PRELIMINARY ANALYSIS OF RELIABILITY AND VALIDITY OF THE QUESTIONNAIRE 'AURAL REHABILITATION OUTCOMES PROFILE' (PIRS)

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Abstract: *The aim of this paper is to provide a preliminary analysis of the reliability and validity of the Aural Rehabilitation Outcome Profile questionnaire (PIRS). This self-assessment questionnaire is used to quantify functional hearing difficulties in adults in regards to factors such as acoustic environment and interlocutor features (parts 1, 3, and 5), frequency of occurrence of different compensating communication strategies, and severity of socio-emotional consequences of acquired hearing loss (part 4), influence of acquired hearing loss (AHL) on everyday activities (part 2), and hearing aid performance and user satisfaction (part 5). An analysis of the reliability and validity of each individual part/scale of PIRS was conducted on data obtained from 47 adult participants (37 hearing aid users and 10 normal hearing individuals), including the analysis of Cronbach's reliability coefficients and intraclass correlation coefficients, factor analysis, and the Mann-Whitney U for testing the self-assessment differences between hearing participants and those with hearing loss as well as correlation analysis between hearing loss degree and self-assessment results. The results indicated that all PIRS subscales/parts show the properties of reliability and validity, warranting additional examination of psychometric properties with the goal of assessing the suitability of using PIRS as a clinical outcome measure of aural rehabilitation for acquired hearing loss.*

Key words: *acquired hearing loss, rehabilitation outcome measures, self-assessment, Aural Rehabilitation Outcome Profile – PIRS, reliability, validity*

INTRODUCTION

Acquired hearing loss (AHL) is the most common age-related sensory impairment that significantly influences quality of life (Roth et al., 2011). It has a constraining effect on spoken language understanding and subsequently interpersonal communication, which leads to possible socio-emotional consequences such as frustration, anxiety, diminished self-confidence and self-esteem, depression and social isolation: it also can negatively influence work ability, diminish cognitive and physical functional status and affect intimacy and mental health (Hogan et al., 2011; Gagnéet al., 2011; Tunet al., 2009; Lotfi et al., 2009; Monzani et al., 2008; Scarinci et al., 2008; Donaldson et al., 2004; Strawbridge et al., 2000; Naramura et al., 1999). Therefore, the focus of contemporary approach to aural rehabilitation is holistic, directed toward supporting and enhancing the overall functional status and the quality of life of a person with AHL (McMahon et al., 2013; Falkenberg, 2007; Dalton et al., 2003).

The holistic approach to intervention encompasses multiple outcome measures of contemporary aural rehabilitation. The objective measures are directed towards the outcomes of hearing aid fitting and provide information regarding functional gain, described as gain in detecting sounds and speech recognition after appropriate hearing aid fitting (Mendel, 2009).

Considering these measures are obtained in a highly controlled clinical setting, the objective aural rehabilitation outcome measures do not provide information regarding listening, commu-

nication, socio-emotional and other issues that a person with acquired hearing loss experiences in everyday life (Dalebout, 2009; Abrams et al., 2005). Therefore, in order to assess overall aural rehabilitation outcomes, subjective measures such as interview or self-assessment are used as well, reflecting realistic functioning as well as opinions and attitudes of hearing aid users regarding changes in everyday life after hearing aid fitting.

Self-assessment methods represent a scientifically justified way or methodology for valid measurement of the success of hearing aid fitting and aural rehabilitation in everyday life. Their use is widespread (Cox, 2008), as they provide information about various domains: perceived benefit and satisfaction with intervention, changes in quality of life, how hearing aids are used, and the influence of aural rehabilitation on significant others (Gatehouse, 2001).

The use of self-assessment allows for the determination of unique contributions of different intervention components (e.g., counseling) and specific rehabilitation methods (e.g., providing a certain, appropriate hearing aid model) to the overall positive intervention results. Self-assessment can also inform professionals regarding needed modifications of the rehabilitation plan, assess the use of different technologies, and compare their effects on the success of rehabilitation, as well as help promote making clinical decisions based on person-specific data (Uriarte et al., 2005).

Considering that the goal of aural rehabilitation of age-related acquired hearing loss is the functional, social, and emotional benefit of individuals with hearing loss in addition to enhancing their hearing and listening skills (Dillon, 2012; Kochkin, 2012; Ross, 2011; Laplante-Lévesque et al., 2010 a/b), self-assessment of rehabilitation outcomes can be useful in detecting possible barriers to the functional communication and social re-engagement of individuals with AHL. The contemporary holistic approach to treating acquired hearing loss puts equal importance on the assessment of technical intervention aspects (hearing aid fitting) and the assessment of the daily functioning of a new hearing aid user, including the evaluation of communication strategies, interactions with the environment, and emotional aspects (Falkenberg, 2007).

The bio-psycho-social approach directed towards each hearing aid user encompasses many clinical activities, since it includes hearing aid fitting, counseling, communication skills learning, and training, as well as mastering coping and self-advocacy skills (Laplante-Lévesque et al., 2010a/b). Thus, the costs of this multifaceted approach to intervention are greater compared to providing hearing aids only. These increased costs warrant justification by providing measurable results, which in turn explain the development and application of subjective measures of rehabilitation outcomes (Boothroyd, 2007).

