

# ICF-Based Analysis of Psychological and Functional Aspects of Tinnitus

Ms. Madhumita James<sup>1</sup>, Dr. Arun Banik<sup>2</sup>

<sup>1</sup>Audiologist and Speech Therapist, Nalco Hospital, Angul, Odisha

<sup>2</sup>Head, Material Development Department, Ali Yavar Jung National Institute of Speech and Hearing Disabilities, Mumbai

Corresponding Author: Ms. Madhumita James

## ABSTRACT

The conceptual International Classification of Functioning Disability and Health (ICF) framework which defines functioning and disability in a new broader, universal perspective has been used to study tinnitus. 22 adults between 30-60 years with tinnitus were included in the study. Routine audiological assessment was followed by administering THI, HHIA and HADS on the subjects. To enhance the context of response, concept mapping of the scales to domains under BF and AP of ICF was done prior to administration. Kappa statistic showed moderate agreement for THI ( $k=0.519$ ,  $p=0.005$ ), fair agreement for HHIA ( $k=0.519$ ,  $p=0.04$ ) and moderate to substantial agreement for HADS ( $k=0.595$ ,  $p=0.02$ ) items. Comparison of performance scores between Body Functions (BF) and Activities and Participation (AP) using Mann Whitney test showed statistically significant high mean score of 32.27 for BF compared to 12.73 for AP ( $U=27$ ,  $p<0.05$ ). Findings indicated psychological issues related to tinnitus were more dominant compared to functional issues. Kruskal - Wallis test conducted to study the comparisons of AP and BF scores across the THI severity grades showed no significant difference ( $\chi^2=3.15$ ,  $p=0.20$ ) of AP scores, whereas BF scores varied significantly across THI severity levels ( $\chi^2=6.28$ ,  $p=0.03$ ). This suggested an equal impact of tinnitus on Activity Limitation and Participation Restriction (AL/PR) of subjects irrespective of its perceived severity.

**Key Words:** International Classification of Functioning Disability and Health, Activity Limitation, Participation Restriction, Tinnitus, Anxiety, Depression

## INTRODUCTION

International Classification of Functioning Disability and Health (ICF) is a universally shared standard framework given by WHO (2001) in its 54<sup>th</sup> World Health Assembly. [1] It is the revised version of International Classification of Impairment, Disability and Handicap (ICIDH, 1980) which underrated the underlying social and environmental factors contributing towards an individual's overall functioning. [2] ICF categories and domains serve as a building block with new

perspectives for measurement of functioning and disability in the field of rehabilitation and medicine. [3] It serves as a platform which comprehensively fuses biomedical, social, emotional, attitudinal, personal and environmental areas of an individual affected by a health condition. 'Body structure' and 'functions' (BS & BF) and 'Activities and Participation' (AP) are the two ICF domains under functioning and disability. Functioning of an individual is defined by his body functions, activities and participation whereas as impairments,

activity limitation and participation restriction (AL/PR) defines the disability. [4]

The use of ICF for classification and measurement of functioning is primarily in the form of two approaches: either to map an existing health status measure to ICF or to construct an ICF based scale for the required purpose. The former method makes use of tools like ICF checklists and ICF Core Sets, depending upon applicability and availability. Mapping can be both 'qualitative', making use of linkage rules [5-7] and 'quantitative', making use of Rasch model for transforming information. [8] Mapping facilitates researchers to select ideal health status measurements for any given health condition, thereupon using it based on ICF framework.

Tinnitus is a common otologic condition with increase in incidence over the years. Approximately 15% to 20% of the world's populations suffer from tinnitus and in 25% of the affected population; the condition interferes with daily activity. Quality of life is severely affected in 1% to 3% of cases. [9] This distressing otologic problem is described by a host of audiological, somatic and psychological symptoms. Byung et al [10] reported close association of tinnitus with reduced hearing sensitivity at frequencies above 3 kHz in cases with noise induced tinnitus or at low frequencies at 125Hz or 250Hz in Meniere's disease. Poor speech discrimination in noise may coexist in some cases. Impaired psychological symptoms like concentration difficulties, insomnia, loss of sleep, vertigo, emotional stress, irritability and annoyance are common features in individuals with chronic tinnitus. [11] Studies from time and now have indicated anxiety and depression a common comorbid psychological correlates of tinnitus. [12-16] Impact of this associated psychological condition can be far wide, ranging from reduced involvement in work related activities and interpersonal problems to decreased enjoyment in life participation activities or even panic attacks. However, the perceived severity of problem varies depending upon the individual's coping

