Short Communication

Age-Related Hearing Impairment and Impact on Quality of Life: A Review of Available Questionnaires

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Abstract

Objectives: The aim of this study was to provide an overview of instruments available to assess the impact of age-related hearing loss (ARHL) on quality of life (QoL), and recommendations and guidance for clinicians that including their respective strengths and shortcomings.

Methods: The search of the literature was performed from 1983 to 2013. The following papers were selected: related to the development or validation process for disease-specific questionnaires, related to the use of generic questionnaires on ARHL populations. A standardized data collection form was generated referring to different aspects of validation: general characteristics (name and acronym, year of publication, original language, number of items, response scale, domains, scoring, and completion time…), population, psychometric properties.

Results: One hundred and twenty papers were analysed. Two questionnaires explored specifically the impact of hearing impairment on QoL; only one had been specifically developed to explore QoL among individuals with ARHL: the Hearing Handicap Inventory for Elderly. Two instruments explored the impact on the QoL and daily life of conditions/symptoms that can be linked to a hearing loss (dizziness and tinnitus). Among the studies assessing the QoL using generic questionnaires, two questionnaires were identified: SF-36 and WHO-QOL BREF.

Conclusion: This literature review identified two ARHL-specific instruments supporting the possibility of developing a new instrument using more recent standard methods of development. Recommendations could be based on: item generation based exclusively on the patient’s point of view, a validation process performed on a large and representative population of patients with ARHL.

ABBREVIATIONS

ARHL: age-related hearing loss; DHI: Dizziness Handicap Inventory; EMA: European Medicines Agency; FDA: Food and Drug Administration; HHIE: Hearing Handicap Inventory for Elderly; HHIA: Hearing Handicap Inventory for Adult; QoL: Quality of life; SF-36: Short Form Health Survey; THI: Tinnitus Handicap Inventory; WHOQOL-BREF: World Health Organization Quality of Life BREF

INTRODUCTION

Hearing impairment is one of the most common disabilities in humans, affecting more than 250 million people in the world [1]. In France, 70% of hearing-impaired people are over 60 years of age [2]. Aging is the most common cause of hearing impairment and is referred to as age-related hearing loss (ARHL).

The consequences of ARHL include difficulty interpreting speech sounds, often resulting in a reduced ability to communicate, and impairing emotional, physical, and social functions. Indeed, this can lead to cognitive deficits, mood disturbances, social isolation, and stigmatization [3]. Physical skills should be deteriorated due to coexistent vestibular pathology, reduced spatial awareness, increasing the risk for falls. Some authors have reported the impact of hearing loss on the social/familial life of the individuals, leading to progressive social deprivation, and deterioration of the quality of life (QoL) of the individuals [4-9].

A variety of hearing assessment measures is available...
to audiologists in their evaluation of ARHL (pure-tone and speech audiometry, electrophysiological measures, and self-assessment handicap scales). While the hearing disability is important to assess, it is now well recognized that it does not reflect a complete picture of an individual's hearing in daily life. Encouraged by the US Food and Drug Administration and the European Medicines Agency [10,11], QoL assessment is being considered increasingly important with regard to evaluating population health, therapeutics and management of care to patients with chronic illnesses. QoL is commonly assessed using self-reported questionnaires. It is important to have robust, valid, and reliable measures to fully explore the effectiveness of any intervention. The aims of our study were to provide the following: i) an overview of instruments available to assess the impact of ARHL on daily living and QoL; ii) the psychometric properties and the content of these questionnaires; iii) guidance for clinicians, including evidence of the utility of the instruments and their respective strengths and shortcomings.

**METHODOLOGY**

**Search strategy**

A search of the literature (1983 to 2013) was conducted to identify studies that focused on the impact of age-related hearing impairment on QoL and daily life. The Medical Subject Headings were determined by the following significant terms: "quality of life" OR "daily life" AND "hearing impairment" OR "hearing-impaired". One of the authors (SL) made an initial selection based on the titles and abstracts of all retrieved articles. The following abstracts were not selected: letters to the editor, case reports, case series, medico economic studies, studies reporting findings focused on hearing rehabilitation, hearing surgery, and hearing disability assessment, and non-English language studies.