However, aside from economic reasons, the added value of their use is establishing a positive relationship between the professional and the hearing aid user through recognizing the client's individual needs, coping mechanisms, and compensation strategies and behaviors, supporting the development of a trusting relationship, which is crucial for perceived benefit of rehabilitation (Grennesset al., 2014). At the same time, self-assessment measures seem to be a result and a prerequisite of a holistic approach to rehabilitation, enabling the individualized treatment of AHL, as the individual perception of AHL is one of the main generators of seeking professional help (Knudsen et al., 2010).

In addition, subjective self-assessment measures can indicate a change in quality in life, which can significantly affect rehabilitation outcomes. Since AHL is a chronic health condition (Archbold et al., 2014), the treatment outcomes can be assessed in a subjective manner, multi-dimensionally, and by evaluating the effects of communication barriers on the person's well-being, much like evaluations in other health-related conditions that influence the quality of life (Goff, 2013). By employing available self-assessment measures, it is possible to fully evaluate the intervention outcomes in the area of AHL (Cox, 2003). The models of intervention have shifted from the medical model directed at *impairment* and *difficulty* (changes in the hearing mechanism structure and their functional results) towards a bio-psycho-social, holistic intervention model emphasizing *handicap* and *restrictions*, or in other words, hearing difficulties and emotional consequences of negative communication and social experiences, including stigma, prejudice, and

stereotypes (Tye-Murray, 2009; Gagné et al, 2011), which has given rise to the development of instruments for the subjective assessment of different dimensions of AHL rehabilitation outcomes. Some of them provide insight into the handicap caused by AHL, or the perception of its influence on the daily functioning of the person with hearing loss, whereas others assess the hearing aid benefit, or the perceived benefit provided by the hearing aid in everyday situations, as well as aural rehabilitation effects on the quality of life (see detailed review in Noble, 2013).

Due to the the large number of available instruments, clinicians ought to consider several points when selecting rehabilitation outcome measures (Cox, 2005), including primary measurement goals, administration difficulty, scoring and interpretation complexity, and availability of norms and psychometric data of specific tools, as well as the degree to which a self-assessment measure contributes to the realization of treatment priorities made by the clinician. Therefore, the selection of the most appropriate measures can seem challenging for a clinician (Saunders et al., 2005). Nevertheless, it is important to realize that using such measures can supplement the traditional parts of intervention, such as hearing aid fitting, that are all directed towards diminishing the barriers in everyday functioning and increasing the social participation of a person with hearing loss, by evaluating the changes that have occurred in this dimension of rehabilitation (Abrams et al. 2005). Finally, a complex concept such as holistic approach to aural rehabilitation of individuals with AHL warrants efficacy measurement via self-assessment measures, as they reflect one of the core dimensions of the intervention outcomes overall (Humes, 2009).

Unfortunately, despite the well-known advantages of administering self-assessment measures in the rehabilitation of AHL, currently there is a lack of instruments intended to evaluate the level of socio-emotional adjustment to AHL and reactions toward hearing aids as well as measures for monitoring final rehabilitation outcomes in Croatia. The only available self-assessment measure is a Croatian version of the internationally used questionnaire *The Abbreviated Profile of Hearing Aid Benefit* (*APHAB*; Cox & Alexander, 1995) adapted by Šimić (2010), although there are no psychometrically evaluated instruments designed specifically for the Croatian population. Some of the self-assessment measures have been widely used, and their linguistic adaptations have been accepted worldwide. The advantages of adapting an instrument for use in other language and cultural environments include the possibility of cross-linguistic and cross-cultural comparisons of research and results (Measuring the psychosocial consequences of hearing loss in a working adult population: focus on validity and reliability of the Italian translation of the Hearing Handicap Inventory, Monzaniet al., 2007). However, it is noteworthy to mention that measuring bio-psycho-social constructs as a final aural rehabilitation outcome is greatly influenced by culture. Also, different cultural components can influence the conceptual and semantic congruency of the adapted and original instrument (Piaultet al., 2012). Therefore, the instrument adaptation could be imprecise in rehabilitation outcomes assessment due to restrictions stemming from the insignificance of certain assessment items in the original instrument for a different linguistic or cultural environment (Wu et al., 2004).

Considering the presented need for a Croatian self-assessment instrument in the area of aural rehabilitation of AHL, this paper aims to provide a preliminary analysis of reliability and validity of a Croatian self-assessment rehabilitation outcomes measure – the questionnaire titled Aural Rehabilitation Outcome Profile (hereinafter referred to by its Croatian abbreviation: PIRS). This article is directed towards an analysis of the principal psychometric properties of the PIRS instrument, which was created based on the results and experiences gained in an interdisciplinary, holistic AHL intervention project that focused on the aural rehabilitation of new hearing aid recipients. The purpose of this study is to evaluate the initial potential of the PIRS instrument for further testing as a measure of aural rehabilitation outcomes in Croatia by quantifying listening difficulties in regards to five factors: (1) acoustic environment, (2) effect on daily activities, (3) speaker features, (4) communication habits and speaker reactions, and (5) perceived benefit and satisfaction with hearing aid(s).