behaviour. The impact of tinnitus is not determined solely by its psychoacoustic characteristics but also by the effect of its comorbidities and contextual factors. [17] Lack of standard objective measures to examine these associated factors in tinnitus makes way for the use of subjective self-assessment questionnaires. A host of standard measures are available for assessment of tinnitus and its comorbid conditions. However, each measure stratifies the results according its own imperative format. The lack of a unifying framework to compile the findings of all aspects of an individual's tinnitus was first pointed by Meikle. [18] He described the applicability of ICF conceptual framework to study tinnitus severity. Unlike the ICF Core sets for hearing loss [19] there are no available ICF core sets for tinnitus. Hence in order to study the features of tinnitus in ICF framework, the possibilities could be either to map the existing standard tinnitus specific scales to ICF or construct an ICF based patient-oriented scale. Self-report generic health status measurement scale based on ICF can be used as well. James and Mukundan [20] studied the validity of use of WHODAS 2.0, a culturally sensitive ICF based tool developed from a comprehensive set of items related to activity and participation component of ICF along with Tinnitus Handicap Inventory (THI) on tinnitus subjects. Results indicated WHODAS 2.0 efficiently capturing the ICF concepts and identifying the affected areas.

The present study aims to profile and examine the domains of ICF which would describe the areas of functioning and disability of tinnitus patient. This would enable a schematic assessment of impairment (mental or physical functions) and its consequent functional aspects (activity limitation and participation restriction) due to tinnitus.

## **MATERIALS AND METHODS**

### **Subjects**

Twenty two adults (Male= 12, Female=10) within the age range of 30 to 60

years (Mean= 44.5yrs, SD=8.39) with a primary auditory complain of subjective unilateral or bilateral continuous tinnitus for not less than 3 three months were selected for the study. Individuals reporting comorbid conditions like vestibular, neurological, psychological and/or middle ear pathologies were excluded. Included subjects either had bilateral normal hearing sensitivity or associated bilateral sensorineural hearing loss upto moderately severe degree [21] in the poorer ear with normal otoscopy findings.

### Procedure

Brief case history of subjects including demographic variables followed by details related to tinnitus onset, nature, occurrence pattern, variations since onset, self-verbal description of tinnitus type, treatment options opted or any specific preventive measures undertaken were documented. Organic conditions like hearing status was also noted which assisted in ascertaining the eligibility of the subject as a sample for the study.

Visual examination of ear canal and tympanic membrane of both the ears were done prior to pure tone audiometry. Audiometry was conducted in a sound treated room to determine the hearing thresholds using MAICO MA-42, dual channel audiometer, with TDH -39 supra-aural headphones and MX-41 cushion and a Radio Ear B71 bone vibrator calibrated to ANSI-S-3.6 (1996) standards. Immittance Audiometry was done using Interacoustics AT235h immittance audiometer with 226 Hz probe tone (calibrated to manufacturer's specifications) for each subject to rule out middle ear pathology, if any.

For profiling frequency (pitch) and intensity (loudness) of tinnitus, Pure Tones (Continuous, Pulse and Warble) and/or Noise (Narrowband, White and Speech) stimuli were presented at possible frequencies following the procedure adapted for tinnitus assessment from Gore, 2006. The case was instructed verbally to first match his tinnitus pitch to the pitch of the test tone

presented contralaterally. The matched tone is then compared with other tones an octave above and below it to ensure any possibility of octave confusion. This was followed by matching tinnitus loudness at the matched pitch tone. A written consent was taken from each subject prior to conducting the various examinations.

### Tools used

Three separate self-rating questionnaires: Tinnitus Handicap Inventory (THI), Hearing Handicap Inventory for Adults (HHIA) and Hospital Anxiety and Depression Scale (HADS) were administered on the subjects post clinical measures. HHIA was administered only on those who had hearing loss. ICF manual was used to map the items of the questionnaires to an appropriate ICF category so as to obtain results in ICF framework.

#### **Tinnitus Handicap Inventory (THI):** [22]

It is a 25 items standard questionnaire used most extensively on tinnitus subjects for both clinical and research purposes. Items are subdivided into 3 categories: emotional=08 items, functional = 12items and catastrophic= 05 items. Scores range from 0-100. Degree of perceived handicapped are categorised as: slight (0-16), mild (18-36), moderate (38-56), severe (58-76), and catastrophic (78-100). It is a psychometrically robust tool with a test-retest reliability of 0.92.

#### **Hearing Handicapped Inventory for Adults (HHIA):** [23]

This is a 25 item questionnaire with a test retest reliability of 0.97. Items are subdivided into social scale=12items, emotional Scale: 13 items. Scoring is obtained in percentage score. Score range are: 0-16%=no handicap, 18-42%=mild-moderate handicap and above 44%=significant handicap.

#### **Hospital Anxiety and Depression Scale (HADS):** [24]

This scale of 14 items is a valid and reliable tool for assessing anxiety and depression of clinically ill patients. The maximum score of the tool is 42, 21 each for either subscale of anxiety and

depression. Each item is rated on a 4 point scale ranging from 0-3. Overall test score between 0-7 is 'normal', whereas 'borderline abnormal' score is between 8-10. Score ranging between 11-21 indicates 'abnormal' case exhibiting psychological morbidity that is a potential case of depression and anxiety. The validity of use of HADS in tinnitus patients has already been established. [14]

### **Tool Linking Procedure**

The International Classification of Functioning, Disability, and Health (ICF) [4] is a multifaceted extensive classification from WHO family of international classifications, designed to assess and document a wide range of information related to any health status in a composite manner.