**Selection criteria**

The first selection identified 120 papers. A second selection was made in accordance with the following criteria: i) inclusion criteria: articles related to the development or validation process for disease-specific questionnaires, articles related to the use of generic questionnaires on ARHL populations; ii) exclusion criteria: articles only focused on populations of children and young adults. Additional articles detailing psychometric characteristics or the instruments’ development processes were identified in the article reference lists and added to the initial selection. Articles reporting transcultural validation were also added.

**Analysis strategy of instruments**

To analyze the content of the articles, we generated a standardized data collection form referring to different aspects of development of an instrument [12-14]. The data collection differed according to whether the QoL questionnaire was a specific or generic instrument.

1. For the specific instruments, the following items were recorded:
   - General characteristics: name of the questionnaire and acronym, authors, year of publication, original language, other available languages,
   - Characteristics of the questionnaire: number of items, modalities of response scale (Likert scale, yes/no),
   - Characteristics of the questionnaire: number of subscales, products, missing data management, administration modalities (self- or proxy-report), time reference (previous week, month), completion time,
   - Characteristics of the validation population: inclusion criteria and sample size,
   - Characteristics of the item generation process (literature review, expert experiences, patient interview analyses, or combined approach)
   - Psychometric properties (the definitions of the main psychometric properties were summarized in the table 1):
     - construct validity: final structure and the number of independent dimensions,
     - internal consistency: item-internal consistency (IIC) and item discriminant validity (IDV) assessed by correlations between each item with its scale and other scales [15],
     - internal structural validity: Cronbach’s alpha coefficient [15],
     - unidimensionality: Rasch statistics,
     - external and discriminant validity: relationships between the scores and other (objective and subjective) measures,
     - reproducibility: capacity to produce the same score between two assessments of the measure when the health status is stable (test-retest: correlation coefficients [16],
     - Sensitivity to change: capacity to detect a change between two assessments of the measure when the health status has changed (effect size).

2. For the generic instruments, the following items were recorded:
   - General characteristics: name of the questionnaire and acronym, original language of the questionnaire,
   - Characteristics of the questionnaire: number of items, modalities of response scale (Likert scale, yes/no), number and names of explored domains, scoring (index, subscores, missing data management), administration modalities (self- or proxy-report), time reference (previous week, month), completion time, item generation process,
   - Number of articles using the generic questionnaire in ARHL populations (Figure 1).

**RESULTS**

The analysis of the citations indicated that 1 instrument had been specifically developed to explore QoL among individuals with ARHL and 1 specifically developed to explore QoL of individuals with hearing loss. We also analyzed 2 other instruments that have been specifically developed to quantify the impact on the QoL and daily life of conditions/symptoms [17] that can be linked to a hearing loss, such as tinnitus and dizziness. Among the studies assessing the QoL of individuals with ARHL that did not use specific questionnaires, two main generic questionnaires were identified.
Table 1: Psychometric properties: definitions and tests used to explore.

**General**
A valid QoL measure refers to the extent to which a concept is well-founded and corresponds accurately to the 'real world'. The validity of a QoL measurement is considered to be the degree to which the tool measures what it claims to measure.

**Reliability**
The reliability or internal consistency is the extent to which a measurement gives consistent results, i.e. the extent with which a set of items in a dimension measures the same attribute. Reliability is assessed by the computation of Cronbach’s alpha coefficients higher than 0.70 result satisfactory reliability.

**Internal Validity**
- Content validity is a non-statistical type of validity that involves the examination of the questionnaire content to determine whether it covers all the aspects of the domain to be measured.
- Construct validity refers to the extent to which the questionnaire developed from a theory do actually measure what the theory says they do. It mainly relies on statistical analyses of the internal structure of the questionnaire including the relationships between responses to different items. Construct validity was assessed by performing:
  - Exploratory or confirmatory factorial analyses: in the case of confirmatory factorial analysis, a Kaiser-Meyer-Olkin (KMO) measure higher than 0.50 and a total variance higher than 70% indicate that the number of identified factors (or QoL dimensions) fit to the model;
  - Rash analysis to explore the unidimensionality of each domain identified: unidimensionality is retained if item goodness-of-fit (INFIT) statistics values range from 0.7 to 1.2;
  - Computation of correlation coefficients: correlation coefficients of each item with its dimension (item internal consistency, IIC) higher than 0.40 and higher than the correlation coefficients of this item with other dimensions (item discriminant validity, IDV) reflect a satisfactory construct validity.

