

Problems and life effects experienced by tinnitus research study volunteers: an exploratory study using the ICF classification

Vinaya Manchaiah^{1,2,3,4}, Eldré W. Beukes⁵, Sarah Granberg^{6,7}, Naresh Durisala⁸, David M. Baguley^{5,9,10}, Peter M. Allen^{5,11} & Gerhard Andersson^{12,13}

1. Department of Speech and Hearing Sciences, Lamar University, Beaumont, Texas, USA
2. Linnaeus Centre HEAD, Swedish Institute for Disability Research, Department of Behavioral Science and Learning, Linköping University, Linköping, Sweden
3. Audiology India, Mysore, Karnataka, India
4. Department of Speech and Hearing, School of Allied Health Sciences, Manipal University, Karnataka, India
5. Department of Vision and Hearing Sciences, Anglia Ruskin University, Cambridge, United Kingdom
6. The Swedish Institute for Disability Research (SIDR), School of Health Sciences, Örebro University, Örebro, Sweden
7. Audiological Research Center, Örebro University Hospital, Örebro, Sweden
8. GN Hearing Pte Ltd, 2 Kallang Avenue, #07-19, CT Hub, Singapore
9. National Institute for Health Research - Nottingham Hearing Biomedical Research Unit, Division of Clinical Neuroscience, School of Medicine, University of Nottingham, Nottingham, United Kingdom

10. Otology and Hearing Group, Division of Clinical Neurosciences, Faculty of Medicine,
University of Nottingham

11. Vision and Eye Research Unit, Anglia Ruskin University, Cambridge, United Kingdom

12. Department of Behavioral Sciences and Learning, Linköping University, Linköping,
Sweden

13. Department of Clinical Neuroscience, Division of Psychiatry, Karolinska Institute,
Stockholm, Sweden

Corresponding author: Dr. Vinaya Manchaiah

Communication address: Department of Speech and Hearing Sciences,
Lamar University, Beaumont, Texas 77710, USA

Email: vinaya.manchaiah@lamar.edu

Tel: +1 (409) 880 8927

Fax: +1 (409) 880 2265

Abstract

Background: Tinnitus is one of the most distressing hearing-related symptoms. It is often associated with a range of physiological and psychological complications such as depression, anxiety, and insomnia. Hence, approaching tinnitus from a biopsychological perspective may be more appropriate than from purely a biomedical model.

Objective: The current study was aimed at determining the relationship between tinnitus and the problems and life effects experienced by UK based tinnitus research study volunteers. Open-ended questions were used. Responses were classified using the International Classification of Functioning, Disability and Health (ICF) framework in order to understand the impact of tinnitus in a multidimensional manner using a bio-psychosocial perspective.

Method: A cross-sectional survey design was used in a sample of 240 adults with tinnitus who were interested in undertaking an Internet-based intervention for tinnitus. The data were collated using two open-ended questions. The first focused on problems related to having tinnitus, and the second to life effects as a result of tinnitus. Responses were analysed using a simplified content analysis approach to link concepts to ICF categories according to established linking rules. A Wilcoxon Signed Rank test was performed to compare the number of responses between the two questions.

Results: There were 764 responses related to problems identified, 797 responses associated with life effects due to tinnitus, and 37 responses that did not fit into any ICF category. No significant differences were observed in the number of responses between the two questions. Also, no association between number of responses reported and demographic variables was found. Most of the problems and life effects experienced by tinnitus sufferers were related to body function, followed by activity limitations, and participation restrictions. Only a few responses were related

to environmental and personal factors. The most frequent responses related to body function involved: *emotional functions (b152)*, *sleep functions (b134)*, *hearing functions (b230)*, *sustaining attention (b1400)*, and *energy level (b1300)*. For activity limitations and participation restrictions they were: *communicating with receiving spoken messages (d310)*, *socialization (d9205)*, *handling stress and other psychological demands (d240)*, and *recreation and leisure (d920)*. The most frequently occurring responses related to environmental factors were: *sound intensity (e2500)*, *sound quality (e2501)*, and *general products and technology for communication (e1250)*. *Coping style* was the most frequently occurring personal factor.

Conclusions: The study highlights the use of open-ended questions in gathering useful information about the impact of tinnitus. The responses coded to ICF show that tinnitus impacts many domains, particularly body function, but also activity limitations and participation restrictions. The results demonstrate the heterogeneous nature of the impact of tinnitus on people affected.

Key Words

Tinnitus, ICF, Body function, Activity limitations, Participation restrictions, Open-ended questions

Introduction

Tinnitus is one of the most distressing hearing-related symptoms (Cima et al., 2011). It is defined as the perception of sound in the absence of an external sound source (Baguley et al., 2013). It is often associated with a range of physiological and psychological complications, such as depression, anxiety, and insomnia (Langguth, 2011). Tinnitus has a high prevalence rate, estimated to be 10-15% of the adult population across the globe (Davis and Rafaie, 2000; Khedr et al., 2010; Michikawa et al., 2010; Shargorodsky, et al., 2010). Although many of those with tinnitus are able to habituate, others find the impact on activities of daily living devastating (Moroe and Khoza-Shangase, 2014). Tinnitus experiences are therefore varied and may depend on many factors unrelated to the tinnitus sound itself (Andersson, 2002). To date there is no ‘cure’ to permanently abolish tinnitus, and standardised assessment and effective treatment methods remain elusive (Baguley et al., 2013).