The ICF has two parts, each containing two separate components: Part 1: covers functioning and disability and includes the components: Body functions (b) and structure (s); and Activities and participation (d). Part 2: covers contextual factors and includes the components: Environmental factors (e) and Personal factors. An ICF code is an alphanumeric representation consists of the letters b, s, d, and e which refer to the respective components of the classification. It is followed by a numeric code representing the content chapters and its domains. Mapping standard health measures to ICF involves assigning the most appropriate ICF alphanumeric code to the test items applying the standard linking rules.

The items of THI and HHIA were linked to the ICF separately by two judges each, who were audiologists and had experience of working with ICF for not less than 5 years. HADS was mapped to ICF by two clinical psychologists who had a work experience with hearing disordered population and ICF for not less than 5 years. Linking was done based on ICF linking rules. [6] To reach out to a consensus between the two judges for coding items of the questionnaires in case of any disagreements, a third judge with experience

of using ICF for practical and research purposes for not less than a period of 10 years was referred.

Tool linking was carried out in two main steps: (1) Identification of Concept: Main and additional concepts were identified from within the item construct of the scales. A single item could have more than one concept. (2) Linking the identified concept to the most appropriate ICF code. Codes were assigned either at the 3-digit level (e.g. b152) or at the fourth-digit level (e.g. b1522) based upon the suitability and extent of match. The alphanumeric ICF code b1522 was interpreted as per the following example: 'b' denotes Body Functions, 'b1' denotes first level (1-digit) i.e. chapter level 'mental functions'; '52' the next 2-digits denotes second level i.e. 'emotional functions'; and the last one digit '2' is the third level denoting further precise classification 'range of emotion'. Clinical assessments however are mapped slightly differently. The aim or the purpose of the test which it intends to measure was identified, which were then assigned an ICF code.

### **Statistical Analysis**

The data was analysed using SPSS 20.0 for windows version 16.0.

Cohen's kappa statistic was applied to verify the inter-rater agreement for the ICF codes assigned to the questionnaire items by the raters.

Descriptive statistics showed the frequency distribution of subjects under the various parameters selected for the study. Percentage analysis was done on the reported attributes of tinnitus and the conducted psychoacoustic evaluation.

Performance scores of subjects between Body functions and Activities and Participation was studied using Mann Whitney test.

Kruskal-Wallis test was conducted to study the comparisons of Activities and Participation and Body functions across the THI severity grades.

## **RESULTS**

**Assigning ICF codes to test items**

Inter rater agreement for the assigned ICF codes were statistically verified by using Cohen’s kappa for the three tools separately. There was moderate agreement between the raters for THI (k= 0.519, p=0.005), fair agreement for HHIA (k= 0.519, p=0.04) and moderate to substantial agreement for HADS (k= 0.595, p=0.02). All the test agreements were statistically significant. The assigned codes to the 64 items are given in [Appendix I, II](#) and [III](#). Scales item distribution under the various ICF categories is enlisted in [Appendix IV](#).

**Demographic variables and Attributes of tinnitus**

Twenty two cases with subjective tinnitus of continuous type (male-12; 54.5% and female-10; 45.5%) with a mean age of 44.5yrs (SD=8.39) were included in the study. Sixteen (73%) of the total subjects had unilateral tinnitus, 4 individuals (18.2%) reported bilateral tinnitus and 2 (9.1%) cases could not lateralise tinnitus to either ear. Hearing loss was present in 12 (54.5%) cases with a mean duration of 1.2yrs (SD=1.4). From among them, 3 (13.6%) subjects were hearing aid users. A detailed case history revealed the associated comorbid conditions like diabetes mellitus (20%), hypertension (20%), gastritis (8%) and thyroid (4%). There were four (18.2%) cases each, who reported of vertigo and hyperacusis. As per the obtained data on the occupational background, none had a history of occupational or sudden noise exposure. About 59% reported tinnitus existing for more than a year. The details of subjective attributes reported by the individuals are given in Table 1. A majority of subjects (31.8%) reported tinnitus to be of ringing type. However they were some cases (9.1%) who were unable to describe the sound they heard. 40.9% reported tinnitus to be more devastating when they were in quiet places whereas 31.9% accorded lack of sleep to be the cause of

enhanced tinnitus. Nearly 77.3% stated tinnitus remaining unaltered all the time.