**External validity**
External validity concerns the extent to which the internal construct can be supported by external criteria. External validity relies on assessment of:
- Convergent validity: relationships between the dimensions of the questionnaire and the dimensions of other previously validated questionnaires measuring the same concept;
- Criterion validity: relationships between the dimensions of the questionnaire and other features: sociodemographic, or clinical features...

### Figure 1: A PRISMA flow diagram.

**Specific questionnaires of hearing impairment exploring quality of life**
- The Hearing Handicap Inventory for the Elderly (HHIE)
  This is the single instrument that was developed for evaluating the impact of hearing loss on daily life/QoL in elderly individuals. Developed in 1982 [18-20], HHIE is designed as a self-assessment tool for evaluating the emotional and social problems elderly people experience because of hearing loss. Item development was based on both gerontological literature and an audiological perspective. The final version consists of 25 questions. Each question has 3 response options (no [score: 0], sometimes [score:...
The Hearing Handicap Inventory for Adults (HHIA)

The HHIA was proposed by the developers of HHIE. The HHIA is based on a modified version of the HHIE to be used with individuals aged below 65 years. Three questions, contributed by experts, were modified to include items identifying the effects of hearing loss on occupational issues because [23]. The number of items, the name of dimensions, and the scoring were strictly identical to the HHIE. The initial validation population included 67 adults from 18 to 65 years of age, both with and without hearing impairment. The structure of the instrument was not given. The instrument presents satisfactory internal consistency and reliability, but some indicators were not provided. External validity was tested using audiometric measures. Reliability was tested on a small sample of 28 individuals [24]. Some other languages were available [25-27]. The details are provided in table 2.

Condition-specific instruments of related-symptoms to hearing impairment exploring quality of life

The Dizziness Handicap Inventory (DHI) was developed by Jacobson & Newman to evaluate the self-perceived handicapping
Internal consistency (Cr alpha coeff)  
- Emotional 0.93  
- Social 0.88  
- Total 0.95  

Internal structure  
- HIC and IDV not distinguished  
- r inter-item [0.09-0.72]  
- r inter-dimensions [0.87-0.97]  

Internal consistency (Cr alpha coeff)  
- Emotional 0.88  
- Social 0.85  
- Total 0.93  

Internal structure  
- HIC and IDV not distinguished  
- r inter-item [0.09-0.68]  
- r inter-dimensions [0.84-0.96]  

Unidimensionality  
NP  
NP  

External/discriminant validity  
- 3-frequency pure-tone: r=0.61  
- (HHIE total score and dB score)  

Speech frequency pure tone: r [0.33-0.34] p<0.05  
High frequency pure tone: r [0.29-0.35] p<0.05  
Word recognition: r [0.26-0.28] p<0.05  

Reproducibility  
N=47  
high test-retest reliability  
N=28  
r [0.93-0.97]  

Sensitivity to change  
NP  
NP  

(a) Cr alpha coeff: Cronbach’ alpha coefficient (at least 0.7 expected)  
(b) IIC: item-internal consistency (item with its scale, at least 0.4 expected), IDV: Item Discriminant Validity (item with other scales, expected inferior to IDV)  
(c) r Pearson’s correlation coefficient  
(d) r test-retest statistics (at least 0.8 expected)  

The details are provided in table 3.

DISCUSSION

Providing valid and reliable instruments is a substantial challenge to help assisting health authorities and/or clinicians.

Generic instruments used in the assessment of the impact of hearing impairment

Two generic instruments were used in the assessment of QoL of hearing-impaired populations: the Short Form Health Survey (SF-36), the World Health Organization Quality of Life BREF (WHOQOL-BREF).