Approaching tinnitus from a biopsychological perspective, which focuses on the interaction of biological factors such as genetics, psychological factors, including mood and personality, and social factors like cultural and socioeconomic, may be more appropriate than from purely a biomedical model (Engel, 1980). To help conceptualize the impact of health conditions and disability, the World Health Organization (WHO) created a comprehensive framework based on a bio-psychosocial approach, namely the International Classification of Functioning, Disability and Health (ICF; World Health Organization, 2001). This framework has been applied extensively to understand the impact of various health conditions including hearing loss (Danermark et al., 2010; Granberg et al., 2014a, 2014b, 2014c, 2014d; Stephens et al., 2001, 2003). The ICF classification contains approximately 1500 categories related to health, divided

into the components body structures (*s*); body functions (*b*); activities and participation (*d*), environmental factors (*e*) and personal factors (*pf*). The personal factors currently contain no fixed categories; however, a broad categorization has been proposed by some audiology researchers (Stephens, 2002; Stephens and Danermark, 2005). The ICF acknowledges a non-causal relation between the components. The term *functioning* denotes the positive aspects and *disability* the negative aspects of the interaction between an individual (with a health condition) and the individual's contextual factors (i.e., environmental and personal factors). Disability is an umbrella term for impairments, activity limitations, and participation restrictions.

Tinnitus is considered as an aspect of body function according to the ICF, i.e., *b2400 – ringing in ears or tinnitus* (World Health Organization, 2001). However, its impact involves various elements related to activity limitations and participation restrictions, or other body functions. A study explored the impact of tinnitus using the ICF perspective (Ramkumar and Rangasayee, 2010). Their results suggest that in those experiencing tinnitus, various body functions (e.g., *emotional function, sleep function*) are more severely affected than aspects of activity limitations and participation restrictions. A standardized questionnaire, namely the Tinnitus Handicap Inventory (THI; Newman et al., 1996), was mapped to ICF categories to conduct the analysis. The construct of this questionnaire is predominantly related to body function (about 70%). Hence, this measure may not have explored all the dimensions of tinnitus impact in a comprehensive manner. Building on this evidence by investigating whether tinnitus has an impact on other dimensions is required. Using open-ended questions could provide more flexibility for participants to highlight wider issues that are important to them.

Some researchers suggest that open-ended questionnaires can be clinically useful in exploring wider aspects related to clinical conditions, and provide clinically more useful information than some of the structured questionnaires (Stephens et al., 2001; Stephens and Pyykko, 2011). Tyler and Baker (1983) explored difficulties caused by tinnitus using a single open-ended question in 72 people with tinnitus who were members of a self-help group. A small positive correlation was found between recent tinnitus onset and the number of difficulties identified. The main difficulties identified fell into four categories, which included: (1) interference with hearing; (2) effect on lifestyle (mainly sleep); (3) health effects (drug use, pain, headache); and (4) emotional effects (depression, distraction, confusion). However, other than Ramkumar and Rangasayee (2010) who used a structured questionnaire, we are not aware of any studies that have explored tinnitus impact in detail using the ICF.

The aim of the current study was to map (link) the responses from open-ended questions regarding the impact of tinnitus using the bio-psychosocial perspective of the ICF framework.

Method

Ethical Considerations

Ethical approval was obtained from the Faculty of Science and Technology Research Ethics Panel of Anglia Ruskin University (FST/FREP/14/478), Cambridge, United Kingdom.

Study Design and Participants Recruitment

A cross-sectional survey design was used. The data were collected during the recruitment of participants for a clinical trial investigating the feasibility and effectiveness of Internet-based

Cognitive-Behavioral Therapy (CBT) in the United Kingdom (Beukes et al., 2015, 2017a, 2017b).

Adults (18 years and over) living in the UK and experiencing tinnitus for a minimum period of three months were invited to participate in the study. Recruitment was UK wide in various formats, including online (e.g., the NHS Choices), Twitter (British Tinnitus Association), Facebook forums (e.g., Action on Hearing loss), Newspapers, and Magazines (e.g., Mature Times), support groups (e.g., tinnitus, thyroid) and from professionals (General Practitioners Clinic, Audiologists). Those interested in participating provided informed consent prior to participation.

Data Collection

The data collection was done online during the registration for the study, prior to undertaking the intervention. The data collection was multimodal and included both structured and open-ended questions. 240 chronic tinnitus patients completed the questionnaires.