**Table: 1 Subjective attributes of tinnitus**

<b>Type of sound perceived:</b>	
Ringing	31.8%
Buzzing	27.3%
Hissing	22.7%
Pulsatile	9.1%
Others	9.1%
<b>Conditions which aggravates tinnitus</b>	
Noisy place	13.6%
Quiet place	40.9%
Change in head position	9.1%
Sleep disturbance	31.8%
Mental stress	40.9%
Excitement	9.1%
Unspecified	27%
<b>Conditions which dampens tinnitus</b>	
Noisy Area	18.2%
Hearing Aid usage	4.5%
Remains unaltered	77.3%

As environmental conditions like low ambient noise levels aggravated tinnitus and noisy area served as a tinnitus relieving agent (18.2%), this reflected the influence of contextual factors on health conditions. Mental stress had similar worsening effect on 40.9% of the tinnitus individuals. Pan et al [25] in his study had reported similar findings. Both the affected areas that are mental stress and ambient noise levels are specified areas in the ICF framework reflecting the ‘body functions’ and ‘environmental factors’ respectively. Similar to findings of [26] Stouffer and Tyler tinnitus perception was unaltered in 77.3% of cases irrespective of variations in the immediate surroundings or mental state. Lack of sleep (31.8%) was another major cause aggravating tinnitus. Crolein et al [27] showed co-existences of sleep disturbances like reduced sleep efficiency, wake up after sleep onset and longer subjective sleep latencies in chronic tinnitus cases which impaired their quality of life. ICF documents all these areas precisely under ‘Sleep functions’ classified under ‘mental functions’. Use of hearing aid was benefitting though only 4.5% of the users reported of it. ICF records the use of hearing aid in ‘assistive products and technology for communication’ section classified under ‘Environmental factors’.

**Clinical measures**

The subjective attributes of tinnitus was further examined through clinical diagnostic protocol through psychoacoustic evaluation of hearing sensitivity and tinnitus matching (Table 2). Majorly 50% of the sample had tinnitus ranging between 1kHz to 4kHz, matched most closely to NBN (40.9%). Loudness of tinnitus was however soft for 68.2% of the cases. As according to Ceiza et al [6] updated ICF linking rules, clinical measures administered on the subject determines the health status of the individual and therefore needs to be addressed using the ICF reference framework to define a complete health condition. It is the objective of a specific clinical measure that is identified as the ‘concept’ which is linked to the ICF. Mapping the clinical measure to ICF increases the efficiency of selecting an appropriate intervention goal. In our study, pure tone audiometry and tinnitus matching were conducted. The test objectives aptly reflected the ‘hearing functions’ and ‘sensations associated with hearing functions’ respectively which are classified under ‘body functions’. Similarly tympanometry conducted with the aim to examine the middle ear status reflected the ‘structure of middle ear’ classified under ‘body structure’ of the ICF framework.

**Table: 2 Details of Psychoacoustic evaluation of tinnitus**

Matched tinnitus pitch	
Low (<500 Hz)	9.1%
Medium(1kHz – 4kHz)	50.0%
High (8kHz – 12kHz)	40.9%
Matched stimulus type	
Pure tone	22.7%
Pulse tone	36.4%
NBN	40.9%
Matched tinnitus intensity	
Soft (0-10 dBSL)	68.2%
Loud (>10 dBSL)	31.8%
Octave confusion	
Positive	4.5%
Negative	95.5%

**Performance on THI, HHIA and HADS**

All of the items of the three scales could be linked on one-to-one basis to the categories of the ICF. The items were classified under ICF categories of ‘body function’ (BF) and ‘activities and

participation’ (AP). Table 3 shows the mean scores of each domain under the two categories. Results indicated a high score (mean=27.5, SD=11.5) in mental functions indicating more difficulties in areas like emotional functions, temperament and personality issues, psychomotor functions, maintaining attention and ideal thought functions and sleep disturbances. The most severely affected areas under the activities and participation domains were interpersonal interactions and relationships, community social and civic life and learning and applying knowledge. A noteworthy aspect of using ICF frame work to study the results from multiple scales, is the representation of outcome measures of various scales on a single common universally accepted framework, irrespective of the number of tool variants used on a subject. This enables a unique amalgamation of different facets of an individual on a continuum. The affected areas of tinnitus patients are vividly described in a multifaceted manner using ICF domains (Table 3). Thus, the ICF framework precisely identifies the concerned areas of life of tinnitus sufferers basing upon which an intervention model can be prepared for both group and individual application. Such models act as a facilitator for symptomatic intervention as problem perceived due to tinnitus is a subjective factor which varies among individuals depending upon their coping and defence mechanisms used, personality traits and personal attitudes towards tinnitus.

