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Psychometrical Evaluation of the Hearing Disability and Handicap Scale

ANNE-SOFIE HELVIK*,**, HANNE THÜRMER†,
GEIR W. JACOBSEN**, METTE BRATT* &
LILLEMOR R.-M. HALLBERG‡

**Ear, Nose and Throat Department (ENT), St Olavs University Hospital, Trondheim, Norway; **Department of Public Health and General Practice, Norwegian University of Science and Technology (NTNU), Trondheim, Norway; †Blefjell Hospital, Notodden, Norway & ‡School of Social and Health Sciences, Halmstad University, Sweden*

ABSTRACT Aim: *To evaluate the Hearing Disability and Handicap Scale (HDHS) in an unselected population of adults with hearing impairment.* Subjects and methods: *A total of 342 consecutive adults who consulted the outpatient unit of audiology in the ENT department of a Norwegian university hospital answered HDHS, which intends to assess the negative consequences of hearing loss. The psychometric evaluation included internal structure analyses and made use of principal factors followed by varimax rotation, construct validity by corrected item–total correlation, and internal consistency reliability by Cronbach's alpha coefficient.* Results: *HDHS showed good psychometric properties with three factors, i.e. speech perception (five items), non-speech sound (five items) and participation restriction (10 items). All had good internal consistency reliability. The inventory distinguished between activity limitations and other problems related to social life participation.* Conclusion: *HDHS was found to be adequate for research and clinical purposes in an unselected adult population with a quite different cultural background and language than the original one.*

Introduction

In developed countries, the overall prevalence of hearing loss (HL) among adults aged 17–80 years is about 16%, with an increase in prevalence by age (Davis 1989, Tambs 1998, Johansson & Arlinger 2003). Davis (1989) found that about 50% of a study cohort between 70 and 79 years had a hearing loss in their better ear. The most common lesions in the hearing pathway are peripheral lesions, which are divided into those with conductive origin and those with sensorineural origin. They are diagnosed through audiometric examinations which show reduced hearing levels at one or several pure tone frequencies.

Correspondence: Anne-S. Helvik, Department of Public Health and General Practice, DMF, MTFS, NTNU, NO-7489 Trondheim, Norway. Tel: +47 73 597565. Fax: +47 73 597577. Email: Anne-Sofie.Helvik@ntnu.no

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The consequences of HL may be quite complex in everyday life. A common complaint among subjects with HL is their difficulty in recognising speech; they frequently mishear consonants like "sh", "f", "v", "t", "p", and "b" (Jerger, Chmiel, Wilson & Luchi 1995). In particular, these difficulties increase in surroundings with background noise (Arlinger 1989, Arlinger & Dryselius 1990). The reduction in hearing ability most often develops gradually and the affected individuals may also have difficulties hearing the telephone, the doorbell, or others walking up to them. According to the World Health Organization's (WHO 2001) current international classification of functioning, disability and health (ICF), such hearing difficulties in everyday life are defined as activity limitations (Stephens & Kerr 2000). Limitations in speech perception and non-speech sound cover the most important areas of activity limitation associated with hearing impairment (Hétu *et al*. 1994). However activity limitation at a personal level describes just partly the consequences of HL. Negative effects in a social context need to be considered as well. In accordance with the ICF, problems that result in less involvement in ordinary social life situations are termed participation restriction (Stephens & Kerr 2000, WHO 2001). For instance, studies have reported that patients felt being cut off and that they encountered restrictions in interpersonal relations within the family (Hallberg & Barrenäs 1993, Hétu, Jones & Getty 1993, Hallberg 1999). Also, there have been reports about restrictions in participation in social life outside the family and at work (Hallberg & Carlsson 1993, Stephens, Vetter & Lewis 2003).

The use of audiometric measures to assess the daily life consequences of HL are quite imprecise and the correlations are moderate (Erdman & Demorest 1998). A number of inventories that aim to assess self-reported negative consequences of HL have therefore been developed (for an overview see Noble 1998). However, most of them were developed before the current ICF model (Noble & Atherley 1970, Ventry & Weinstein 1982, McCarthy & Alpiner 1983, Hétu *et al*. 1994, Kramer, Kapteyn, Festen & Tobi 1995, Ringdahl, Eriksson-Mangold & Andersson 1998). On the other hand, the Hearing Disability and Handicap Scale (HDHS) complies well with the audiological framework of HL consequences (Stephens & Hétu 1991, Noble & Hétu 1994, Stephens 1996) and has in its original version been used by others in line with the conceptual framework of WHO, ICF (Stephens, Gianopoulos & Kerr 2001).

