive system+bolt-on (LSS and index value)	percentage of patients who reported improvement by at least one response level of the item + standardised response mean (SRM) + F-statistic	N/A	the majority of the patients have reported improvement in the 3L vision bolt-on item (51%); EQ-5D-3L + bolt-on vs EQ-5D-3L index values: SRM: 0.46 vs 0.10; F statistics: 13.2 vs 0.6 EQ-5D-3L + bolt-on vs EQ-5D-3L LSS: SRM: 0.72 vs 0.20; F statistics: 32.9 vs 2.4
5L	A-5L-VI-02	Gandhi et al 2020	cataract surgery patients	Self-report	Descriptive system+bolt-on (LSS)	percentage of patients who reported improvement by at least one response level of the item + standardised response mean (SRM) + F-statistic	N/A	the majority of the patients have reported improvement in the 3L vision bolt-on item (56%) EQ-5D-5L + bolt-on vs EQ-5D-5L LSS: SRM: 0.71 vs 0.30; F statistics: 31.7 vs 5.5
3L	A-3L-VI-01	Dewilde et al 2025	adult general population 18+	Self-report	Descriptive system+bolt-on (LSS)	Changes in rescaled LSS; Paretian classification of health change	N/A	Mean change in rescaled LSS (rescaled between 0-100) EQ-5D-3L+bolt-on: 0.10; - EQ-5D-3L: improved 22%, mixed 5%, no change 49%, worsened 23%; - EQ-5D-3L+bolt-on: improved 26%, mixed 10%, no change 38%, worsened 26%
5L	A-5L-VI-02	Dewilde et al 2025	adult general population 18+	Self-report	Descriptive system+bolt-on (LSS)	Changes in rescaled LSS; Paretian classification of health change	N/A	Mean change in rescaled LSS (rescaled between 0-100) 5L+bolt-on: 0.04 - EQ-5D-5L: improved 26%, mixed 12%, no change 35%, worsen 27%; - EQ-5D-5L+bolt-on: improved 28%, mixed 21%, no change 24%, worsened 27%

Responsiveness was not assessed in the included studies for hearing bolt-ons

Abbr. LSS= level summary score

Table 6. Psychometrics evidence summary in publications

Wording	Dimension title	Examples mentioned in dimension title or response levels	Qualitative input	Ceiling (bolt-on item)	Ceiling (EQ-5D+bolt-on item)	Absolute informativity	Relative informativity	Divergent validity (bolt-on item)	Convergent validity (bolt-on item)	Known-groups validity (bolt-on item)	Known-groups validity (EQ-5D+bolt-on item)	Structural validity (bolt-on item)	Associations with EQ VAS	Responsiveness (bolt-on item)	Responsiveness (EQ-5D+bolt-on item)	Test-retest reliability	Patient-proxy agreement
Vision Three-level version																	
A-3L-VI-01	Vision (using glasses or contact lenses if needed)	Seeing		[a-g]	[d, g, h]	[g]	[g]	[g]	[g, h]	[c]	[e, g, h]				[d, g]		
3L TOTAL			**0**	**7**	**3**	**1**	**1**	**1**	**2**	**1**	**3**	**0**	**0**	**0**	**2**	0	0
Vision Five-level version																	
A-5L-VI-01	Vision	Reading, seeing		[i]	[i]												
A-5L-VI-02	Vision (using glasses or contact lenses if needed):	Seeing		[d, g, j, k]	[d, g, j, k]	[g, j]	[g, j]	[g, j, k]	[g, j]		[g, k]	[k]	[k]		[d, g]		
A-5L-VI-03	Visual acuity	Vision while reading	[l]	[l]	[l]			[l]	[l]		[l]		[l]				
A-5L-VI-04	Vision	Seeing	[m]	[m]													
5L TOTAL			**2**	**7**	**6**	**2**	**2**	**4**	**3**	**0**	**3**	**1**	**2**	**0**	**2**	0	0
Hearing Three-level version																	
A-3L-HE-01	Hearing (using equipment if needed, e.g. hearing aids)	Hearing		[b]													
3L TOTAL			**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0	0
Hearing Five-level version																	
A-5L-HE-01	Hearing	Hearing in usual conversation		[i]	[i]												
A-5L-HE-02	Hearing	Hearing		[n]	[n]	[n]	[n]	[n]	[n]		[n]						
A-5L-HE-03	Hearing (using equipment if needed, e.g. hearing aids)	Hearing		[k]	[k]			[k]			[k]	[k]	[k]				
A-5L-HE-04	Hearing	Hearing	[m]	[m]													
A-5L-HE-05	Hearing	Hearing	[o]	[o]													
5L TOTAL			**2**	**5**	**3**	**1**	**1**	**2**	**1**	**0**	**1**	**1**	**1**	**0**	**0**	0	0

Vision and hearing (composite) Three-level versions:																			
A-3L-VH-01	Seeing and hearing (with glasses, contact lenses or hearing aid if you have them)	Seeing or hearing			[p]		[p]												
Composite TOTAL			**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0	0		

a) Longworth, L., et al., *Use of generic and condition-specific measures of health-related quality of life in NICE decision-making: a systematic review, statistical modelling and survey.* Health Technology Assessment, 2014.
b) Yang, Y., et al., *An exploratory study to test the impact on three "bolt-on" items to the EQ-5D.* Value in Health, 2015. **18**(1): p. 52-60.
c) De Sousa Peixoto, R., et al., *Predicting quality of life in AMD patients—insights on the new NICE classification and on a bolt-on vision dimension for the EQ-5D.* Eye, 2021. **35**(12): p. 3333-3341.
d) Gandhi, M., et al., *A vision 'bolt-on'increases the responsiveness of EQ-5D: preliminary evidence from a study of cataract surgery.* The European Journal of Health Economics, 2020. **21**: p. 501-511.
e) Luo, N., et al., *A vision "bolt-on" item could increase the discriminatory power of the EQ-5D index score.* Value in Health, 2015. **18**(8): p. 1037-1042.
f) Day, A.C., et al., *Femtosecond laser-assisted cataract surgery versus phacoemulsification cataract surgery (FACT): a randomized noninferiority trial.* Ophthalmology, 2020. **127**(8): p. 1012-1019.
g) Dewilde, S., et al., *Comparing Psychometric Properties of Six 5-Level and 3-Level EQ-5D Bolt-Ons in a Large, Multinational, Longitudinal General Population Sample.* Value in Health, 2025. **in press**.
h) Breheny, K., et al., *Assessing the construct validity and responsiveness of Preference-Based Measures (PBMs) in cataract surgery patients.* Quality of Life Research, 2020. **29**(7): p. 1935-1946.
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m) Thakumar, A., A. Shafie, and C. Lim, *Exploration of EQ-5D-5L bolt-on Items among Malaysian population.* Malaysian Journal of Pharmacy (MJP), 2017. **3**(1): p. 8-17.
n) Wang, P., et al., *A hearing bolt-on item increased the measurement properties of the EQ-5D-5L in a community-based hearing loss screening program.* The European Journal of Health Economics, 2023. **24**(3): p. 393-398.
o) Finch, A.P., J. Brazier, and C. Mukuria, *Selecting bolt-on dimensions for the EQ-5D: testing the impact of hearing, sleep, cognition, energy, and relationships on preferences using pairwise choices.* Medical Decision Making, 2021. **41**(1): p. 89-99.
p) Perneger, T.V. and D.S. Courvoisier, *Exploration of health dimensions to be included in multi-attribute health-utility assessment.* International Journal for Quality in Health Care, 2011. **23**(1): p. 52-59.