METHODS

Participants

There were 47 participants in this study, including 37 individuals with acquired hearing loss and 10 individuals with hearing within normal limits. The participants with hearing loss (19 females and 18 males) ranged in age from 30 to 93 years and had an average age of 66.9 years. The hearing participants (5 females and 5 males) were individuals without any previous hearing problems per self-report or the reports of their families. This group range in age from 46 to 92 years and have an average age of 64.3 years. They were age- and gender-matched with the hearing-impaired participants. All participants resided in the greater Zagreb metropolitan area. The majority had mid-level socio-economic status and had completed secondary to higher education.

Confirmation of hearing loss for each individual was carried out in the otorhinolaryngology department at one of Zagreb's four clinical centers. The individuals with acquired hearing loss were then referred to a hearing aid distributor for various resaons, where they were approached to participate in the current study. The mean pure tone average was 63.5 dB HL in each ear, ranging from 38 to 120 dB in the left ear and 40 to 101 dB HL in the right ear. Some of the participants with hearing loss were very experienced hearing aid users with more than 40 years of experience, whereas others were new users (1 month of hearing aid experience). The average length of hearing aid usage was 7 years. The majority of participants used behind-the ear type (23 participants) and in-the-ear type hearing aids (14 participants). Twenty participants wore one hearing aid, and seventeen wore both hearing aids. Twenty-four participants reported that they use their aid regularly, eleven reported that they use it often, and two participants reported using it occasionally. Their daily use ranged from 3 to 12 hours per day, with a daily average of 8.92 hours.

Instrument

The PIRS questionnaire was constructed as a part of the "Stay connected!" project, which provided interdisciplinary (audiological, SLP, and psychological) support for the aural rehabilitation of adults with acquired hearing loss. It was conducted during 2011 and 2012 by the Association of the Deaf and Hard-of-Hearing Individuals of the City of Zagreb and funded by the Ministry of Health and Social Services of the Republic of Croatia.

The PIRS was designed as an instrument for the evaluation of intervention outcomes in the area of aural rehabilitation, in other words, as a self-assessment measure of rehabilitation outcomes in individuals with fitted hearing aid(s). Based on the clinical experiences of two speech and language pathologists and one psychologist conducting the support program of the "Stay connected!" project the first version of PIRS was modified so the number of items, initially 65, was reduced, the language used in the majority of items was simplified, and certain items were inverted on purpose. All three clinicians who carried out the program agreed that reducing the number of items and simplifying the language of PIRS items added to its possible clinical value, especially for the geriatric population. After consultation with two independent self-assessment instrument design experts, inverse PIRS items were introduced due to the need of avoiding the habit of uniformly filling out the questionnaire.

The modified version of PIRS, containing five sections and a total of 38 items, is designed as a self-assessment instrument to quantify functional hearing difficulties. It measures the frequency of hearing difficulties in regards to acoustic environment and speaker features (sections 1, 3, and 5), the frequency of occurrence of different compensation communication strategies, and the prominence of social and emotional consequences of AHL (section 4), the degree of influence of AHL on everyday activities (section 2), and the quality of hearing aid performance and user satisfaction with hearing aid(s) (section 5).

The PIRS questionnaire is filled out by selecting one out of five possible answers that best reflects the frequency of the situation described in the statement (*almost never*, *rarely*, *sometimes*, *often*, and *almost always*). The answers are scored on a 0–4 point scale according to the scoring key. The total is expressed as the sum of item scores for each section of the questionnaire. The lesser total indicates better functional hearing, less pronounced social and

emotional consequences of AHL, better listening skills after hearing aid fitting, and more satisfaction with hearing aid(s). PIRS was originally designed to be administered at the initial intervention session and then at various time points during intervention in order to monitor changes in section totals and the overall total to obtain specific information regarding hearing handicap prominence, perceived benefit and satisfaction with hearing aid(s), communication strategies and coping mechanisms, and an overview of hearing difficulties and their effects on an individual with AHL. In the current study, PIRS was administered only once as the aim was to evaluate the main psychometric properties of the instrument, with test-retest reliability assessed by calculating the intraclass correlation coefficient (McGraw and Wong, 1996).

Procedure

Data was gathered during the summer of 2015 in collaboration with a hearing aid distribution, manufacturing, and repair center. After the management board approval, the employees of the center were instructed regarding the presentation of the study to prospective participants who came to the center. Clients who came for hearing assessments, hearing aid fittings, or other appointments were presented with details of the study, including its goal, the expectations of participants, and the researchers' commitment to using the data for research purposes and respecting the anonymity of the research participants. Finally, 37 clients signed the informed consent for the current study. Audiological data was gathered from the participants' hearing assessment records. PIRS data was collected individually by filling out the questionnaire in the quiet, well-lit premises of the center. All participants were offered assistance during the administration of PIRS by the center's employees. Each individual administration of PIRS lasted approximately 20 to 30 minutes. The hearing participants' personal data was collected following the same procedure.