The following structured questionnaires were administered:

- A demographic questionnaire to obtain information related to age, gender, tinnitus, and hearing difficulties
- The Tinnitus Functional Index (Meikle et al., 2012) to determine the level of tinnitus severity

- The Insomnia Severity Index (ISI; Bastien et al., 2001) was used to determine the presence of insomnia, as sleep difficulties are prevalent amongst those with tinnitus (Crönlein et al., 2016).
- The Generalised Anxiety Disorder (GAD-7; Spitzer et al., 2006) was used to quantify the level of anxiety, as the prevalence of anxiety is high in persons with severe tinnitus (Pinto et al., 2014).

In addition, in order to allow participants to fully express any effects of tinnitus, two open-ended questions were asked. These questions were related to the impact tinnitus may have in terms of problems faced and the life effects related to tinnitus namely: (i) *A Problem Question (PQ)*:

Make a list of difficulties, which you have as a result of your tinnitus. Write down as many as you can think of. (ii) *A Life Effects Question (LEQ)*: Make a list of the effects your tinnitus has on your life. Write down as many as you can think of. For consistency, the questions used were based on those used by previous studies related to hearing loss (Barcham and Stephens, 1980; Stephens et al., 2001; Durisala et al., 2017). Responses were required for both questions. If there were no problems or effects, participants could indicate this by saying “none”.

Data Analysis

Quantitative analysis

The Statistical Package for Social Sciences version 23.0 was used for quantitative analysis.

Descriptive statistics regarding the means and standard deviations were obtained. For the open-ended questions, the number of individual responses for PQ and LEQ and total responses were determined. To determine if there were significant differences between the number of responses

for each question (in all ICF domains), the Wilcoxon Signed Rank test was performed, as the data were not normally distributed. To determine the relationship between the number of problems and life effects mentioned and demographic and clinical variables, the spearman's rho correlation coefficient was performed as some of the data was non-parametric. For all analyses, a two-tailed significance level of <0.05 was considered statistically significant. However, Bonferroni corrected significance levels (i.e., $0.05 / 5$ comparisons = 0.01) were used to interpret the significance levels in multiple comparisons.

Qualitative analysis and ICF mapping

In the first instance, reported problems were coded into small and meaningful units using a simplified qualitative content analysis (Graneheim and Lundman, 2004), e.g., *'This is something I have to cope with every minute of every day and night, no matter where I am or what I am doing'* ('coping or regulating emotions,' 'daily routine'). In many cases, however, single words or short phrases were used requiring no real content analysis. In those cases, a single word or phrase was considered as the meaningful concept. In the next stage, these meaningful units were categorized into four main areas as defined by the ICF (i.e., functional impairment, activity limitation and participation restrictions, environmental factors or personal factors) and ICF codes were assigned. All responses were translated ("linked") to the ICF based on established linking rules (Cieza et al., 2005; Granberg et al., 2014b). The objective of the linking process is to translate concepts found in the participants' responses into the most appropriate ICF categories. The ICF does not provide detailed classification for personal factors. Hence, a classification proposed by audiology researchers was used to classify personal factors (Stephens, 2002; Stephens and Danermark, 2005). Information that was not possible to assign to any ICF category

was labelled *nd* (not definable), *nc* (not covered by ICF), or *hc* (health condition). Two researchers (ND and SG) independently reviewed the responses and conducted the linking in order to increase the reliability of the linking procedure. If there was a disagreement (i.e., in nearly 20% of the original coding), it was discussed and if an agreement could still not be reached (i.e., nearly 5% of the coding after discussion), a third researcher (VM) was consulted.

Results

Study Sample

There were 240 adults (137 males and 103 females) with an average tinnitus severity indicating severe levels of tinnitus (see Table 1). The mean tinnitus duration was more than 10 years, and more than 80% of participants had some degree of a self-reported hearing disability.

Table 1: Demographic information of participants

Category	Number/ mean (n=240)
Gender	
▪ Male (n / %)	▪ 137 (57.1%)
▪ Female (n / %)	▪ 103 (42.9%)
Age (in years)	56.95 (SD: 12.51)
Tinnitus duration (in years)	11.52 (SD: 11.88)
Tinnitus severity (TFI)	55.16 (SD: 21.86)
Insomnia (ISI)	12.01 (SD: 6.81)
Anxiety level (GAD7)	6.93 (SD: 5.66)

Self-reported difficulty hearing	
▪ None	▪ 47 (19.6%)
▪ Slight	▪ 131 (54.6%)
▪ Moderate	▪ 51 (21.3%)
▪ Great	▪ 11 (4.5%)

Number of responses

There were 1,599 responses to the two open-ended questions with 765 from the PQ and 797 from the LEQ questionnaire. There were 22 responses (15 for PQ and 7 from LEQ) that could not be categorized using the ICF classification, and were hence coded as *nc*. There were also 15 responses (6 for PQ and 9 from LEQ) that were related to a different health condition that were coded as *hc*.

The number of meaningful responses ranged from 0 to 10, while most respondents provided 2-3 meaningful responses for both questions, as shown in Figure 1. The mean number of responses per participant was 3.2 and 3.3 for PQ and LEQ respectively. No significant differences were observed in the number of responses between the two questions in all the ICF domains as seen in Table 2.