HDHS is a second generation inventory developed with the aim of evaluating subjects with different aetiologies in clinical settings and for research purposes. The Hearing Measurement Scale (HMS) with 42 weighted questions was developed for individuals with noise induced HL (Noble & Atherley 1970), and formed the basis for HDHS (Hétu *et al*. 1994). When the final version of HDHS was employed to a general French-Canadian population with HL in need of audiological rehabilitation it was found to distinguish well between dimensions of auditory limitations at a personal level and non-auditory problems in a social context (Hétu *et al*. 1994). HDHS further distinguished between factors of speech-perception and non-speech sound of the auditory limitation dimension. HDHS was found adequate for auto-administrative use, practical to answer for patients seeking audiological rehabilitation, easily interpretable, practical in clinical settings, and useful in research of daily self-reported life consequences of HL. Although a need has been identified to test the inventory psychometrically in various populations with HL (Hétu *et al*. 1994), little has been done so far. One exception is a sample of Swedish men with noise-induced HL (Hallberg, 1998).

Clinicians have stated the need for psychometrically valid and reliable scales to assess consequences of HL in everyday life (Stephens 1980, Stephens & Hétu 1991). However, there were no available psychometrically evaluated inventories aimed at assessing the consequences of HL in an unselected hearing impaired adult Norwegian population. We wanted to address that situation and followed a detailed and accredited translation process of the items in the original version of HDHS (Helvik, Jacobsen & Hallberg 2006a, Werner & Campbell 1973).

Therefore, the purpose of this article was to evaluate the Hearing Disability and Handicap Scale (HDHS) in an unselected adult population with HL seeking hearing aid fitting and rehabilitation.

Methods

Sample

The sample consisted of 342 adult subjects ($\geq$20 years), 187 men and 155 women, with a possible need for hearing aid fitting (HA) and rehabilitation. All were outpatients at the unit of audiology of the ear, nose and throat (ENT) department of St Olavs University Hospital in Trondheim, Norway from May 2002 to April 2003. In all, 474 consecutive and unselected patients were invited to participate. As a result of the recruiting process, 50 were ineligible for study entry, 59 were excluded because of severe illness or lack of Norwegian understanding, and 22 refused to participate. Of the remaining 343 subjects, one was excluded due to incomplete self-report information.

The study sample is described in Table 1 according to self-reported hearing impairment severity, i.e. “slight” (1), “moderate” (2), “severe” (3) or “very severe” (4). The mean age of the total sample was 68.9 years (SD = 13.8) with no significant age or gender differences between categories of perceived HL severity. About half (n = 175, 51%) of the subjects reported the lowest level of education as measured by the following three categories, i.e. “below or equal to 10 years”, “11–13 years”, and “14 years or more”.

All patients who had indications for HA fitting (n = 169, 49%) or refitting (n = 173) were included in the study based on the pure tone audiogram. Pure tone thresholds at 0.5–1–2–4 kHz in the better ear formed the mean threshold of hearing (MTH-B) (Martini 1996). For the total sample, the MTH-B was 43.3 dB (SD = 16.7) and 53.1 dB (SD = 19.9) for the worse ear (MTH-W). There was a significant relation between perceived severity and measured degree of HL in both ears as well as for previous HA experience (yes vs. no). Overall, 313 patients (92%) had HL of sensorineural origin, while 6 (2%) had conductive HL and 22 (6%) mixed HL. The sample is described in more detail elsewhere (Helvik *et al*. 2006b).