Data analysis

Positively worded PIRS items were scored based on the following score key: *almost never* = 0; *rarely* = 1; *sometimes* = 2; *often* = 3; *almost always* = 4. Answers to negatively keyed items in PIRS were reverse scored: *almost never* = 4; *rarely* = 3; *sometimes* = 2; *often* = 1; *almost always* = 0. Descriptive statistical analysis was carried out for individual items, section totals, and the overall total. Furthermore, the reliability analysis of PIRS sections was completed by calculating Cronbach's alpha reliability coefficient, observing the criteria suggested by George & Mallery (2003) implying high internal consistency with a reliability coefficient of 0.9 or higher, good internal consistency with a coefficient between 0.8 to 0.9, and acceptable reliability with Cronbach's alpha between 0.7 and 0.8. Also, the intraclass correlation coefficient (Streiner & Norman, 2003) is calculated as a measure of the repeatability of scores of PIRS section totals. Considering that PIRS questionnaire items function as an ordinal scale, construct validity of its sections is analyzed by using principal component analysis (Costello & Osborne, 2005). The requirement of having a 4:1 ratio of participants to variables, needed to be able to perform the factorial validity analysis (MacCallum et al., 2001), was fulfilled for all but the fourth section of PIRS. However, a factor analysis was carried out for this section as well, considering there were less than 20 variables and the expected number of factor was one to two (Zeller, 2006, according to de Winter, Dodou & Wieringa, 2009). The discriminant validity of PIRS was analyzed by comparing the section and overall totals of participants with and without AHL using a non-parametric Mann Whitney U-test, as indicated by the results of distribution normality testing with a Shapiro-Wilks test. Concurrent validity was evaluated using the Spearman correlation coefficient between participants' PIRS total scores and their degrees of hearing loss in both ears. The significance level for all statistical analyses was $p < 0.05$.

RESULTS AND DISCUSSION

The descriptive analysis of PIRS data obtained from participants with and without AHL is shown in Table 1.

The participants with AHL reported occasional hearing difficulties in adverse conditions (increased background noise or listening to softer sounds, such as TV or telephone conversations).

Table 1. *Descriptive statistics for the AHL group and the normal hearing (NH) group for all PIRS items. Data for section five are not shown for the normal hearing group because they did not own hearing aid(s).*

		Median		Mean		Standard deviation		Min. score		Max. score		Range	
PIRS	**Item**	**AHL**	**NH**	**AHL**	**NH**	**AHL**	**NH**	**AHL**	**NH**	**AHL**	**NH**	**AHL**	**NH**
Section 1	**1.**	2	0	2	0.5	0.78	0.71	0	0	3	2	3	2
	2.	2	0.5	2.05	0.8	0.78	1.23	0	0	3	4	3	4
	3.	2	1	2.38	1	0.72	1.05	1	0	4	3	3	3
	4.	1	0	0.89	0	0.84	0	0	0	3	0	3	0
	5.	2	1	2	1.2	0.75	1.23	0	0	3	4	3	4
	6.	2	0	2.08	0.5	0.80	0.85	1	0	3	2	2	2
	7.	1	00	1.62	0.3	0.92	.48	0	0	40	1	4	1
	8.	1	0	1.30	0.6	0.70	.84	0	0	3	2	3	2
	Total	13	4.5	14.32	4.9	4.53	5	6	0	24	16	18	16
Section 2	**9.**	2	0	2.03	0.4	1.01	0.84	0	0	4	2	4	2
	10.	2	0	1.81	0	0.94	2	0	2	4	2	4	2
	11.	2	0	1.49	0.2	0.77	0.42	0	2	3	1	3	1
	12.	1	0	1.14	0.2	0.71	0.63	0	2	3	2	3	2
	Total	6	0	6.46	0.8	2.83	1.62	0	0	12	5	12	5
Section 3	**13.**	1	0	0.86	0.2	0.75	0.42	0	0	2	1	2	1
	14.	2	0.5	2.08	0.8	0.76	1.03	1	0	3	3	2	3
	15.	2	0	2	0.6	0.58	0.84	1	0	3	2	2	2
	16.	3	1	2.57	0.9	0.60	0.99	1	0	4	3	3	3
	17.	2	0	1.89	0.3	0.77	0.67	1	0	3	2	2	2
	18.	1	0	1.22	0.1	0.48	0.32	1	0	3	1	2	1
	Total	11	2.5	10.62	2.9	2.77	3.10	5	0	16	10	11	10
Section 4	**19.**	2	0	1.54	0.3	0.87	0.48	0	0	4	1	4	1
	20.	2	0	1.70	0.3	0.66	0.48	0	0	3	1	3	1
	21.	2	1	1.95	1.1	0.85	1.29	0	0	3	4	3	4
	22.	1	0	1.27	0.3	0.77	0.48	0	0	3	1	3	1
	23.	2	0	1.62	0.3	0.72	0.95	0	0	3	3	3	3
	24.	2	0	1.46	0.6	0.84	0.84	0	0	3	2	3	2
	25.	2	0	1.62	0.3	0.72	0.48	0	0	3	1	3	1
	26.	1	0.5	1.46	0.6	1.04	0.70	0	0	4	2	4	2
	27.	2	0	1.70	0.3	0.74	0.67	0	0	3	2	3	2
	28.	1	0.5	1.16	0.7	0.87	0.82	0	0	3	2	3	2
	Total	21	6	21.24	4.8	5.69	4.49	8	0	34	11	26	11
Section 5	**29.**	2	-	1.76	-	0.68	-	1	-	3	-	2	-
	30.	1	-	1.02	-	0.37	-	0	-	2	-	2	-
	31.	2	-	2.46	-	0.65	-	1	-	4	-	3	-
	32.	2	-	1.89	-	0.77	-	1	-	3	-	2	-
	33.	1	-	1.57	-	0.73	-	1	-	3	-	2	-
	34.	2	-	1.51	-	0.96	-	0	-	3	-	3	-
	35.	1	-	0.76	-	0.86	-	0	-	3	-	3	-
	36.	1	-	0.81	-	0.81	-	0	-	3	-	3	-
	37.	3	-	2.645	-	0.72	-	1	-	4	-	3	-
	38.	1	-	0.89	-	0.77	-	0	-	2	-	2	-
	Total	21	-	15.92	-	4.98	-	7	-	24	-	17	-

