

# Evaluating the Revised Work Rehabilitation Questionnaire in Cochlear Implant Users Cochlear Implant Outcome Assessment Based on the International Classification of Functioning, Disability, and Health (ICF)

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**Objectives:** The 59-item Work Rehabilitation Questionnaire (WORQ) was developed based on the International Classification of Functioning, Disability and Health (ICF) core set for vocational rehabilitation to assess work related functioning. It was revised to include 17 questions, assigned to 14 ICF categories relevant to cochlear implant (CI) users. This cross-sectional multicenter study aimed to evaluate CI users' responses on the WORQ questions to describe and generate ICF qualifiers for the revised WORQ in CI users, forming part of a broader framework of CI outcome measures linked to the ICF.

**Methods:** One hundred seventy-seven adults over the age of 18 years with a minimum of one year's device experience were included in the analysis. The WORQ was completed by the participants at a routine visit to the clinic, via email, or via post.

**Results:** Most of the CI users perceived no problem on the WORQ questions (53.7%-91%), finished secondary school

(54.2%) or obtained a college or university degree (32.8%) and are either employed (41.2%) or retired (34.5%). CI users that are currently working mostly have a full-time position (34.5%). Subjects reported no problem (91%) with sensation of falling, while handling communication devices and techniques (10.9%) and tinnitus (9.6%) showed the highest number of subjects reporting a complete problem.

**Conclusions:** Overall, most of the CI users experienced no impairment, restriction or limitation on the WORQ questions and their assigned ICF categories. Their education level resembles the education level of the general population and they seem to integrate or reintegrate well in professional life postoperatively.

**Key Words:** Cochlear implant—Hearing loss—ICF—Quality of life—WORQ.

*Otol Neurotol* 43:e571–e577, 2022

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The Antwerp University Hospital receives a research grant from the company MED-EL GmbH, Innsbruck (Austria). Ilona Anderson and Edda Amann are employees of MED-EL GmbH. All participating centers are members of the HEARRING network, which is supported by MED-EL GmbH.

The authors disclose no conflicts of interest.

**DOI:** 10.1097/MAO.0000000000003524

The International Classification of Functioning, Disability, and Health, more commonly known as ICF, has had a considerable impact on healthcare in recent years (1). The ICF is a biopsychosocial framework for the description and classification of functioning and disability, using standard concepts and terminology. It provides a common language to define the health state of individuals and can be used to compare this health state between several health care disciplines, institutes, countries,

sectors, time periods, and various groups of people and to enhance inter- and multidisciplinary communication. The ICF includes individually coded categories serving as units of classification to define individuals' health and health-related states. A number or "qualifier" can be added to each category to specify the extent or magnitude of functioning or disability in that category or the extent to which a contextual factor is a facilitator or barrier. However, the elaborate ICF volume of more than 1,400 categories in different levels impedes its implementation in clinical routine, as such assessments would be too lengthy for clinicians to apply to all their patients (2–8). Therefore, the World Health Organization (WHO) initiated the development of ICF core sets including only the most relevant categories for particular health conditions. These core sets have been developed for a wide variety of health conditions, including hearing loss.

Hearing loss is a growing global issue, as the number of individuals with some degree of hearing loss is expected to rise to 25% of the world population in 2050 if no action is undertaken (9). Hearing loss can have significant negative effects on communication abilities and societal participation and often leads to limitations in daily life functioning, resulting in a decreased quality of life (QoL) (10–12). These adverse implications are particularly evident in severely to profoundly hearing impaired individuals, for which cochlear implantation has currently been standard care. To evaluate and quantify the benefits of a cochlear implant (CI), a comprehensive outcome assessment is needed but this can only be achieved if CI users' functioning and disability is thoroughly evaluated and documented. In this context, McRackan et al. (13) recently developed the CI-specific Cochlear Implant Quality of Life (CIQOL) instrument for the evaluation of QoL in CI users to supplement performance-based outcomes such as speech audiometry. Nevertheless, there is lack of consensus on which instruments, outcome measures and methods are the most appropriate to use in research and in clinical practice for CI outcome evaluation. No questionnaire or instrument comprising all relevant CI outcome aspects currently exists for this population, which could lead to unaddressed health care needs and missed treatment effects. Moreover, since the restrictions of CI users are evident in multiple domains, a multidimensional approach in a multidisciplinary setting is advocated to address their health care needs (10). This approach requires a shared framework to facilitate inter-professional communication and collaboration between all healthcare professionals involved. Therefore, the ICF model should be implemented in the process of cochlear implant provision. An international core group of CI experts has recently defined the ICF core sets for CI users, based on the ICF core sets for hearing loss developed by Danemark et al. (2,14) These core sets provide an overview of which domains of functioning can be measured, but do not provide an actual assessment tool or protocol to measure these domains in clinical practice. Hence, the appropriate measures need to be searched and selected per ICF core set.