Table 1. Sample characteristics by perceived severity of hearing loss (HL) ($N = 342$)

		Slight		Moderate		Severe		Very severe	
Demographic									
Number	*n* (% of total)	31	(9.1)	175	(51.2)	104	(30.4)	32	(9.4)
Female gender	*n* (% of total)	12	(3.5)	78	(22.8)	47	(13.7)	18	(5.3)
Age	Mean (SD)	66.0	(14.5)	69.3	(13.4)	68.4	(14.2)	71.4	(14.3)
Education[a,b]									
≤10 years	*n* (% of total)	11	(3.2)	86	(25.2)	52	(15.2)	25	(7.3)
11–13 years	*n* (% of total)	6	(1.8)	47	(13.7)	39	(11.4)	5	(1.5)
>13 years	*n* (% of total)	14	(4.1)	41	(12.0)	12	(3.5)	2	(0.6)
Audiological									
HL in best ear[c]	Mean (SD)	36.6	(20.4)	39.2	(14.1)	48.2	(16.1)	57.0	(16.2)
HL in worst ear[d]	Mean (SD)	49.1	(28.2)	47.6	(15.6)	59.2	(20.1)	68.0	(18.7)
Perceived duration of HL in years	Mean (SD)	11.6	(14.1)	11.4	(11.4)	20.1	(16.2)	21.8	(16.4)
HA experience[e]	*n* (% of total)	5	(1.5)	68	(19.9)	68	(19.9)	28	(8.2)
Sensorineural HL	*n* (% of total)	31	(9.1)	162	(47.4)	93	(27.2)	27	(7.9)
Life situation									
Activity limitation[f]	Mean (SD)	22.4	(6.1)	25.3	(5.2)	30.5	(5.0)	33.9	(4.0)
Participation restriction[g]	Mean (SD)	14.2	(3.3)	17.4	(4.2)	21.6	(5.2)	23.1	(4.9)

[a]Missing data about two subjects.
[b]Pearsons Chi-square $= 29.480$ (df $= 6$); $p < 0.001$.
[c]ANOVA $F = 17.467$ (df 3); $p < 0.001$.
[d]ANOVA $F = 15.369$ (df 3); $p < 0.001$.
[e]Pearsons Chi-square $= 50.724$ (df $= 3$); $p < 0.001$.
[f]ANOVA $F = 49.267$ (df 3); $p < 0.001$.
[g]ANOVA $F = 39.940$ (df 3); $p < 0.001$.

Characteristics of HDHS

The Hearing Disability and Handicap Scale (HDHS) intends to measure the consequences of HL, on two subscales with 10 items on each. The first subscale deals with difficulties in speech and nonverbal sound perception. Sound perception concerns the ability to catch what is said in quiet or with some background noise, while nonverbal sound perception includes e.g. the sound of boiling water, footsteps on the floor, doorbell and telephone. According to the ICF (WHO 2001) these measure the experienced activity limitation. The second 10-item subscale includes non-auditory consequences in a social perspective, e.g. whether the hearing limitation restricts social life, has an influence on intimate relationships, whether the affected person is neglected or cut off from social situations, or if he/she feels socially embarrassed. This subscale measures problems people with hearing impairment may experience in everyday life. In ICF terms it assesses the extent of experienced social participation and thereby experienced participation restriction (WHO 2001).

On a four point scale responses are rated from "never" (1) to "always" (4). As in the original version we reversed items 2, 6, 10 and 18 before analysis so higher score indicated higher problems. The original version reported internal consistency reliability coefficients (Chronbach's Alpha) of 0.81, 0.84 and 0.80 for speech-perception, non-speech sound and handicap, respectively. The overall Cronbach's alpha for HDHS was 0.88 and it explained 58% of the total variance (Hétu *et al*. 1994).

Procedure

Information about the study and an invitation to participate was mailed to all eligible patients. They were asked to come 30 minutes before their scheduled appointment for further information and inclusion. After written consent was obtained the self-report questionnaire was administered to the participants with the same instructions as in the original study (Hétu *et al*. 1994). The clinical team did not partake in the information obtained during this part of the study. Further information about the procedure was published previously (Helvik *et al*. 2006b).

Statistics

Data were analysed using SPSS version 13.0 (SPSS, Chicago, IL, USA). The study sample was described by ANOVA and Pearson's chi-square statistics for continuous and categorical data, respectively. The score distribution of HDHS and the correlations under study were measured by the mean value with standard deviation (SD) and Pearson's product moment coefficient, r. Values of p below 0.05 were considered statistically significant.