Furthermore, listening difficulties partially reflected on their family and social life, but rarely caused financial issues (section 2). Considering speaker features and communication behaviors (section

Table 2. *Reliability analysis results of all PIRS sections*

PIRS	N	Reliability measures	Item	Item correlation with the total score	Cronbach's correlation coefficient after item removal
Section 1 (8 items)	47	Cronbach's reliability coefficient: 0.92 Intraclass correlation coefficient: 0.92 95% confidence interval: 0.86-0.95	1.	0.78	0.90
			2.	0.77	0.90
			3.	0.64	0.91
			4.	0.74	0.91
			5.	0.68	0.91
			6.	0.82	0.90
			7.	0.69	0.91
			8.	0.71	0.91
Section 2 (4 items)	47	Cronbach's reliability coefficient: 0.89 Intraclass correlation coefficient: 0.92 95% confidence interval: 0.83-0.94	9.	0.85	0.84
			10.	0.87	0.82
			11.	0.80	0.86
			12.	0.60	0.92
Section 3 (6 items)	47	Cronbach's reliability coefficient: 0.90 Intraclass correlation coefficient: 0.90 95% confidence interval: 0.84-0.94	13.	0.57	0.90
			14.	0.80	0.86
			15.	0.78	0.87
			16.	0.83	0.86
			17.	0.79	0.87
			18.	0.57	0.90
Section 4 (10 items)	47	Cronbach's reliability coefficient: 0.91 Intraclass correlation coefficient: 0.91 95% confidence interval: 0.86-0.94	19.	0.80	0.85
			20.	0.73	0.86
			21.	0.68	0.86
			22	0.68	0.86
			23.	0.19	0.88
			24.	0.78	0.85
			25.	0.75	0.86
			26.	0.62	0.86
			27.	0.74	0.86
			28.	0.68	0.86
Section 5 (10 items)	37	Cronbach's reliability coefficient: 0.86 Intraclass correlation coefficient: 0.86 95% confidence interval: 0.78-0.92	29.	0.50	0.85
			30.	0.23	0.87
			31.	0.60	0.85
			32.	0.64	0.84
			33.	0.29	0.87
			34.	0.67	0.84
			35.	0.63	0.84
			36.	0.68	0.84
			37.	0.69	0.84
			38.	0.73	0.83

3), participants with AHL reported on average listening difficulties that were relatively frequent, especially with multiple speakers, greater distance from the speaker(s), and less facial visibility of the speaker(s). Also, participants with hearing loss reported mild to moderate prominence of social and emotional difficulties and negative communication compensation strategies rooted in the above-mentioned functional hearing difficulties (section 4). Moreover, when evaluating hearing aid performance, participants expressed partial satisfaction with the ability to localize sounds and focus on specific sounds within background noise, speaker intelligibility, and clarity of environmental sounds. They expressed concerns related to the aid sometimes causing discomfort due to providing too