<Figure 1 near here>

Table 2: Number of responses in each of the ICF domains listed in the two questions

Category	PQ Mean (SD)	LEQ Mean (SD)	Wilcoxon Z	Sig.
All responses	3.2 (2.0)	3.33 (2.1)	-0.99	0.32
Functional impairment (body function)	1.46 (1.1)	1.59 (1.2)	-1.38	0.17
Activity limitations and Participation restriction	1.08 (1.2)	1.09 (1.2)	-0.15	0.98
Environmental factors	0.50 (0.8)	0.56 (0.8)	-1.17	0.24
Personal factors	0.15 (0.4)	0.09 (0.3)	-1.94	0.05

The the spearman's rho correlation showed that the strength of the relationship between the number of problems listed for the problems question and the life effect question was weak for the demographical variables of age, gender and tinnitus duration (see Table 3). The strength of the relationship was weak for tinnitus severity for the problem question and marginal for the number of life effects. The correlation was positive for tinnitus severity and gender, negative for age and linear for gender. Due to the non-linear nature of the relationships the correlations for these measures are low even though a significant proportion of the data was accounted for by the relationship between the two variables.

Table 3: Relationship between number responses to problem and life effects question and the demographic variables such as tinnitus severity, age, duration, gender

Question	Comparison	Spearman's rho correlation			
		r_s	p	R^2	% of variability
Problem question (all)	TFI	0.21	0.002	0.042	4.20
	Age	0.13	0.042	0.017	1.70
	Duration	0.08	0.225	0.002	0.20
	Gender	0.17	0.006	0.031	3.10
Life effects question (all)	TFI	0.33	0.000	0.106	10.60
	Age	0 .05	0.472	0.002	0.20
	Duration	0.10	0.117	0.006	0.60

	Gender	0.11	0.103	0.011	1.10
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Impairment of body function

Impairment of body function was the most frequently listed problem and life effect associated with tinnitus. There were 731 responses with a similar distribution for both questions, with 350 responses from the PQ and 381 from the LEQ, as shown in Table 4. The most frequently occurring category was *emotional functions* (b152) with 202 responses. Both *sleep functions* (b134) and *hearing functions* (b230) had more than 100 responses each. Other frequently occurring categories included *sustaining attention* (b1400) and *energy level* (b1300).

Table 4: Impairments of body functions

Function	ICF Code	PQ (n=350)	LEQ (n=381)	Total (n=731)
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Temperament and personality function	b126	6	5	11
Extraversion	b1260	1	0	1
Psychic stability	b1263	8	7	15
Optimism	b1265	2	1	3
Confidence	b1266	5	3	8
Energy and drive functions	b130	8	3	11
Energy level	b1300	23	20	43
Motivation	b1301	1	2	3
Appetite	b1302	3	1	4
Sleep function	b134	71	94	165
Amount of sleep	b1340	0	1	1
Onset of sleep	b1341	5	13	18
Maintenance of sleep	b1342	1	1	2
Attention function	b140	12	22	34
Sustaining attention	b1400	38	45	83
Memory functions	b144	0	1	1
Emotional functions	b152	108	94	202
Thought functions	b160	15	8	23
Hearing functions	b230	36	37	74
Sound discrimination	b2301	1	3	4
Localization of sound source	b2302	0	3	3
Speech Discrimination	b2304	0	1	1
Vestibular function of balance	b2351	1	1	2

Sensation associated with hearing and vestibular function	b240	2	0	2
Dizziness	b2401	1	1	2
Nausea associated with dizziness and vertigo	b2403	1	1	2
Aural pressure	b2405	0	1	1
Sensation of pain	b280	2	1	3
Pain in head and neck	b28010	1	9	10
Sexual functions	b640	1	1	2
Muscle power function	b730	1	1	2
Muscle endurance function	b740	1	0	1

Activity limitations and participation restrictions

Activity limitations and participation restrictions were impacted second most frequently with 518 responses as shown in Table 5. There was an equal number of responses to the PQ (i.e., 258) and LEQ (i.e., 260). The most frequently occurring category was *communicating with receiving - spoken messages* (d310), which had 83 responses. This was followed by *socialization* (d9205), *handling stress and other psychological demands* (d240), and *recreation and leisure* (d920).