The formal psychometric evaluation included internal structure properties, construct validity, and consistency reliability. The internal structure of the scale was assessed by exploratory factor analyses, first using principal factor analysis followed by a varimax rotation to find factor loadings. In line with similar tests and accepted principles, loadings at 0.40 or higher are reported (Fayers & Machin 2000). The number of factors retained for extraction and rotation was based on eigenvalues of 1 or higher (Fayers & Machin 2000). The mean factor loadings were measured by the sum of the loadings of all the items included in each factor and divided by the number of items. Second, the construct validity of each factor was assessed by use of corrected item–total correlations (r_{it}), i.e. the correlations between one item and the sum of the remaining items in the scale (Nunnally & Bernstein 1994). As a consequence, high r_{it} scores give higher representativity for the scale and greater strength in homogeneity. Finally, Cronbach's alpha was used to assess the internal consistency reliability for each factor, for the dimension of activity limitation and for the scale as a whole.

Results

Distribution of HDHS scores

The reported total mean of the activity limitation and participation restriction was 27.4 (SD = 6.1) and 18.9 (SD = 5.2), respectively. Increasing self-reported severity of HL was positively related to activity limitation and participation restriction ($p < 0.001$, Table 1). The score distribution of each item in HDHS is reported in Table 2. The five most frequently reported negative consequences of HL in daily life were all related to speech perception (i.e. item 1, 5, 9, 13, and 17).

Factor analyses and corrected item–total correlations

The internal structure of HDHS was explored by factor analyses. As shown in Table 3, three factors had an eigenvalue higher than one. They were factor 1 (eigenvalue 6.6), factor 2 (eigenvalue 2.2), and factor 3 (eigenvalue 1.4). They explained a total variance of 51% (Table 3) in the principal factor analysis. Five items in factor 1 regarded speech perception, but another two items, i.e. item 8 (restriction in social life) and item 19 (feeling cut off) also loaded on factor 1. Their loading was similar on factor 2 which regarded participation restriction. In all, 10 items loaded on factor 2 while five items loaded on factor 3 which related to non-speech sound. The mean factor loading for factor 1 (speech perception), factor 2 (participation restriction), and factor 3 (non-speech sound) was 0.65, 0.56, and 0.72, respectively.

A corrected item–total correlation (r_{it}) was calculated for all items in each scale and were all highly significant ($p < 0.001$). In speech perception, items with relation to "television and radio difficulties" (item 5 and item 9) had the highest r_{it} (0.70 and 0.73, respectively). In non-speech sound items which targeted "hearing the sound of a door opening" and "footsteps without seeing" (item 2 and item 10) contributed most (with r_{it} of 0.63 and 0.64, respectively). In the participation restriction scale, items that dealt with personal reactions (no 11: "Upset communication" 16 "Lack

Table 2. Descriptive statistics for items in the Norwegian version of the Hearing Disability and Handicap Scale (HDHS) ($N = 342$)

Item		Response categories[a]				Total	Mean	SD
		1	2	3	4			
Item 1	Follow conversation	5	116	129	92	342	2.9	0.8
Item 2	Door opening	92	89	128	33	342	2.3	1.0
Item 3	Worry people find out	241	72	17	12	342	1.4	0.7
Item 4	Ask people to repeat	66	151	88	37	342	2.3	0.9
Item 5	Difficulty hearing TV	11	85	121	125	342	3.1	0.9
Item 6	Hear water boiling	89	73	94	86	342	2.5	1.1
Item 7	Upset if wrong answer	110	164	56	12	342	1.9	0.8
Item 8	Restriction in social life	82	125	94	41	342	2.3	1.0
Item 9	Difficulty hearing radio	10	88	124	120	342	3.0	0.9
Item 10	Hear footsteps	67	81	137	57	342	2.5	1.0
Item 11	Upset communication	71	157	74	40	342	2.2	0.9
Item 12	Tense and tired	125	129	68	20	342	2.0	0.9
Item 13	Group conversation	2	63	117	160	342	3.3	0.8
Item 14	Ringing of doorbell	101	84	127	30	342	2.3	1.0
Item 15	People avoiding me	265	63	9	5	342	1.3	0.6
Item 16	Lack of self-confidence	180	112	32	18	342	1.7	0.9
Item 17	Hear but not understand	7	88	186	61	342	2.9	0.7
Item 18	Hearing telephone ringing	72	142	65	63	342	2.7	1.0
Item 19	Feeling of being cut off	107	127	85	23	342	2.1	0.9
Item 20	Close relationships	144	129	58	11	342	1.8	0.8
							46.3	9.9