Table 3. *PIRS sections factor analysis*

PIRS	Item	Communalities	Factor loadings	Kaiser-Meyer-Olkin test	Bartlett's test of sphericity	Extracted component	Total explained variance
Section 1 (8 items)	1.	0.704	0.839	0.83	H2=253.72df=28 p=0.000	5.09	63.65%
	2.	0.697	0.835				
	3.	0.509	0.713				
	4.	0.658	0.811				
	5.	0.578	0.760				
	6.	0.754	0.868				
	7.	0.579	0.761				
	8.	0.613	0.783				
Section 2 (4 items)	9.	0.847	0.920	0.82	H2=123.37df=6 p=0.000	3.06	76.48%
	10.	0.873	0.935				
	11.	0.790	0.889				
	12.	0.549	0.741				
Section 3 (6 items)	13.	0.450	0.671	0.87	H2=159.111 df=15 p=0.000	3.95	65.88%
	14.	0.759	0.871				
	15.	0.734	0.857				
	16.	0.794	0.891				
	17.	0.750	0.866				
	18.	0.466	0.683				
Section 4 (10 items)	19.	0.809	0.900	0.82	H2=160.30 df=45 p=0.000	6.32	63.21%
	20.	0.651	0.807				
	21.	0.487	0.698				
	22.	0.474	0.688				
	23.	0.724	0.851				
	24.	0.654	0.809				
	25.	0.495	0.703				
	26.	0.624	0.790				
	27.	0.497	0.705				
	28.	0.519	0.720				
Section 5 (10 items)	29.	0.288	0.537	0.83	H2=253.72df=28 p=0.000	4.05	40.47%
	30.	0.065	0.254				
	31.	0.412	0.642				
	32.	0.486	0.697				
	33.	0.093	0.305				
	34.	0.501	0.708				
	35.	0.491	0.701				
	36.	0.547	0.740				
	37.	0.565	0.751				
	38.	0.600	0.774				

much gain for loud sounds. Overall, the least satisfaction was noted with the visibility of the hearing aid and the price–to–perceived-benefit ratio.

As expected, the hearing participants' average results were different from the mean results of the group with hearing loss, with the most frequent answers indicating lack of hearing difficulties and

the effects on communication, social, and emotional functioning.

Reliability analysis results for the five PIRS sections are shown in Table 2. Based on the George and Mallery (2003) criteria, high reliability (alpha greater than 0.9) was obtained for section 1, measuring hearing ability in different acoustic environments (alpha = 0.92), section 4, assessing communication habits and speaker reactions (alpha = 0.91), and section 3, evaluating the effects of speaker characteristics and behaviors on listening difficulties (alpha = 0.9). Good reliability was established for PIRS section 2, measuring the effects of hearing difficulties on everyday activities (alpha = 0.89) and section 5, evaluating satisfaction with the hearing aid and its perceived benefit for the user (alpha = 0.86). Intraclass correlation coefficients and their 95% confidence intervals, shown in Table 2, also show high repeatability of PIRS section totals.

Furthermore, table 2 provides information about item correlation with the section totals and alpha values after item removal. The results indicate that only three PIRS items do not exhibit acceptable correlation coefficient values with their section totals, as defined by the correlation coefficient greater than 0.4 (Gliem & Gliem, 2003). These include item 23 (*People I talk to warn me I do not answer their questions*), item 30 (*Female and male voices sound very similar to me*) and item 33 (*Loud sounds cause discomfort or pain*). It is also important to mention that the removal of item 12 (*Hearing difficulties cause financial problems for me*), despite its appropriate correlation coefficient value, positively influences overall reliability, changing it from good to high.

Table 3 shows construct validity analysis results for PIRS sections. Using Bartlett's sphericity test and the Kaiser-Meyer-Olkin test confirmed that factor analysis is suitable to use with the current PIRS dataset. Its application extracted one factor per section. The uni-dimensionality of sections, high communalities of items with sections and high factor loadings of items in each section onto the extracted factor (greater than 0.5) suggest the stability of five extracted factors (Costello & Osborne, 2005). These factor analysis results confirm than all five sections of PIRS are valid in what they purport to measure: listening ability in various acoustic environments (section 1), the effects of hearing difficulties on everyday activities (section 2), the effects of speaker features and behaviors on hearing difficulties (section 3), communication habits and speaker reactions (section 4), and hearing aid satisfaction and user's perceived benefit (section 5). It is indicative that the final PIRS section shows the least stability of the original items in defining the section construct, as it contains low communality items, such as item 34 (*Female and male voices sound very similar to me*) and item 39 (*Loud sounds cause discomfort or pain for me*), which do not share even 10% of shared variance with other items in the extracted factor (Pallant, 2007). However, the stability of this factor is defined by other eight items with factor loadings greater than 0.5 (Costello & Osborne, 2005).

Results of discriminant validity analysis of the PIRS sections are presented in table 4. The comparison of section totals of participants with and without hearing loss revealed significant differences between the two groups, indicating that all four analyzed sections possess discriminant validity.

Table 4. *Comparison of four PIRS section totals for participants with and without hearing loss*

PIRS	Group/N**	Mean rank	Sum of ranks	Mann-Whitney test	
				U	p
SECTION 1	AHL (37)	28.22	1044	29	0.000*
	NH (10)	8.40	84		
SECTION 2	AHL (37)	28.46	1053	20	0.000*
	NH (10)	7.50	75		
SECTION 3	AHL (37)	28.55	1056.5	16.50	0.000*
	NH (10)	7.15	71.5		
SECTION 4	AHL (37)	28.84	1067	6	0.000*
	NH (10)	6.10	61		

*statistically significant at $p<0.05$

**AHL – participants with acquired hearing loss; NH – normal hearing participants

The results of the concurrent validity analysis of PIRS sections are presented in table 5. These findings indicate that PIRS sections exhibit concurrent validity as shown by significant positive values of Spearman's correlation coefficient between section totals obtained by participants with AHL and degrees of hearing loss in each ear.

