Int. Adv. Otol. 2009; 5:(1) 80-86

ORIGINAL ARTICLE

Results of Factorial Validity and Reliability of the International Outcome Inventory for Hearing Aids in Turkish

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Objective; The International Outcome Inventory for Hearing Aids (IOI-HA) with seven-item questionnaire is used to evaluate the effectiveness of audiological rehabilitation programme utilizing hearing aids. Factor analysis of the subscales of the IOI-HA has been previously reported for English and Dutch translations, but not for the Turkish Language. Thus, the main objective of this study was to evaluate the internal consistency and factorial (construct) validity of the IOI-HA that was translated to Turkish.

Materials & Methods; Participants were 45 hearing impaired adults (23 male, 22 female) who were included in audiological rehabilitation programme between January 2006 and June 2007. The study was performed in tertiary referral center, Dokuz Eylül University, Medical School, Department of Otolaryngology. The mean age of subjects was 64.15 ± 13.8 years. Average pure-tone thresholds at frequencies of 0.5, 1 and 2 kHz (PTA1) of the aided ear were ranged from 33 dB HL to 78 dB HL with a mean of 51.7 ± 10.1 dB HL. Mean speech discrimination score was 70.2%±18.08. Forty-five adult patients were evaluated by using IOI-HA as a part of the audiological rehabilitation programme.

Results; The factor analysis yielded strong support for a unifactorial structure of the scale, and a high internal consistency of the inventory ($p<0.05$) (Cronbach's alpha value were found to be 0.773 at first month and 0.783 at sixth month). It is interpreted that the IOI-HA translated to Turkish has enough reliability and factorial validity.

Conclusion; This version can be used in the evaluation of the hearing aid satisfaction in Turkish hearing impaired population.

Submitted : 20 March 2008 *Revised : 27 November 2008* *Accepted : 27 November 2008*

In the hearing aid industry, consumer satisfaction is defined as the degree of reducing the impact of the hearing loss in their lives. It is used to judge the success or failure of all aspects of the hearing-aid selection and fitting processes. It is widely accepted that the successful hearing aid fittings require measurement of hearing-impaired subjects' satisfaction.

The International Outcome Inventory for Hearing Aids (IOI-HA) was developed for assessment of rehabilitative planning [1] to assess the usefulness of the fitted hearing aid in patients' daily life. The effectiveness of the hearing aid was measured by IOI-HA inventory having seven items targeting different domains of satisfaction. Seven item instrument measures the following domains respectively: daily use (USE), benefit (BEN), residual activity limitations (RAL), satisfaction (SAT), residual participation restrictions (RPR), impact on others (IoO) and quality of life (QoL). This self assessment inventory was developed for use in research settings to facilitate the co-operation among researchers in different hearing healthcare settings. This inventory also has potential

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applications in clinical evaluation of hearing aid fitting outcomes. Inventory, which was originally produced in English, has been translated into more than 20 languages [2] and was widely used in the hearing aid rehabilitation programmes. After translation of IOI-HA into different languages and using for patients from different nationalities, the reliability-validity and factor analysis were required [3].

The translation of the inventory (Addendum-1) into Turkish was performed by the authors (Addendum- 2). Validity of the Turkish version is assessed in several dimensions such as content, construct (factorial), as well as criterion related (concurrent and predictive). There are few internal consistency and validity studies based on inventory data obtained from patients of different nationalities. Thus, the present study was designed to investigate internal consistency and factorial validity of IOI-HA for a Turkish population. This study may be replicated for other populations in different countries.

By using self assessment inventory, the present study was also aimed to find an answer to the following questions and to determine the reliability and factorial validity of the Turkish version of IOI-HA instrument by analyzing its factorial structure.