Table 5: Activity limitations and participation restrictions

Function	ICF Code	PQ (n=258)	LEQ (n=260)	Total (n=518)
Watching	d110	1	0	1
Listening	d115	19	17	36
Copying	d130	0	1	1
Acquiring skills	d155	1	0	1
Focusing attention	d160	1	1	2
Thinking	d163	3	1	4
Reading	d166	8	18	26
Making decisions	d177	1	0	1
Undertaking a single task	d210	1	0	1
Understanding multiple tasks	d220	0	3	3

Carrying out daily routine	d230	2	0	2
Handling stress and other psychological demands	d240	26	22	48
Communicating with receiving spoken messages	d310	35	48	83
Speaking	d330	1	0	1
Conversation	d350	14	23	37
Conversing with one person	d3503	1	1	2
Conversing with many people	d3504	6	3	9
Using communication devices	d360	1	0	1
Using telecommunication devices	d3600	4	12	16
Using communication techniques	d3602	6	3	9
Walking	d450	0	1	1
Moving around in different locations	d460	1	2	3
Using transportation	d470	2	5	7
Using human powered vehicles	d4700	1	0	1
Using public motorized transportation	d4702	1	0	1
Driving	d475	1	3	4
Drinking	d560	1	0	1
Shopping	d6200	0	4	4
Basic interpersonal interactions	d710	2	0	2
Complex interpersonal interactions	d720	0	1	1
Interacting according to social rules	d7203	2	0	2
Informal social relationships	d750	2	0	2
Informal relationships with friends	d7500	0	1	1

Family relationships	d760	8	5	13
Parent-child relationships	d7600	0	1	1
Child parent relationships	d7601	1	2	3
Extended family relationships	d7603	1	0	1
Intimate relationships	d770	1	0	1
Spousal relationships	d7701	3	0	3
Interpersonal interactions and relations, unspecified	d799	1	1	2
Remunerative employment	d850	17	18	35
Community life	d910	4	0	4
Recreation and leisure	d920	25	19	44
Sports	d9201	3	1	4
Arts and culture	d9202	20	16	36
Hobbies	d9204	1	0	1
Socialization	d9205	27	23	50
Religion and spirituality	d930	2	3	5

Environmental factors

Environmental factors included both inanimate and animate factors in the world that may influence an individual. Table 6 presents all the ICF categories related to environmental factors in participants. The most frequently occurring categories included: *sound intensity* (e2500), *sound quality* (e2501), and *general products and technology for communication* (e1250).

Table 6: Environmental factors

Function	ICF Code	PQ (n=120)	LEQ (n=134)	Total (n=254)
Food	e1100	1	3	4
Drugs	e1101	1	2	3
Products and technology for personal use in daily living	e115	5	2	7
General products and technology for personal use in daily living	e1150	1	2	3
Assistive products and technology for personal use in daily living	e1151	6	1	7
Products and technology for communication	e125	3	7	10
General products and technology for communication	e1250	21	24	45
Assistive products and technology for communication	e1251	4	4	8
Products and technology for education	e130	1	0	1
	e1401	1	0	1

Assistive products and technology for culture, recreation and sport	e150	4	2	6
Design, construction and building products, and technology for entering and exiting buildings for public use	e1650	0	1	1
Financial assets	e225	0	1	1
Climate	e245	2	0	2
Time related changes	e250	5	12	17
Sound	e2500	30	26	56
Sound intensity	e2501	21	34	55
Sound quality	e310	2	1	3
Immediate family	e320	1	0	1
Friends	e410	3	4	7
Individual attitudes of immediate family members	e420	0	1	1
Individual attitudes of friends	e460	1	0	1
Societal attitudes	e498	2	1	3
Attitudes, others specified	e499	4	2	6
Attitudes unspecified	e5600	1	2	3
Media services				

Personal factors

Personal factors, was the ICF category with the least mention from this sample of research volunteers experiencing tinnitus as seen in Table 7. These factors are specific to an individual and influence the problems and life experience reported/experienced. *Coping styles* was the single most frequently occurring personal factor related to tinnitus.

Table 7: Personal factors

Function	PQ (n=36)	LEQ (n=22)	Total (n=58)
Lifestyle	2	1	3
Habits	1	-	1
Coping styles	27	17	44
Profession	1	2	3
Past and current experience	2	-	2
Overall behaviour patterns and characteristics	3	2	5