[a]The response categories were "never" (1), "sometimes" (2), "often" (3) and "always" (4).

of self-confidence") had the highest r_{it} of 0.59 and 0.60, respectively. The item with the lowest contribution to any scale was the one about "being avoided because of HL consequences" (item 15). Even so, the r_{it} was reasonably high (0.39).

Internal reliability coefficient by Cronbach's alpha

Internal consistency reliability (Cronbach's alpha) was good for speech perception, non-speech sound, and participation restriction (0.84, 0.81 and 0.82, respectively; Table 3) while it was 0.86 for activity limitation i.e. speech perception and non-speech sounds combined and 0.89 overall for the entire scale.

Correlations between HDHS and audiological characteristics

The correlations between the three scales and the items of HDHS and age and different audiological characteristics are presented in Table 4. Except for age, most of the correlations were statistically significant, but weak or moderate at best. We observed that the strongest correlations with audiometric measures

Table 3. Factor structure of the Norwegian version of HDHS, corrected item-total correlation and internal consistency reliability (Chronbach Alpha) ($N = 342$)

		Factor[a]			Corrected item-total correlation	Cronbach's Alpha
		1	2	3		
Speech perception						0.84
Item 1	Follow conversation	0.58			0.56	
Item 5	Difficulty hearing TV	0.78			0.70	
Item 9	Difficulty hearing radio	0.79			0.73	
Item 13	Group conversation	0.74			0.65	
Item 17	Hear but not understand	0.70			0.58	
Non-speech sound						0.81
Item 2	Door opening			0.77	0.63	
Item 6	Hear water boiling			0.67	0.59	
Item 10	Hear footsteps			0.78	0.64	
Item 14	Ringing of doorbell			0.74	0.61	
Item 18	Hearing telephone ringing			0.63	0.54	
Participation restriction						0.82
Item 3	Worry people find out		0.63		0.42	
Item 4	Ask people to repeat		0.66		0.53	
Item 7	Upset if wrong answer		0.57		0.40	
Item 8	Restriction in social life	0.52	0.41		0.54	
Item 11	Upset communication		0.60		0.59	
Item 12	Tense and tired		0.59		0.55	
Item 15	People avoiding me		0.45		0.39	
Item 16	Lack of self-confidence		0.67		0.60	
Item 19	Feeling of being cut off	0.44	0.45		0.56	
Item 20	Close relationships		0.59		0.44	
	Eigenvalue of factors	6.6	2.2	1.4		
	Cumulative explained variance	32.9	43.7	50.5		

[a]Loadings ≥ 0.40 were reported

were between degree of HL in better ear and factors related to speech and non-speech perception. Self-reported severity of HL correlated better with participation restriction than the observed audiometric measures. Perceived severity of the HL was the only such measure that correlated moderately to all factors.

Discussion

The psychometrical evaluation of a newly translated Norwegian version of the original Hearing Disability and Handicap Scale (HDHS) turned out well. The internal structure of the entire scale showed that three factors – speech perception, non-speech sound, and participation restriction – explained 51% of the variance. The internal consistency reliability was good and the inventory distinguished successfully between activity limitations and other problems

Table 4. Pearson product moment correlations between the three factors and the items of HDHS and age, degree of hearing loss (HL) in worst and best ear and perceived duration and severity of HL ($N = 342$)