**Table: 3 Mean scores of various subdomains under BF and AP**

Body function	Mean	SD
Mental functions	27.5	11.5
Sensory functions and pain	4.3	1.8
<b>Activities and Participation</b>		
Community social and civic life	8.73	6.9
Domestic life	1.17	1.8
Applying knowledge and learning	7.73	8.9
Interpersonal relations	9.18	8.2
Communication	3.0	2.6
Major life areas	1.09	1.6

**Comparison of scores between body functions and activity and participation**

A comparative analysis between the overall scores of the two ICF component body functions and activities and participation using Mann Whitney U test (Table 4) showed a statistically significant high mean score of 32.27 for body functions in comparisons to 12.73 for activities and participation (U = 27, p <0.05). These findings indicated that psychological issues related to tinnitus were more dominant compared to functional issues. Ramkumar and Rangasayee [17] had reported similar findings on tinnitus subjects suggesting impact of tinnitus on body functions greater than on activity limitation and participation restriction. It indicates that individual with

tinnitus may still be competent enough to fulfill their roles at a personal or societal level in spite of their health condition. So as to say, the impact of tinnitus is more 'invisible' than 'visible'. Although they were no such evidences of any case with extreme variants of mental functions in our study sample, however this possibility cannot be completely ruled out for all individuals with tinnitus. Further, this finding has to be kept in knowledge for future policy making in India, for individuals claiming compensation for permanent tinnitus induced due to noise or other medico-legal conditions.

**Table: 4 Test statistic on performance on BF and AP**

N	BF scores	AP scores	
Mean Rank	22	32.27	12.73
Sum of Ranks	710	280	
Mann Whitney U	Z	Asymp.Sig.(2-tailed)	
Test Statistics <sup>a</sup>	27	-5.051	<0.0005
A Grouping Variable: Group			

**Comparison of scores between body functions and activity and participation across the THI severity levels**

The difference in mean scores of BF and AP was studied across THI severity levels. The Kruskal Wallis test (Table 5) results revealed no significant difference ( $\chi^2=3.15$ ,

p=0.20) of AP scores across THI severity levels suggesting an equal impact on functional areas irrespective of tinnitus severity. However, mean scores of BF varied significantly across mild, moderate and severe THI levels ( $\chi^2=6.28$ , p=0.03).

**Table: 5 Comparison of AP and BF performance scores at different THI severity levels**

	Group	n	Mean Rank	Test statistics (Kruskal-Wallis)		
				d.f.	$\chi^2$ test	p value
AP scores	Mild	4	10.38	2	3.151	0.20
	Moderate	12	12.46			
	Severe	6	14.67			
BF scores	Mild	4	9.62	2	6.287	0.03
	Moderate	12	14.33			
	Severe	6	19.83			

It can be inferred from this results, that the severity of tinnitus is not a factor that predicts the functionality of the individual. In other words, even a mild degree of tinnitus can cause severe activity limitation and participation restriction in subjects. This indicates that the severity ratings measures are insufficient to address the activity limitation and participation restriction in tinnitus. The composite scores of rating scales may conceal the actual affected areas of functioning pertaining to

tinnitus. Therefore the current study highlights the utility of the ICF framework in documentation of health condition-tinnitus and tinnitus related measures across its classified domains.

**DISCUSSION**

As evident, the effect on mental functions was more predominant in the subjects and increased with the ascending severity of tinnitus. However its reciprocal impact on AL/PR was not significant in the

subjects. This turns our focus on the adequate coping mechanisms used by the tinnitus subjects. Hallberg et al [28] had studied some phenomenal variants in coping strategies adapted by individuals with tinnitus and hearing loss. He categorised coping strategies broadly into two categories: general coping strategies to deal with stressful events and specific communication strategies to tackle demanding auditory situations. These areas can be taken up for future research in the present context.

Often the role of an audiologist is to perform clinical assessment, collect subjective responses, planning and administering suitable intervention and counselling patients with tinnitus. Use of ICF in profiling a case report aids in adopting suitable measures for these stages. Results from this present study highlights the significance of good counselling to a tinnitus case which should be an integral part of intervention model. Bauch et al [29] stated there might be issues related to disclosure of personal information or personal problems or experiences which could prove be devastating or fatal at one end. In such instances, clinical audiologist should be prudent and decisive regarding when and how to make referrals to psychology or psychiatry.

Also, similar study can be conducted to examine any improvement in the outcome measures following an intervention. Comparison of body function and activities and participation can be further studied between individuals reporting of only tinnitus and those with tinnitus and hearing loss in future.

## **CONCLUSION**

This study had most vividly described the health condition 'tinnitus' at an impairment level explained through identified categories of body structure and functions, and at a functioning and disability level explained through identified areas of activity limitation and participation restriction. Diagnostic terms like 'anxiety'

and 'depression' become redundant as the ICF codes describe the various comorbid psychological symptoms in terms of 'mental functions'. Hence, in the present study, ICF based analysis of tinnitus has not only surfaced a broader picture of impairment, functioning and disability than the traditional approaches but also defined them in common universal language.

There are possibilities for hearing care professionals to view their practice within the narrowly defined aspects of aural rehabilitation and treatment. This, in turn, might create a create gap and minimize contributions of the profession to broader areas of life where functional communication plays key role. Although the existing standard tools are excellent measures to study the conditions and issues related to tinnitus, they may not engulf the complete sphere of events the subject undergoes in his day to day living. Use of ICF based classification fills this gap to a larger extent. However as every individual is a separate identity so are the areas of perceived difficulties. This study poses limitation on the key issue of individual briefing and personalised assessment which would enable the researcher to get a deeper insight of a tinnitus sufferer in terms of his 'environmental' and 'personal' conditions. As it is difficult to customize the standard measures to individual needs, mapping the identified areas from personal interviews to ICF can further resolve this issue.