Table 5. *Correlation between PIRS section totals of participants with AHL and their audiological characteristics.*

	PIRS				
	SECTION 1	**SECTION 2**	**SECTION 3**	**SECTION 4**	**SECTION 5**
Degree of hearing loss in the left ear	0.42*	0.38*	0.31	0.39*	0.42*
Degree of hearing loss in the right ear	0.49*	0.40*	0.42*	0.45*	0.33*

*statistically significant at $p<0.05$

DISCUSSION

The current study revealed that the PIRS questionnaire was relatively straightforward to administer and interpret. The majority of participants needed approximately 20 to 30 minutes to fill it out, which is acceptable considering its length. Also, the distribution of the mean results of participants with hearing loss suggests an appropriate range or "weight" of PIRS sections, avoiding ceiling or floor effects. Moreover, descriptive data analysis can provide insight into the daily functional hearing and listening difficulties of the participants with AHL, their communication strategies, and consequential speaker reactions, as well as their attitudes regarding hearing aid benefit. The possibility of administration and interpretation of selected PIRS sections seems to be clinically useful, as sometimes only specific information are needed in the clinic (Dillon, 2012).

Also, the obtained Cronbach's alpha values and intraclass correlation coefficients indicate that PIRS sections exhibit the potential to *reliably* measure hearing ability in various acoustic environments (section 1), the effects of hearing difficulties on daily activities (section 2), the influence of speaker characteristics and their behaviors on listening difficulties (section 3), communication habits and speaker reactions to them (section 4), and finally, satisfaction with hearing aid and perceived hearing aid benefit. Moreover, the findings clearly show that PIRS sections have the potential to *validly* measure the five constructs detailed above. Their validity is also suggested by high correlations between the degree of hearing loss and all PIRS section totals, indicating that the sections have the potential to represent the following relations: (a) the proportional relations between higher degrees of hearing loss and greater (self-assessed) hearing difficulties and more severe communication, social, and emotional consequences and (b) the inverse relations between higher degrees of hearing loss and lower scores on the self-assessed hearing ability with hearing aid(s) and satisfaction with the aid(s).

However, the findings of the current study yield further questions regarding possible modifications of some parts of PIRS to make it more reliable and valid. For example, item 12 in PIRS section 2 should be reworded or even excluded from PIRS, as it was presumed that it evaluated possible economic consequences of AHL such as change in job positions or even loss of work. Instead, it is possible that this item is semantically associated with the added costs of hearing aid fitting and repairs rather than financial burdens caused by the loss of main income. Low communality values and low factor loadings of items 30 and 33 can be interpreted in two ways. These characteristics can indicate the necessity of adding new items to PIRS section 5 to possibly create another factor or, alternatively, removing them from PIRS. It is important to note, though, that the former suggestion does not seem practical due to the increased number of items and the time needed to complete the questionnaire, whereas the latter warrants further assessment of the section's construct possible disintegration (Osbourne & Costello, 2005) and the loss of important information related to aural rehabilitation outcomes. The latter concern is valid as both items carry important information regarding hearing aid performance, so it would be advisable to first attempt to modify these items linguistically. Overall, it is possible to conclude that PIRS has the potential for further evaluation regarding its application in quantifying AHL rehabilitation outcomes. It seems that additional linguistic modification and adaptation of some of the PIRS items might make it more clinically useful.

In addition to validity and reliability, one of the main indicators of clinical applicability of a rehabilitation outcome measure is its sensitivity or the ability to register changes in the observed construct or characteristic (Hefford et al., 2011). The current

study did not include analyses that would indicate possible changes in the perception of hearing difficulties, the resulting communication, social and emotional issues, hearing aid performance, and hearing aid satisfaction after some form of treatment (counseling, auditory training, and other services). This research shows that assessment instruments similar to PIRS can show changes in these areas within three months of hearing aid fitting (Yueh et al., 2005). This information warrants further testing of PIRS clinical efficacy in a way that will analyze the results at two or more time points, at the beginning of aural rehabilitation (hearing aid fitting session) and three or more months after continuous rehabilitation. Finally, future studies of clinical applicability of the modified PIRS version would benefit from a greater number of participants divided into more homogenous groups based on their audiological, demographic, and socio-economic characteristics, as well as the inclusion of additional variables, such as number and type of hearing aids, number of hours hearing aids are used daily, and different ways of providing auditory training and counseling.

CONCLUSION

The current study was aimed at providing a preliminary assessment of the reliability and validity of the PIRS questionnaire. The obtained findings of the analysis of these psychometric properties should be observed in two ways. First, they suggest the potential of the five PIRS sections to reliably and validly quantify hearing difficulties in different sound environments, the influence of listening difficulties on daily activities, the effects of speaker characteristics and their behavior on hearing difficulties, communication habits and strategies as well as satisfaction with hearing aid(s), and the user's perceived hearing aid benefit. Secondly, the results provide a good starting point for further PIRS adaptation and modifications and warrant future studies that will analyze its psychometric properties in more detail, with the aim of evaluating its clinical application as an outcome measure of rehabilitation of acquired hearing loss.