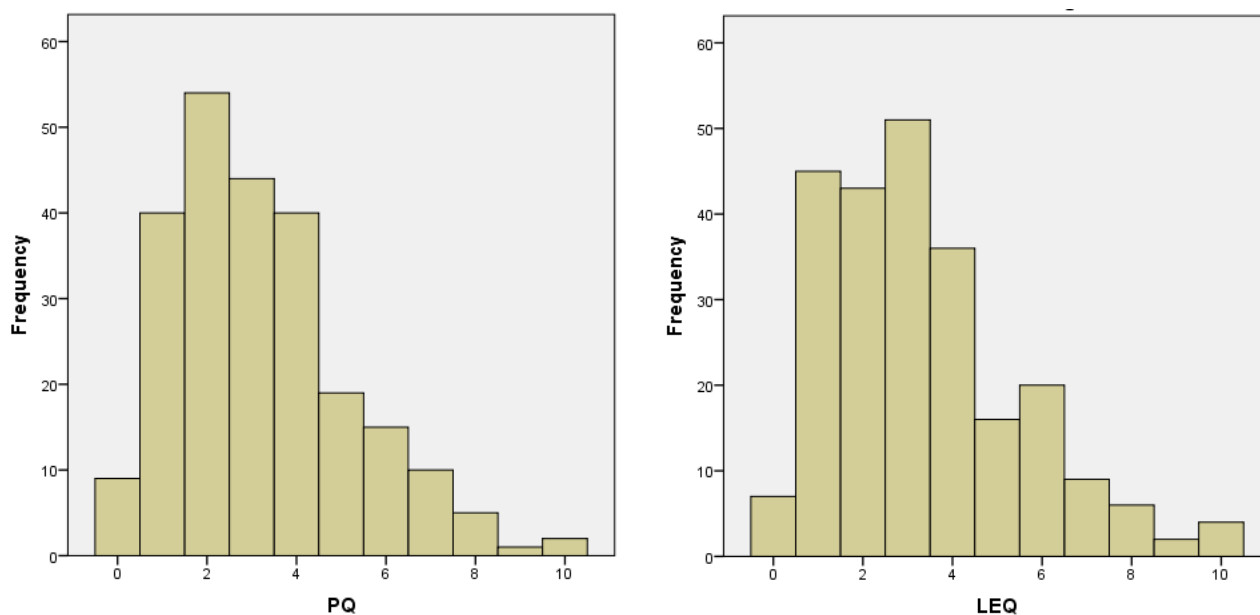


Figure 1: Number of problems listed in problems question (PQ) and life effect question (LEQ).

Overall impact of tinnitus

A summary of the ICF functions most frequently impacted by tinnitus is shown in Figure 2.

Emotional functions and *sleep functions* were the functions most affected.

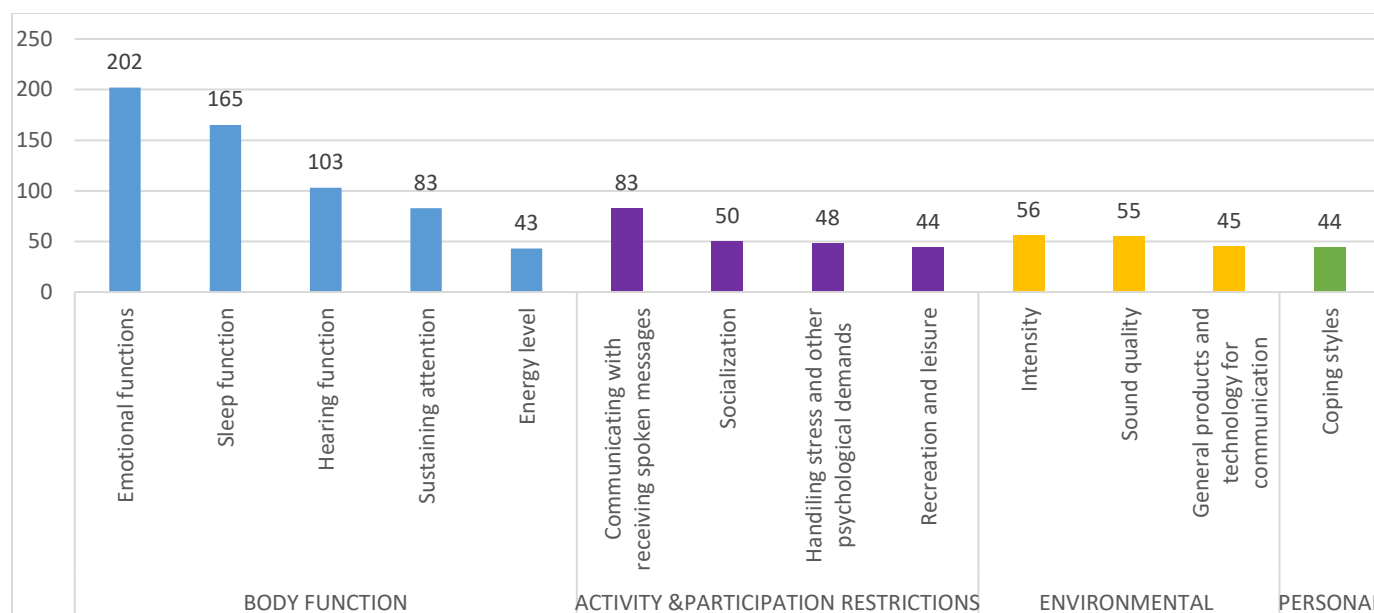


Figure 2: The most frequently reported factors impacted due to tinnitus.

Discussion

This study explored problems and life effects experienced by 240 tinnitus research volunteers using an open-ended questioning approach. Responses were coded using the ICF classification system. There were 1,562 responses in total. The majority of individuals provided 2-3 meaningful responses to each question. This indicates the multidimensional nature of tinnitus, and that it impacts various domains. It also indicates that including an open-ended approach has great value in obtaining information related to the impact of tinnitus. There was only a weak or marginal relationship between the number of problem and/or life effects mentioned and the demographic variables such as age, gender and tinnitus duration and clinical variable tinnitus severity.