Study Questions:

1. Is Turkish version of IOI-HA applicable for Turkish hearing impaired population?

2. Is the factorial structure of the IOI-HA variable among the nations?

3. Is Cronbachs' alpha value for Turkish version of IOI-HA sufficient for clinical use?

4. Is there any correlation between the total score of Turkish version of IOI-HA and speech discrimination scores?

Materials & Methods

Participants:

Forty-five (23 males and 22 females) hearing impaired adults who were first time hearing aid users served as participants in the present study. The mean age of subjects was 64.15± 13.8 years, with the age ranges between 28 to 85 years.

Out of forty-five adults with hearing loss, thirty-four patients (75.5 %) were fitted with behind-the-ear, six (13.4 %) were fitted with in-the-ear, and five (11.1%) were fitted with in-the-canal hearing aids. Eighty-five percent of the participants were using their hearing aids unilaterally.

Procedures:

After the clinical examination by otolaryngologist, their audiological assessments were performed (including pure-tone audiometry, acoustic immitancemetry, speech discrimination score test and evoked oto-acoustic emission test) by an experienced audiologist, at Dokuz Eylul University, Medical School, Department of Otolaryngology, between January 2006 and June 2007. The audiological parameters of the study group were as follow: Average pure-tone thresholds at frequencies of 0.5, 1 and 2 kHz (PTA1) of the aided ears were ranged from 33 dB HL to 78 dB HL with a mean of 51.7 ± 10.1 dB HL. Mean speech discrimination score was 70.2% ± 18.08. The degree of hearing loss of the fitted ear was mild (26-40 dB HL) for 3 (6.7%), moderate (41-55 dB HL) for 28 (62.2%), moderately severe (56-70 dB HL) for 12 (26.7%) and severe (71-90 dB HL) for 2 (4.4%) patients based on PTA1 values.

After fitting the hearing aids binaurally or monaurally, participants were included in audiological rehabilitation programme in which counseling the patients concerning their hearing loss, explaining the speech reading and contextual aspects of communication and encouragements for maximal use of the fitted hearing aid or aids. After discussing the rehabilitation procedure, all participants were given detailed information concerning the study. Only the participants who were volunteered to participate into the study at 1st and 6th months post-fitting were included. Participants were asked to fill the inventory at hospital. They were instructed to circle the answer that best reflects his/her experience with the fitted hearing aids. After the patients were completed the

IOI-HA inventory, clinician simply added up the numbers for each of the answers to the seven questions. The confidentiality of the responses was assured as much as possible. Assistance was provided only when requested by the participants to clarify any questions in order to obtain accurate responses.

Scoring of the Inventory:

A rating of 1-5 is assigned to each of the seven questions, with higher ratings indicating greater satisfaction/ benefit. Thus, the higher score is indicative of a better outcome. Based on clinical research, if a patient obtains a score of 22 or greater, it means that there is significant benefit and satisfaction for the hearing aids. This makes the test easy to use, and it provides an efficient way to standardize the satisfaction measures of rehabilitation programme.

Results

Audiological parameters were compared with IOI-HA total score by using Pearson's Bivariate Correlation Analysis. Factorial (construct) validity was assessed by inter-item and inter-scale correlations and exploratory factor analysis (principal components with varimax rotation). Cronbach's[4] alpha coefficient (an indicator of internal consistency of the scale) was used to assess how reliable the scale in measuring a single underlying construct. The intraclass correlation coefficient was used to explore the test-retest reliability. Statistical analysis was performed using SPSS 11.0 for Windows.

Validation and correlation tests were applied to all raw data from IOI- HA scores. There was no significant difference between test-retest sessions of IOI-HA (1st and 6th month) ($p>0.05$). Figure 1 presents relative frequency distributions of response scores for the IOI-HA items obtained at different sessions. Higher scores represent better outcomes.

When the correlation analysis were performed using Pearson's bivariate correlation analysis, no significant correlation was found between audiological parameters and IOI-HA total scores at 1st and 6th month (Table 1). However, there was strong correlation between items and total score (Table 2).

The factor analysis resulted in a uni-factorial structure, and the item 1, USE value was found to be different from the others. The factor loadings for all items were as high as 0.70, except item 1 (Table 3).