			Degree of HL		Perceived	
		Age	Best ear	Worst ear	Duration of HL	Severity of HL
Factor: Speech perception		**0.08**	**0.41**[b]	**0.34**[b]	**0.28**[b]	**0.53**[b]
Item 1	Follow conversation	0.06	0.39[b]	0.36[b]	0.30[b]	0.52[b]
Item 5	Difficulty hearing TV	0.05	0.35[b]	0.26[b]	0.24[b]	0.39[b]
Item 9	Difficulty hearing radio	0.03	0.34[b]	0.25[b]	0.19[b]	0.40[b]
Item 13	Group conversation	0.09	0.27[b]	0.25[b]	0.22[b]	0.40[b]
Item 17	Hear but not understand	0.09	0.23[b]	0.19[b]	0.14[b]	0.34[b]
Factor: Non-speech sound		**0.06**	**0.52**[b]	**0.45**[b]	**0.37**[b]	**0.44**[b]
Item 2	Door opening	0.09	0.39[b]	0.30[b]	0.24[b]	0.37[b]
Item 6	Hear water boiling	0.08	0.42[b]	0.36[b]	0.21[b]	0.34[b]
Item 10	Hear footsteps	0.01	0.36[b]	0.34[b]	0.31[b]	0.32[b]
Item 14	Ringing of doorbell	−0.03	0.35[b]	0.34[b]	0.37[b]	0.34[b]
Item 18	Hearing telephone ringing	0.06	0.44[b]	0.35[b]	0.27[b]	0.29[b]
Factor: Participation restriction		**−0.06**	**0.29**[b]	**0.24**[b]	**0.25**[b]	**0.50**[b]
Item 3	Worry people find out	0.01	0.14[b]	0.10	0.12[a]	0.19[b]
Item 4	Ask people to repeat	−0.01	0.07	0.01	0.04	0.29[b]
Item 7	Upset if wrong answer	−0.15[b]	0.17[b]	0.11[a]	0.08	0.21[b]
Item 8	Restriction in social life	0.04	0.25[b]	0.23[b]	0.29[b]	0.44[b]
Item 11	Upset communication	−0.03	0.20[b]	0.14[a]	0.15[b]	0.36[b]
Item 12	Tense and tired	−0.07	0.11[a]	0.15[b]	0.20[b]	0.29[b]
Item 15	People avoiding me	−0.01	0.22[b]	0.18[b]	0.12[a]	0.26[b]
Item 16	Lack of self-confidence	−0.06	0.24[b]	0.26[b]	0.26[b]	0.34[b]
Item 19	Feeling of being cut off	−0.02	0.39[b]	0.27[b]	0.22[b]	0.46[b]
Item 20	Close relationships	−0.05	0.08	0.01	0.07	0.22[b]

[a] $p < 0.05$.
[b] $p < 0.01$.

related to social life participation. The present version of HDHS is considered adequate for research and clinical purposes in unselected Norwegian populations seeking audiological rehabilitation. This indicates that the inventory is suitable for use in a population with a quite different cultural background and language than the Canadian original (Hétu *et al*. 1994).

Activity limitation

The factors "speech perception" and "non-speech sound" included the same items as the original French inventory. Items related to speech perception can be categorized as "communicating with receiving of the spoken message" (d310) as phrased by the ICF (WHO 2001). On the other hand, items of non-speech sound are examples of "listening" (d115). In "speech perception" (factor 1) the two items related to difficulties listening to TV and radio loaded highest and represented the factor most (highest r_{it}). The same items had the highest factor loadings in similar evaluations, i.e. of the French-Canadian population and the Swedish sample with noise induced HL in men (Hétu *et al*. 1994, Hallberg 1998). In "non-speech sound" (factor 3), the difficulty hearing doors opening and footsteps without seeing loaded highest. That was also the case in the French version (Hétu *et al*. 1994), but it was not so among Swedish men (Hallberg 1998), whose difficulty hearing the doorbell loaded highest. In the present study the internal reliability coefficient for factors of speech perception and non-speech sound was quite the same as in both the Canadian and Swedish evaluations (Hétu *et al*. 1994, Hallberg 1998).