At the same time, it is emphasized that ICF is no substitute for these instruments. Based on the interactive model of ICF, this study has shown how the results of using three different ICF linked scales reflect a relationship between the identified impairments and its correlated disability areas in individual with tinnitus. These findings further suggest that the ICF classification can be used as a cardinal reference for existing health-status measures.

## REFERENCES

1. Stucki G. International Classification of Functioning, Disability, and Health (ICF): a promising framework and classification for rehabilitation medicine. *Am J Phys Med Rehabil.* 2005 Oct;84(10):733–40.
2. Bickenbach JE, Chatterji S, Badley EM, Üstün TB. Models of disablement, universalism and the international classification of impairments, disabilities and handicaps. *SocSci Med.* 1999;48(9):1173–87.
3. Stucki G, Kostanjsek N, Ustün B, Cieza A. ICF-based classification and measurement of functioning. *Eur J PhysRehabil Med.* 2008 Sep;44(3):315–28.
4. WHO. International Classification of Functioning, Disability and Health (ICF) [Internet]. WHO. [cited 2018 Oct 5]. Available from: <http://www.who.int/classifications/icf/en/>
5. Cieza A, Brockow T, Ewert T, Amman E, Kollerits B, Chatterji S, et al. Linking health-status measurements to the international classification of functioning, disability and health. *J Rehabil Med.* 2002 Sep;34(5):205–10.
6. Cieza A, Geyh S, Chatterji S, Kostanjsek N, Ustün B, Stucki G. ICF linking rules: an update based on lessons learned. *J Rehabil Med.* 2005 Jul;37(4):212–8.
7. Cieza A, Fayed N, Bickenbach J, Prodinger B. Refinements of the ICF Linking Rules to strengthen their potential for establishing comparability of health information. *DisabilRehabil.* 2016 Mar 17;1–10.
8. Cieza A, Hilfiker R, Boonen A, Chatterji S, Kostanjsek N, Ustün BT, et al. Items from patient-oriented instruments can be integrated into interval scales to operationalize categories of the International Classification of Functioning, Disability and Health. *J ClinEpidemiol.* 2009 Sep;62(9):912–21, 921.e1-3.
9. Swain SK, Nayak S, Ravan JR, Sahu MC. Tinnitus and its current treatment--Still an enigma in medicine. *J Formos Med Assoc Taiwan Yi Zhi.* 2016 Mar;115(3):139–44.
10. Han BI, Lee HW, Kim TY, Lim JS, Shin KS. Tinnitus: Characteristics, Causes, Mechanisms, and Treatments. *J ClinNeurol Seoul Korea.* 2009 Mar;5(1):11–9.
11. Härter M, Maurischat C, Weske G, Laszig R, Berger M. [Psychological stress and impaired quality of life in patients with tinnitus]. *HNO.* 2004 Feb;52(2):125–31.
12. Harrop-Griffiths J, Katon W, Dobie R, Sakai C, Russo J. Chronic tinnitus: association with psychiatric diagnoses. *J Psychosom Res.* 1987;31(5):613–21.
13. Simpson RB, Nedzelski JM, Barber HO, Thomas MR. Psychiatric diagnoses in patients with psychogenic dizziness or severe tinnitus. *J Otolaryngol.* 1988 Oct;17(6):325–30.
14. Zöger S, Svedlund J, Holgers K-M. The Hospital Anxiety and Depression Scale (HAD) as a screening instrument in tinnitus evaluation. *Int J Audiol.* 2004 Sep;43(8):458–64.
15. Falkenberg E-S, Wie OB. Anxiety and Depression in Tinnitus Patients: 5-Year Follow-Up Assessment after Completion of Habituation Therapy. *International Journal of Otolaryngology.* 2012
16. Gül AI, Özkırış M, Aydın R, Şimşek G, Saydam L. Coexistence of anxiety sensitivity and psychiatric comorbidities in patients with chronic tinnitus. *Neuropsychiatr Dis Treat.* 2015;11:413–8.
17. Ramkumar V, Rangasayee R. Studying tinnitus in the ICF framework. *Int J Audiol.* 2010 Sep;49(9):645–50.
18. Vernon JA, Meikle MB. Tinnitus: clinical measurement. *OtolaryngolClin North Am.* 2003 Apr;36(2):293–305, vi.
19. Granberg S, Swanepoel DW, Englund U, Möller C, Danermark B. The ICF core sets for hearing loss project: International expert survey on functioning and disability of adults with hearing loss using the international classification of functioning, disability, and health (ICF). *Int J Audiol.* 2014 Aug;53(8):497–506.
20. James M, Mukundan G. Use of WHODAS 2.0 in Tinnitus Patients: Correlating Results with THI.
21. Clark JG. Uses and abuses of hearing loss classification. *ASHA.* 1981 Jul;23(7):493–500.
22. Newman CW, Jacobson GP, Spitzer JB. Development of the Tinnitus Handicap Inventory. *Arch Otolaryngol Head Neck Surg.* 1996 Feb;122(2):143–8.
23. Newman CW, Weinstein BE, Jacobson GP, Hug GA. Test-Retest Reliability of the Hearing Handicap Inventory for Adults. *Ear Hear.* 1991 Oct;12(5):355.