Cronbach's alpha coefficient values were used in the reliability assessment of IOI-HA. Cronbach's Alpha

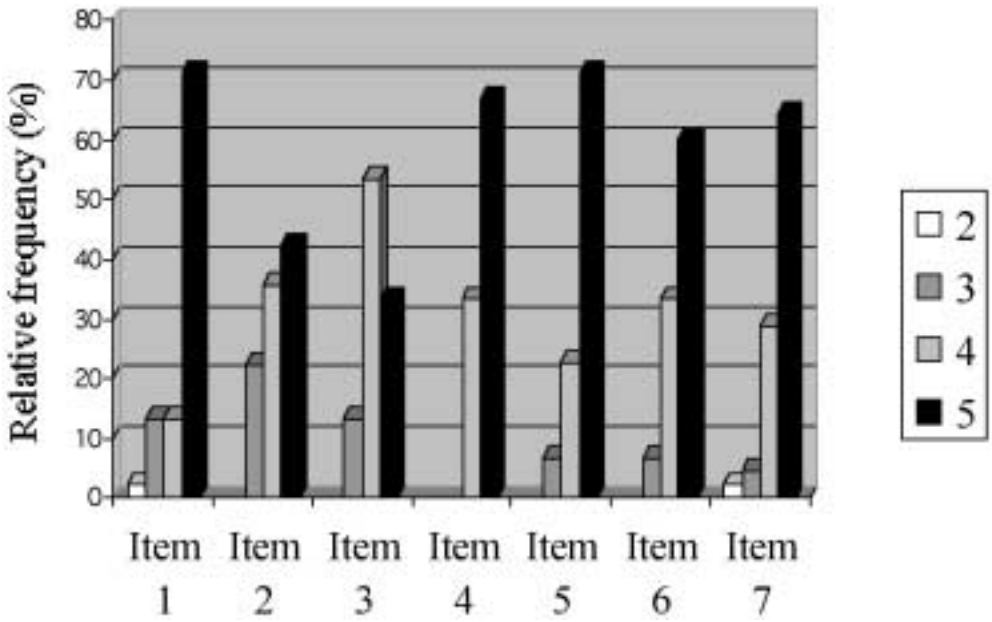

Figure 1. Relative frequency distributions of response scores for the IOI-HA items obtained at test-retest sessions, i.e. at 1st month (upper panel) and 6th month (bottom panel) (n=45)

Table 1. Results of Pearson's bivariate correlation analysis between audiological parameters and total scores (r values) of Turkish version of IOI-HA.

	AGE	**PTA_1**	**PTA_2**	**SRT** (Speech Reception Threshold)	**SDS** (Speech Discrimination Score)	**1st** Month Total Score	**6th** Month Total Score
AGE	1	-.006	.101	.008	-.361*	-.366*	-.366*
PTA_1		1	.785**	.919**	-.266*	.139	.112
PTA_2			1	.657**	-.419*	.092	.004
SRT				1	-.149*	.083	.083
SDS					1	.120	.117
First Month Total Score						1	.753**
Sixth Month Total Score							1

p<0.05
p<0.01

Table 2. Inter-item correlations of Turkish version of IOI-HA at 6th month (r values).

	Item 1 (USE)	**Item 2** (BEN)	**Item 3** (RAL)	**Item 4** (SAT)	**Item 5** (RPR)	**Item 6** (IoO)	**Item 7** (QoL)	**Total** Score foR 6th month
Item 1	1	,360*	,228	,212	,280	,356*	,417*	,567**
Item 2		1	,604**	,492*	,456*	,630**	,704**	,824**
Item 3			1	,409*	,513**	,608**	,591**	,760**
Item 4				1	,556**	,560**	,582**	,677**
Item 5					1	,521**	,536**	,699**
Item 6						1	,825**	,851**
Item 7							1	,887**
Total Score of 6th month								1

p<0.05
p<0.01

Table 3. The factor loadings of IOI-HA (Turkish version)

	First Month Component	**Sixth Month Component**
IOI-HA Items	1	1
Item 1	0.538	0.489
Item 2	0.791	0.812
Item 3	0.783	0.757
Item 4	0.848	0.723
Item 5	0.727	0.725
Item 6	0.714	0.868
Item 7	0.781	0.894

values was found to be 0.773 for the first month , and 0.783 for the sixth month .