- The SF-36 is a generic questionnaire used worldwide [41] describing eight subscales (physical function, social functioning, role-physical, role-emotional, mental health, vitality, bodily pain, and general health). Two composite scores (physical and mental) can be calculated. International norms are available and allow for the comparison of varying populations [42]. Sixty-six studies used the SF-36 in the assessment of QoL of hearing-impaired populations including some performed on older populations [43-45]. These studies involved different aims: assessment of intervention efficacy [44,46,47], assessment of the impact of the hearing impairment on QoL[4, 36, 43, 45, 48-50]. Comparison of QoL levels between different population [51, 52], and prediction of occurrence of health events [53].

- The WHOQOL-BREF is a well-validated [54] generic questionnaire used worldwide [55, 56] that describes four domains using 26 items: physical health, psychological health, social relationships, and environment. Six studies used this questionnaire, only one of which was performed on non-deaf individuals. The WHO-QOL demonstrated satisfactory reliability for deaf individuals [57].

<table>
<thead>
<tr>
<th>Name</th>
<th>Short Form (36) Health Survey</th>
<th>World Health Organization Quality of Life BREF</th>
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<tr>
<td>Acronym</td>
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<td>physical health psychological health social relationships environment</td>
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<td>1 score per dimension</td>
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<td>Literature review Experts’ point of view</td>
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<tr>
<td>Number of articles of use</td>
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The effects of vestibular system disease [28]. The instrument was modeled on the HHIE to quantify changes that can result from an intervention. The Tinnitus Handicap Inventory (THI) was developed by Newman et al. to quantify the impact of tinnitus on daily living [29]. Item development was performed based on HHIE, HHIA, and DHI questionnaires. These two related-symptoms to hearing impairment instruments are widely used in auditory diseases like tinnitus, sensorineural hearing loss and Meniere, and less used for the assessment of the impact of ARHL [30-40].
Health authorities should be encouraged to optimize the use of financial resources [58], to show agents the effectiveness of audiologic services rendered. The development and validation process of instruments should be performed in accordance with typical standards [12, 14, 59, 60].

This study highlights the lack of specific instruments exploring the impact of hearing impairment on the daily life of elderly individuals. The Hearing Handicap Inventory for the Elderly (HHIE) received considerable attention when it was first developed; its popularity may be attributed to its brevity, ease of administration, high internal consistency, and test-retest reliability. However, some important limitations should be mentioned. The content of the questionnaire was based on expert opinions. This approach is now recognized as less appropriate and informative compared to the procedure based on patients’ points of view [61]. Interviews with patients provide an important contribution to the understanding of people living with a specific condition and allow the screening of all aspects of daily life that the disease, condition or symptom may impact for individuals. The validation papers reported restricting data regarding the construct and the structure of the questionnaire. While internal consistency and internal structure were fully explored with satisfactory results, external validity was minimally explored. While reproducibility was available, sensitivity to change, defined as the ability to detect a meaningful change, was never explored. This last property, also called responsiveness, is a core psychometric property of a measurement instrument [62,63]. Examination requires longitudinal data collection and is therefore rarely reported.

Comments should be made about the populations used for validation. The sample sizes were small. The population included both hearing impaired and non-impaired individuals who would be not appropriate in a process of validation. Validation population should be composed of individuals presenting with the disease or condition.

To our knowledge, no normative values were provided for these specific questionnaires. One of the difficulties encountered by clinicians when interpreting a QoL score is the lack of normative values. The QoL scores of the reference population described in the validation publications are often used as normative values, although these may or may not be representative of this specific reference population.

Generic instruments are also frequently used to assess QoL in individuals with ARHL. One advantage of generic instruments compared to specific is the possibility to compare QoL across populations presenting with different conditions or diseases, while disease-specific instruments focus on particular health problems and are generally more sensitive for detecting and quantifying small changes [64]. Most of the studies combined the use of the two types of questionnaires, optimizing the ability to highlight changes or differences between groups or over time.

CONCLUSION

This literature review identified only two ARHL-specific instruments that have been psychometrically validated with varying evidence supporting the possibility of developing a new instrument using more recent standard methods of development. Recommendations could be based on the following principles: i) item generation based exclusively on the patient’s point of view using semi-structured interviews, ii) a validation process performed on a large and representative population of patients with ARHL.

REFERENCES

56. [No authors listed]. Development of the World Health Organization...