24. Zigmond AS, Snaith RP. The hospital anxiety and depression scale. *ActaPsychiatr Scand.* 1983 Jun;67(6):361–70.
25. Pan T, Tyler RS, Ji H, Coelho C, Gogel SA. Differences Among Patients That Make Their Tinnitus Worse or Better. *Am J Audiol.* 2015 Dec;24(4):469–76.
26. Stouffer JL, Tyler RS. Characterization of tinnitus by tinnitus patients. *J Speech Hear Disord.* 1990 Aug;55(3):439–53.
27. Crönlein T, Langguth B, Geisler P, Hajak G. Tinnitus and insomnia. *Prog Brain Res.* 2007;166:227–33.
28. Hallberg LR-M, Erlandsson SI, Carlsson SG. Coping strategies used by middle-aged males with noise-induced hearing loss, with and without tinnitus. *Psychol Health.* 1992 Oct 1;7(4):273–88.
29. Bauch CD, Lynn SG, Williams DE, Mellon MW, Weaver AL. Tinnitus impact: three different measurement tools. *J Am Acad Audiol.* 2003 Jun;14(4):181–7.

### Appendix I

THI items	ICF code	Item description
1. Because of your tinnitus it is difficult for you to concentrate?	b1400	sustaining attention – special mental functions – Body functions
2. Does the loudness of your tinnitus make it difficult for you to hear	b230	hearing functions – Body functions people?
3. Does your tinnitus make you angry?	b1522	range of emotions – emotional functions – Body functions
4. Does your tinnitus make you confused?	b126	temperament and personality functions – Body functions
5. Because of your tinnitus are you desperate?	b152	emotional functions – Body functions
6. Do you complain a great deal about your tinnitus?	b126	temperament and personality functions – Body functions
7. Because of your tinnitus do you have trouble falling asleep at night?	b1341	onset of sleep – sleep functions – Body functions
8. Do you feel as though you cannot escape from your tinnitus?	b160	thought functions - Body functions
9. Does your tinnitus interfere with your ability to enjoy social activities (such as going out to dinner or to the cinema)?	d920	recreation and leisure – community social and civic life - AP
10. Because of your tinnitus do you feel frustrated?	b152	emotional functions – Body functions
11. Because of your tinnitus do you feel that you have a terrible disease?	b160	thought functions - Body functions
12. Does your tinnitus make it difficult to enjoy life?	d920	recreation and leisure – community social and civic life - AP
13. Does your tinnitus interfere with your job?	d8451	maintaining a job –work and employment – AP;
	d640	doing housework – domestic life - AP
14. Because of your tinnitus do you find that you are often irritable?	b152	emotional functions – Body functions
15. Because of your tinnitus is it difficult for you to read?	d166	reading – learning and applying knowledge - AP
16. Does your tinnitus make you upset?	b152	emotional functions – Body function
17. Do you feel that you tinnitus had placed stress on your relationships with members of your family and/ or friends?	d760	family relationship – interpersonal interaction and relationship - AP
	d750	informal social relationships - - interpersonal interaction and relationship – AP
18. Do you find it difficult to focus your attention away from tinnitus and Body functions on to other things?	b1401	shifting attention - special mental functions –
19. Do you feel you have no control over your tinnitus?	b160	thought functions - Body functions
20. Because of your tinnitus do you often feel tired?	b130	energy and drive functions - Body functions
21. Because of your tinnitus do you feel depressed?	b152	emotional functions – Body function
22. Does your tinnitus makes you feel anxious?	b1522	range of emotions – emotional functions – Body functions
23. Do you feel you can no longer cope with your tinnitus?	b160	thought functions - Body functions
24. Does your tinnitus get worse when you are under stress?	b240	sensations associated with hearing and vestibular functions – Body functions
25. Does your tinnitus make you insecure?	b126	temperament and personality functions – Body functions

### Appendix II

HHIA items	ICF code	Item description
1. Does your hearing problem cause you to use the phone less often than you would like?	d3600	using telecommunication devices –communication - AP
2. Does your hearing problem cause you to feel embarrassed when meeting new people?	b152	emotional functions – Body function
3. Does your hearing problem cause you to avoid groups of people?	d710	basic interpersonal interaction - - interpersonal interaction and Relationships - AP
4. Does your hearing problem make you irritable	b126	temperament and personality functions – Body functions