Discussion

In the study by Cox and Alexander8, severity of hearing losses was presented as follow: 37% mild to moderate, 36% moderately severe and 27% severe sensorineural hearing loss. The same categories were used in the present study and the distribution was as follow: 6.7% mild, 62.2% moderate, 26.7% moderately severe and 4.4% were severe sensorineural hearing loss. The most significant difference in the distribution was observed in severe hearing loss. Non-availability of any subject in the profound hearing loss category in studies was incidental. These demographical characteristics are well comparable to those described in previous studies concerning psychometric properties of the IOI-HA[5-9].

While Vestergaard[5] and Heuermann[6] have defined the degree of hearing loss as a mean of 250-8000 Hz pure tone thresholds, Hickson[7] has defined as a mean of 500-4000 Hz. Whereas Kramer has defined as a mean of 1,2 and 4 kHz pure tone thresholds. In the present study, both PTA1 (average pure tone thresholds at frequencies of 0.5, 1 and 2 kHz) and PTA2 (average pure tone thresholds at frequencies of 1, 2 and 4 kHz) values were calculated. Calculated values were used in the statistical analysis.

There was no significant correlation in the comparison of the total score of IOI-HA and audiological findings (PTA1, PTA2, SDS, SRT) in both 1st and 6th month data ($p>0.05$). The present study was carried out with 45 adults with the mean age of 64.15±13.8 years. On the other hand, age data were significantly correlated with IOI-HA total scores ($p<0.05$). These findings correlated with the study by Vestegaard[5].

In this study the correlation levels of Item 1 (USE) with other items and total score were lowest. The inter-item and total item score correlations were similar to studies by Heuermann, Hickson and Kramer [6,7,9]. Probably it is related to the fact that Item 1 (USE) is not related to satisfaction directly. Item 7 (QoL) showed the highest item-total correlation values since Item 7 measures the satisfaction directly and coincides to the main purpose of the inventory. Item 7 scores of this study were very close to those of results by Heuermann et al. 6 The values of item-total correlations (except Item 1, (USE)) were high. This was interpreted that all the items of Turkish version of IOI-HA measure the same domain (factorial validity). The exploratory factor analysis of the IOI-HA translated to Turkish, showed unifactorial structure. However, the original version and other translations of IOI-HA have showed 2 or 3 factorial structure [5-9]. The factor loading values of all items except item 1 were higher than 0.7. In the present study, there was only item 1 (factor loading values = First Month: 0.538, Sixth Month: 0.489, Table 3) has differentiated from the others but it couldn't change the factorial profile since it has not got enough loading value. The low value of item 1 was supported by its low score in inter-item and total correlation analysis. In the studies by Hickson [7], Cox [8] and Kramer[9] have displayed the comparable score, and these authors explained it as a possible cause of misunderstanding of the individual item. In this study, assistance was provided in order to prevent misunderstanding when requested by the participants. Thus, described manner of filling out the inventory in this study may have contributed to unifactorial structure score of the inventory.

Conclusion

As a conclusion, the IOI-HA is considered to be a reliable and valid instrument for hearing impaired patients, in order to evaluate their satisfaction with hearing aids. The translation of IOI-HA to another language (i.e. Turkish), have no negative effect in terms of reliability and factorial (construct) validity level. However, it is found that the factorial structure of the instrument may be variable among the nations. The higher Cronbach's alpha value of IOI-HA and its unifactorial structure implies that this inventory can be used in clinical assessment studies. However, no correlation was found between the speech discrimination scores and total scores of IOI-HA.