Functioning and disability

Body functions was the area most frequently affected. *Emotional functions* (b152) was the domain with the most responses overall at 202 responses. This may be related to effects such as anxiety, stress, depression, and negative thinking patterns often associated with tinnitus (Langguth, 2011). This finding accentuates the need for appropriate assessment measures that fully investigate emotional functioning in those with tinnitus. From the mapping done of the THI distribution on ICF domains by Ramkumar and Rangasayee (2010), mental functions accounted for 18 of the 25 THI items. Mapping of these domains on other commonly used tinnitus assessment measures is required. Assessing emotional functioning in those with tinnitus on assessment instruments designed to identify anxiety and depression is therefore of value. This finding also highlights the importance of addressing emotional functioning during tinnitus interventions. Psychologically based interventions such as cognitive behavioural therapy are structured to address these issues (Andersson, 2002).

Sleep functions (b134) was the domain with the second most overall responses with 165 responses. This highlights the strong link between tinnitus and quality of sleep. Assessing this domain using appropriate outcome measures is important to identify where problems lie and subsequently to design a management plan. Addressing sleep difficulties, when present, should form an integral part of tinnitus management services. Also, *hearing functioning* (b230) had 103 responses and was the third most frequently impacted area. As hearing loss is one of the greatest risk factors for developing tinnitus, this is perhaps to be expected (Shargorodsky et al., 2010); although, this may also be indicative of the impact of tinnitus upon auditory processing, leading to increased listening effort (Degeest et al., 2017). Accessibility to the newest technology in the hearing aid field, which aids both hearing loss and tinnitus problems, is important. Patient

education on the potential of these devices is important, as the stigma of wearing hearing aids remains in many cultures (David and Werner, 2016). The fourth most frequently impacted area was *sustaining attention* (b1400). A systematic review by Tegg-Quinn et al. (2015) concluded that tinnitus impairs cognitive function due to its impact upon executive control of attention. Hearing loss, anxiety, and depression may further exacerbate these effects. Exploring these effects in those with tinnitus is important so that they can be appropriately addressed.

In terms of activity limitations and participation restrictions, *Communicating with receiving spoken messages* (d310) was most frequently reported with 83 responses followed by *socialization* (d9205) with 50 responses. These findings are related to those of Degeest et al. (2017) who explored listening effort in normal-hearing participants with chronic tinnitus. Listening effort increased across various listening conditions when compared to those without tinnitus. This will also have an impact upon socialization. Moreover, those with tinnitus often avoid situations due to fear of these having a negative impact on their tinnitus (Hesser and Andersson, 2009). This, in turn, impacts socialization and also on *recreation and leisure* (d920), which was also a domain frequently affected. Another domain featured in this category was *handling stress and other psychological demands* (d240). In a large epidemiological population study in Sweden, stress was found to be an important risk factor for severe tinnitus (Baigi et al., 2011). Tinnitus management needs to include assessment of these domains (i.e., communication, recreation and leisure, handling stress and other psychological demands), and should provide those with tinnitus effective coping mechanisms in order to ensure that activities and participation restrictions are less problematic.

The current study results are in line with a previous study by Ramkumar and Rangasayee (2010), suggesting that the component *body functions* is the main element that is affected in tinnitus sufferers with a mean score being almost twice that of activity and participation restrictions. However, in the current study the domain of activity limitations and participation restrictions was also found to be affected in people with tinnitus, which is in contrast to the previous study. There were numerous methodological differences between the studies as the previous study used a smaller sample size (n=21) and used a structured questionnaire. The average tinnitus duration in the previous study was 2.05 years, which is much lower than the average duration of 11.52 years in the present study. The impact of tinnitus in the acute and prolonged stages of the condition may therefore differ. In addition, the current study included people with tinnitus both with and without hearing loss, whereas Ramkumar and Rangasayee's study included people with tinnitus without hearing loss. Patients with tinnitus with and without hearing loss have different characteristics (Hallberg and Erlandsson, 1993), which may have resulted in the difference in findings.

Contextual factors

Contextual factor domains were featured less in this study. *Sound intensity* (e2500) and *sound quality* (e2501) were reported 56 and 55 times, respectively. Those with tinnitus often comment on the overpowering nature of tinnitus. Various objective measures focus on understanding the frequency, intensity, and masking level required to mask the tinnitus. These measures have, however, been found to be unrelated to the degree of distress caused by tinnitus (Erlandsson et al., 1992). Hearing aids are often provided to try to assist in reducing the intensity of tinnitus as well as to improve hearing. Frustrations when hearing aids do not provide enough benefit were

mentioned in the domain *general products and technologies for communication* (e1250).

Although hearing aids can help in reducing tinnitus distress, evidence to support or refute their use is still required (Hoare et al., 2014).

Coping styles was the only personal factor that was discussed frequently in the current study participants. Hallberg et al. (1992) observed coping strategies used by males with noise induced-hearing loss having tinnitus (n=89). Coping strategies are more likely to include drinking alcohol and wishful thinking in people with severe tinnitus, along with strategies common to less severe groups matched on other relevant variables. In the current study, the main coping style was ignoring the tinnitus or becoming habituated to it.