Participation restriction

We observed that Cronbach's alpha for participation restriction was 0.82 (Table 3), which was similar to the study of Hétu *et al*. (1994). Factor 2 made up the "participation restriction" dimension in the present study. In comparison, Hétu *et al.* (1994) found that this dimension consisted of two factors. However, the inventory did not separate out the non-auditory consequences in a social context as ideally as the intention was and the dimension was treated as one factor in the original evaluation, too. In accordance with the ICF codex (WHO 2001), five items that related to non-auditory consequences in a social context tap into interpersonal interaction and relationships termed "general interpersonal interactions" (d710–d729, items 11, 15 and 19) and "particular interpersonal relationships" (d750–d770, items 8 and 20). Moreover, the five remaining (items 3, 4, 7, 12 and 16) mainly deal with personal reactions due to involvement in social life situations and did not exactly fit in the ICF codex. As early as the 1970s it was argued that personal reactions should have a significant place in the overall evaluation (Noble & Atherley 1970). Both interpersonal restrictions and negative personal reactions related to social interactions contribute to how the patient's situation should be understood. Those two components are closely interconnected and both are included in the participation restriction concept. For example, Barrenäs and Holgers (2000) argued that in clinical situations both aspects should be treated and not separated. Hallberg (1998) reported that patients who score high on participation restriction in HDHS may in the rehabilitation process need support in accepting their HL as well as support from the environment. The established personal perception of oneself as a hearing impaired individual is influenced by one's relations (friends, family and associates) and vice versa (Hétu 1996). Still, it is reported that patients hardly bring up interpersonal restrictions or personal reactions unless they are asked directly or via a structured inventory such as HDHS (Stephens, Jones & Gianopoulos 2000).

We found that the correlation between participation restriction and audiometric measures was negligible and low (Table 4). Participation restriction correlated highest with perceived severity of HL, but was moderate at the best. The use of audiometric measures and other traditional measurable variables cannot make up for the information from participation restriction obtained through HDHS. Therefore, we, in line with for example Stephens (1980), argue that inventories about daily life consequences of HL should be used as a supplement to audiometric measures in order to improve the audiological rehabilitation.

Strength and limitation of study

The first step of the factor analysis tries to explain as much of the total variance as possible with as few conceptually meaningful factors as possible (Kleinbaum, Kupper, Muller & Nizam 1998). We regard it as a strength that we observed an explained variance (51%) that compared favourably with previously published evaluations of the same inventory (Hétu *et al*. 1994, Hallberg 1998).

Cronbach's alpha might be somewhat influenced by a wide and heterogeneous sample; our acceptable and good alpha results could then be sample dependent (Fayers & Machin 2000). However, the sample size and diversity of the original study of HDHS was quite similar to ours, with equally as high internal reliability coefficients (Hétu *et al*. 1994). Hallberg (1998), who used a smaller sample with less variability, also reported corresponding coefficient alpha values. Furthermore, high corrected item–total correlation scores were found and may suggest that a high homogeneity contributed to the high coefficient alphas. Consequently, we conclude that the reliability of our translated version of the inventory was not explained by sample heterogeneity, but had good internal consistency reliability in line with the original one (Hétu *et al*. 1994).

All but one of our 343 participating patients in the unselected sample completed the entire HDHS, strengthening results. However, the unselected clinical sample we used reflected the fact that HL mostly affects the elderly (mean age 69 years). The younger respondents may have additional experiences of participation restriction not focused in HDHS, e.g. in relation to work. In clinical practice, such restrictions need to be covered outside the frame of HDHS. Furthermore, subjects with a lack of Norwegian understanding were excluded from the study participation to get reliable results of the Norwegian translation. Even so, the growing number of people with different ethnic background deserves a special focus in audiological rehabilitation and research since they may have additional problems with participation in social life.

All instructions given to the participants were in line with the original ones. As a consequence, patients with previous HA experience thus were requested to answer HDHS as if they did not use their HA (Hétu *et al*. 1994). The present study could have been further strengthened if respondents with HA experience were randomised to answer HDHS either as unaided or in accordance with how they normally experienced their auditory situation, and the properties of HDHS could have been stratified and analysed by the instructions given.

In conclusion, HDHS seems relevant in the ICF context. Furthermore, the study results of HDHS support the introduction of HDHS in an unselected Norwegian population seeking audiological rehabilitation, but we outlined some limitations. We found that the inventory is adequate for research purposes in populations with different cultural background and language, and with HL of different aetiologies.

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