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APPENDIX

PIRS original questionnaire items

AURAL REHABILITATION OUTCOMES PROFILE (PIRS)
Self-assessment aural rehabilitation outcome questionnaire
Second version

Section 1: Acoustic environment				
1. I have difficulty hearing when I'm outside (in the street, at the market, in the park or a playground).				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
2. I have a hard time hearing in large, closed rooms (churches, halls, stairways, etc.)				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
3. I do not experience any problems when listening in noisy environments such as restaurants, coffee shops, waiting rooms, etc.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
4. I experience hearing difficulties even in quiet environments such as my bedroom.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
5. With different background noise, coming from home appliances or tools, I cannot hear other sounds, such as other people speaking.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
6. I have difficulty listening to TV or radio.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
7. I can easily hold a telephone conversation.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
8. I do not notice door bells, telephones ringing, car honking, public transport announcements, etc.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
Section 2: Everyday activities				
9. The way I hear affects the relationship with my family.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
10. My hearing supports my social life.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
11. I miss out on hobbies because of my hearing.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
12. Hearing difficulties create financial problems for me.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
Section 3: Speaker characteristics				
13. I can easily follow a conversation with a familiar person in a quiet environment.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
14. I have difficulty participating in a conversation with multiple persons, even in a quiet environment.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
15. I can understand strangers I talk to, regardless of the environment we are in.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
16. I can understand a person I talk to, even if that person is far away from me.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
17. I do not understand the person I talk to if I do not see his/her face.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
18. It is easier for me to understand male speakers than female speakers and children.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐

Section 4: Communication habits and speaker reactions				
19. I avoid starting conversations or try to end them.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
20. I can easily follow a conversation even though I do not know the topic.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
21. I pretend to understand conversations.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
22. I am ashamed to ask people I talk to to repeat themselves.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
23. People I talk to say I do not answer their questions.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
24. While conversing, I react inappropriately or give a wrong answer.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
25. People tell me I talk too loudly.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
26. I can hear the TV very well.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
27. The way I hear annoys the people I talk to.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
28. Family and friends praise my good hearing.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
Section 5: Hearing aid satisfaction				
29. It is challenging for me to localize sounds or a speaker's voice.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
30. Female and male voices sound almost the same to me.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
31. In noisy environments, I can easily pick out a sound I want to focus on.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
32. The people I talk to mumble and other sounds are unclear.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
33. Loud sounds cause discomfort or pain for me.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
34. My hearing aid whistles.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
35. I can easily put on my hearing aid(s) and do not have issues manipulating it.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
36. Hearing aid maintenance seems complicated.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
37. Everybody notices that I cannot hear well because I wear hearing aid(s).				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐
38. The benefit I get from hearing aid(s) equals its cost and time invested in its maintenance.				
Almost never ☐	Rarely ☐	Sometimes ☐	Often ☐	Almost always ☐

Scoring

Items 3, 7, 10, 13 15, 16, 20, 26, 28, 31, 38	Almost never = 4 points; Rarely = 3 points; Sometimes = 2 points; Often = 1 point; Almost always = 0 points
Other items	Almost never = 0 points; Rarely = 1 points; Sometimes = 2 points; Often = 3 point; Almost always = 4 points

PRELIMINARNA ANALIZA POUZDANOSTI I VALJANOSTI UPITNIKA PROFIL ISHODA REHABILITACIJE SLUŠANJA

Sažetak: *Cilj ovog rada je provedba preliminarne analize pouzdanosti i valjanosti Profila ishoda rehabilitacije slušanja (PIRS) – upitnika samoprocjene namijenjenog kvantifikaciji funkcionalnih teškoća slušanja s obzirom na zvučno okruženje i obilježja sugovornika (1., 3. i 5. dio), učestalost pojave različitih kompenzacijskih komunikacijskih strategija i izraženost socio-emocionalnih posljedica SOS-a (4. dio), stupanj utjecaja SOS-a na svakodnevne aktivnosti (2. dio) te kvalitetu slušne izvedbe i zadovoljstvo dodijeljenim slušnim pomagalom (5. dio). Analiza navedenih metrijskih obilježja svakog pojedinog dijela PIRS-a provedena je na uzorku od 47 odraslih sudionika (37 korisnika slušnog pomagala i 10 čujućih osoba), a uključila je analizu Cronbachovih koeficijenata pouzdanosti i međuklasnih korelacijskih koeficijenata, provedbu faktorske analize, primjenu Mann-Whitney U Testa u ispitivanju razlika u samoprocjeni između čujućih i sudionika s oštećenjem sluha te korelacijsku analizu stupnjeva oštećenja sluha i rezultata samoprocjene. Rezultati navedenihpostupaka pokazali su da svi dijelovi PIRS-a posjeduju pouzdanost i valjanost čiji potencijal opravdava daljnje ispitivanje njihovih metrijskih svojstava s ciljem provjere kliničke primjene PIRS-a kao mjere ishoda rehabilitacije SOS-a.*

Ključne riječi: *stečeno oštećenje sluha, mjere ishoda rehabilitacije, samoprocjena, Profil Ishoda Rehabilitacije Slušanja (PIRS), pouzdanost, valjanost*