Study implications

The use of the bio-psychosocial perspective has aided comprehensive understanding of the impact of tinnitus. The implications are of value at several different levels. Assessment methods should focus on the functions most frequently affected, and can inform the development of future outcome measures. There is a strong movement toward applying appropriate outcome measures, especially in the context of clinical trials (Williamson et al., 2012). The Tinnitus Research Initiative also has prioritised creating appropriate outcome measures for tinnitus (Langguth et al. 2006), and concerns about this issue continue to be raised (Londero and Hall, 2017). A systematic review indicated that the outcome domains most frequently used in clinical trials of tinnitus relate to the tinnitus percept, the impact of tinnitus, other co-occurring complaints, health-related quality of life, and body structures and functions (Hall et al., 2016). Results of the present study could be used to ensure future outcome measures that target the domains most frequently

found to be problematic in those with tinnitus. Moreover, the use of open-ended questions may be used as add-on questions in addition to structured questionnaires designed to gather individual specific information from tinnitus sufferers (Stephens and Pykkö, 2011).

Considering the average tinnitus duration of this sample was more than 10 years, it indicates that the impact of tinnitus may continue regardless of tinnitus duration. Those with tinnitus may benefit from more accessible tinnitus interventions that can help address these problem areas. The results should also be used to guide the development and planning of future tinnitus interventions so that they focus on the areas identified. Reducing the impairments of body functions (e.g., *sleep functions, attention functions, emotional functions*), and also reducing the activity limitations and participation restrictions (e.g., *handling stress and other psychological demands, socialization*) should be the key focus of audiological management.

Strengths and limitations of the study

The study used open-ended questions in a cross-sectional design administered online. Online administration of questionnaires may have an advantage. For example, it is easier to read the responses of participants when compared to the paper and pencil method. Open-ended questions have the advantage of being useful in exploring wider aspects related to tinnitus than can be obtained from structured questionnaires (Stephens et al., 2001; Stephens and Pykkö, 2011). For the purposes of this study, this approach is perhaps more ecologically valid as it provides the opportunity for participants to decide the problems experienced rather than imposing the responses and ideas on them in structured questionnaires. Open-ended questions, however, have drawbacks such as making it difficult for some to remember or come up with responses, and can

lead to a lower response rate (about 40-50%; Manchaiah et al., 2015a). The response rate to the questions in this study was high as a response was required from all participants to each question presented. A further strength of the study was the experience in linking ICF codes of multiple authors of this study. However, the contextual factors (i.e., environmental and personal factors) can act as both facilitators and a hindrance to health and disability. Hence, they can be coded as positive, negative, or neutral influencing factors (Manchaiah et al., 2015b), which was not done in this study due to limited contextual information in the questionnaire responses.

Participants in this study were recruited from a UK based population that had expressed interest in being involved in a trial of an Internet-based treatment programme for tinnitus. This may have introduced certain biases, which may limit the generalizability of the findings to a wider population of people with tinnitus. Volunteering for the study may imply that other treatment approaches have not been effective. It may be that having the time to consider being involved in a research study could be associated with being unemployed or retired. The motivation for being involved may be associated with particularly severe tinnitus.

Conclusions

The study explored problems and life effects experienced by people with tinnitus. No significant differences were observed in the number of responses for different elements between the two questions (i.e., a problem question and a life effect question). Most of the problems and life effects experienced by tinnitus sufferers were related to body function followed by activity limitations and participation restrictions. However, limited responses were related to environmental and personal factors. The most frequently occurring responses related to body

function were: *emotional functions (b152)*, *sleep functions (b134)*, *hearing functions (b230)*, *sustaining attention (b1400)*, and *energy level (b1300)*. The most frequently occurring responses related to activity limitations and participation restrictions included: *communicating with receiving - spoken messages (d310)*, *socialization (d9205)*, *handling stress and other psychological demands (d240)* and *recreation and leisure (d920)*. The most frequently occurring responses related to environmental factors were: *sound intensity (e2500)* and *sound quality (e2501)*. Also, the most frequently occurring personal factor was related to *coping styles*. The results suggested that the open-ended questions were found to be useful in gathering useful information about problems and life effects experienced by tinnitus sufferers. The responses coded to the ICF show that tinnitus sufferers have a wide range of issues, although some issues, mainly in body functions, seem to stand out and are more common. The results demonstrate the heterogeneous nature of the impact of tinnitus on people affected and has implications towards tinnitus management. Future research should focus on ensuring tinnitus assessment methods and interventions for tinnitus sufferers, as these are problem areas. Future ICF coding for tinnitus could combine closed and open-ended questions as this provides a more comprehensive assessment, and is advised both in research and clinical practice.

Disclaimer

This paper presents independent research funded by the National Institute for Health Research (NIHR). The views expressed are those of the authors and not necessarily those of the NHS, the NIHR, or the Department of Health.

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