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Addendum-1:

INTERNATIONAL OUTCOME INVENTORY - HEARING AIDS (IOI-HA) (ENGLISH VERSION)

1. Think about how much you used your present hearing aid(s) over the past two weeks. On an average day, how many hours did you use the hearing aid(s)?

none	less than 1 hours a day	1 to 4 hours a day	4 to 8 hours a day	more than 8 hours a day

2. Think about the situation where you most wanted to hear better, before you got your present hearing aid(s). Over the past two weeks, how much has the hearing aid helped in that situation?

Helped not at all	helped slightly	helped moderately	helped quite a lot	helped very much

3. Think again about the situation where you most wanted to hear better. When you use your present hearing aid(s), how much difficulty do you STILL have in that situation?

very much difficulty	quite a lot of difficulty	moderate difficulty	slight difficulty	no difficulty

4. Considering everything, do you think your present hearing aid(s) is worth the trouble?

not at all worth it	slightly worth it	moderately worth it	quite a lot worth i	very much worth it

5. Over the past two weeks, with your present hearing aid(s), how much have your hearing difficulties affected the things you can do?

affected very much	affected quite a lo	affected moderately	affected slightly	affected not at all

6. Over the past two weeks, with your present hearing aid(s), how much do you think other people were bothered by your hearing difficulties?

bothered very much	bothered quite a lot	bothered moderately	bothered slightly	bothered not at all

7. Considering everything, how much has your present hearing aid(s) changed your enjoyment of life?

Worse	no change	slightly	quite a lot better	very much better better

Addendum-2:

INTERNATIONAL OUTCOME INVENTORY - HEARING AIDS (TURKISH TRANSLATION)

İŞİTME CİHAZI DEĞERLENDİRME ENVANTERİ:

1. Son iki hafta boyunca kendi cihazınızı ne kadar sıklıkta kullandığınızı göz önüne alarak, ortalama olarak bir günde ne kadar süre ile işitme cihazınızı kullandınız?

Hiç(1) *1 saatten az (2)* *1-4 saat (3)* *4-8 saat (4)* *8 saatten fazla (5)*

2. Cihazınızı kullanmaya başlamadan önceye göre, iyi duymayı en çok istediğiniz ortamları göz önüne aldığınız takdirde, son iki hafta boyunca cihazınız size ne kadar yardımcı olmuştur?

Hiç (1) *Çok az (2)* *Orta derecede (3)* *Oldukça fazla (4)* *Çok fazla (5)*

3. Cihazınızı kullanmaya başlamadan önceye göre, iyi duymayı en çok istediğiniz ortamları göz önüne aldığınız takdirde, son iki hafta boyunca şimdiki cihazınızı kullandığınız halde hala ne kadar sıkıntı yaşıyorsunuz?

Çok fazla (1) *Oldukça fazla (2)* *Orta derecede (3)* *Çok az (4)* *Hiç (5)*

4. Her şeyi göz önüne aldığınızda, işitme cihazınız verdiği sıkıntıya değer mi?

Değmez (1) *Çok az değer (2)* *Hafif derecede değer (3)* *Orta derecede değer (4)* *Tamamen değer(5)*

5. Son iki hafta boyunca, mevcut işitme cihazınız takılı iken, işitme kaybınız yapacağınız işleri ne denli olumsuz etkiledi?

Çok fazla (1) *Oldukça fazla(2)* *Orta derecede (3)* *Hafif (4)* *Hiç etkilemedi(5)*

6. Son iki hafta boyunca, mevcut işitme cihazınız takılı iken, yakınlarınız sizin işitme kaybınızdan dolayı ne ölçüde rahatsız oldular?

Çok fazla(1) *Oldukça fazla(2)* *Orta derecede(3)* *Hafif (4)* *Hiç olmadılar(5)*

7. Herşeyi gözönüne alarak değerlendirdiğinizde, işitme cihazını kullanmak sizin yaşamınızdan zevk almanızı ne kadar etkiledi?

Çok fazla (1) *Oldukça fazla (2)* *Orta derecede (3)* *Çok az (4)* *Hiç (5)*

1. AY SKORU: ..... **6. AY SKORU: .....** **1.YIL SKORU: .....**