5.	Does your hearing problem cause you to feel frustrated when talking to members of your family?	b152	range of emotions – emotional functions – Body functions
6.	Does your hearing problem cause you difficulty when attending a party?	d9205	socialising - recreation and leisure – community social and civic life - AP
7.	Does your hearing problem cause you difficulty hearing/ understanding co-workers, clients , or customers?	d115	listening – learning and applying knowledge - AP
8.	Do you feel handicapped by your hearing problem?	b160	thought functions - Body functions
9.	Does your hearing problem cause you difficulty when visiting friends, relatives or neighbours?	d750	informal social relationships -- interpersonal interaction and Relationship – AP
10.	Does your hearing problem cause you to feel frustrated when talking to co-workers, clients, or customers?	b152	emotional functions – Body function
11.	Does your hearing problem cause you difficulty in the movies or theatre?	d9202	arts and culture - recreation and leisure – community social and civic life - AP
12.	Does your hearing problem cause you to be nervous?	b152	emotional functions – Body function
13.	Does your hearing problem cause you to visit friends, relatives or neighbours less often than you would like?	d9205	socialising - recreation and leisure – community social and civic life - AP
14.	Does your hearing problem cause you to have arguments with family members?	d355	discussion – communication - AP
15.	Does your hearing problem cause you difficulty when listening to TV or radio?	d115	listening – learning and applying knowledge - AP
16.	Does your hearing problem cause you to go shopping less often than you would like?	d6200	shopping – acquisition of goods and services – domestic life - AP
17.	Does any problem or difficulty with your hearing upset you at all?	b152	emotional functions – Body function
18.	Does your hearing problem cause you to want to be by yourself?	d799	interpersonal interactions and relationships – interpersonal Interactions and relationships - AP
19.	Does your hearing problem cause to talk to family members less often than you would like?	d760	family relationship – interpersonal interaction and relationship –AP
20.	Do you feel that any difficulty with your hearing limits or hampers your personal or social life?	d9205	socialising - recreation and leisure – community social and civic life - AP
21.	Does your hearing problem cause you difficulty when in a restaurant with relatives or friends?	d9205	socialising - recreation and leisure – community social and civic life - AP
22.	Does your hearing problem cause you to feel depressed?	b152	emotional functions – Body function
23.	Does your hearing problem cause you to listen to TV or radio less often than you would like?	d115	listening – learning and applying knowledge - AP
24.	Does your hearing problem cause you to feel uncomfortable when talking to friends?	d7202	regulating behaviours with interactions – interpersonal interactions and relationships - AP
25.	Does your hearing problem cause you to feel left out when you are with a group of people?	d710	basic interpersonal interaction -- interpersonal interaction and Relationships - AP

### Appendix III

HADS items	ICF code	Item description
1. I feel tense or wound up:	b152	emotional functions – Body function
2. I still enjoy the things I used to enjoy:	b126	temperament and personality functions – Body functions
3. I get a sort of frighten feeling as if something awful is about to happen:	b152 b1602	emotional functions – Body function; content of thought – thought functions – specific mental Functions -- Body functions
4. I can laugh and see the funny side of things:	b126	temperament and personality functions – Body functions
5. Worrying thought go through my mind	b126	temperament and personality functions – Body functions
6. I feel cheerful:	b1265	optimism - temperament and personality functions – Body functions
7. I can sit at ease and feel relaxed:	b1263	psychic stability -temperament and personality functions – Body functions
8. I feel as if I am slowed down:	b1470	psychomotor control – specific mental functions – mental Functions - Body functions
9. I get a sort of frightened feeling:	b1522	range of emotions – emotional functions – Body functions
10. I have lost interest in my appearance:	b130	energy and drive functions – mental functions – Body functions
11. I feel restless as I have to be on the move:	b1470	psychomotor control – specific mental functions – mental functions - Body functions
12. I look forward with enjoyment to things:	b1265	optimism - temperament and personality functions – Body functions
13. I get sudden feelings of panic:	b152	emotional functions – Body function
14. I can enjoy a good book or radio or TV program:	b126	temperament and personality functions – Body functions

**Appendix IV**

**Identified concept distribution of THI, HHIA and HADS items under ICF components**

<b>Components</b>	<b>Domains</b>	<b>THI</b>	<b>HHIA</b>	<b>HADS</b>
Body function	Mental functions	18	8	14
	Sensory functions and pain	2	-	-
Activities and Participation	Learning and applying knowledge	1	3	-
	General tasks and demands	-1	-	-
	Communication	-	2	-
	Domestic Life	1	1	-
	Interpersonal Relations	2	5	-
	Major life areas	1	-	-
	Community social and civic life	2	5	-
	Total identified concepts	27	25	14

How to cite this article: James M, Banik A. ICF-based analysis of psychological and functional aspects of tinnitus. Int J Health Sci Res. 2018; 8(11):226-237.

\*\*\*\*\*