The 59-item Work Rehabilitation Questionnaire (WORQ) was originally developed to measure ICF categories selected from the ICF core set for vocational rehabilitation and assesses work related functioning (15). It consists of two parts addressing demographics and relevant background information (Part I) and work functioning (Part II), of which each item represents an ICF category. The WORQ was found to be valid, reliable, and feasible in different populations and consists of relevant questions for CI users that are not all included nor linked to the ICF in other existing instruments (15–17). Therefore, WORQ was selected to measure part of the ICF categories in the ICF core set for CI. It was modified and reduced to 17 items, assigned to 14 ICF categories relevant to CI users, with permission of the original WORQ developers. This cross-sectional study aims to evaluate CI users' responses on the WORQ questions to describe and generate ICF qualifiers for the revised WORQ in CI users. The questionnaire will be part of a broader framework of relevant CI outcome measures, such as pure tone or speech audiometry, linked to the appropriate ICF categories and qualifiers.

## METHODS

### Ethics

The study was conducted in accordance with the recommendations of the local ethical committees of the following five participating centers: Antwerp University Hospital (Antwerp, Belgium), La Paz University Hospital (Madrid, Spain), World Hearing Center (Warsaw, Poland), Fiona Stanley Fremantle Hospital Group (Perth, Australia) and University Clinic of Würzburg (Würzburg, Germany). Informed consent was waived as this is a retrospective noninterventive analysis of WORQ results in CI users, with WORQ as part of the questionnaires used in the regular clinical follow-up of CI patients. All patient data was anonymized prior to the respective analysis. The study protocol was retrospectively registered at ClinicalTrials.gov (NCT04602780) on October 26, 2020.

### Participants

In total, a consecutive sample of 177 adults over the age of 18 years with a minimum of one year's device experience were included in the analysis between February and June 2020. The age of 13 subjects could not be retrieved. The mean age of the remaining subjects was 54 years (standard deviation: 18), ranging from 18 to 86 years. Subjects had the following hearing indications and device fitting: 1) unilateral CI with severe-to-profound hearing loss ( $n = 60$ ); 2) bilateral CI with severe-to-profound hearing loss ( $n = 19$ ); 3) single sided deafness (SSD), where the poorer ear pure tone average was (PTA)  $\geq 70$  dB HL and the better ear was PTA  $\leq 30$  dB HL with an interaural threshold gap of  $\geq 40$  dB HL ( $n = 15$ ); 4) asymmetrical hearing loss using a CI in the poorer ear and a hearing aid in the better ear (bimodal fitting). The poorer ear was PTA  $\geq 70$  dB HL and the better ear was PTA  $\geq 30$  dB HL and  $\leq 55$  dB HL with an interaural threshold gap of  $\geq 15$  dB HL ( $n = 83$ ).

### Work Rehabilitation Questionnaire Revision and Assessment

An international group of CI experts modified the 59-item ICF-based WORQ questionnaire to a 17-item questionnaire,

including questions relevant for CI users based on the ICF Core set for CI. These revised WORQ questions are part of a broader framework of relevant CI outcome measures, such as pure tone and speech audiometry, linked to the ICF. The revised WORQ for CI users includes questions related to two ICF components: “Body Functions and Structures” and “Activities and Participation.” Part I of the WORQ includes three questions concerning background information on work status and education level. Question 3 is divided into two parts (a and b) based on work status (employed or not employed). Participants only have to fill in the part that is applicable to them. All Part I questions are linked to ICF categories, but do not have a qualifier as they are considered as personal factors. In Part II of the WORQ, participants have to rate to what extent they had problems with a certain task or activity in the last week based on a numerical scale ranging from 0 (no problem) to 10 (complete problem). These scores are linked to ICF qualifiers, which are numerical codes that specify the extent or magnitude of functioning or disability in that category or the extent to which a contextual factor is a facilitator or barrier. Results of the revised WORQ questions will be assigned according to the same quantified qualifiers as the original WORQ, as suggested in Table 1. All Part I items and 10 Part II items and their assigned ICF categories and codes are taken verbatim from the original WORQ. Four items (question 5, 6, 7, and 8) relevant for CI users were added to Part II of the revised WORQ and linked to the appropriate ICF category and code according to the standardized ICF linking rules. An overview of the revised WORQ questions and their corresponding ICF components, categories and codes per part is shown in Table 2. The WORQ was completed by the participants at a routine visit to the clinic, via email, or via post.

### Statistics

IBM SPSS Statistics 24 (IBM, Armonk, NY) was used for descriptive statistics. For WORQ Part I, percentages were calculated based on the total number of participants ( $n = 177$ ), including missing data. The variance ( $s^2$ ) was calculated based on the percentages per ICF qualifier per WORQ question. For WORQ Part II, the number of participants per WORQ scale score covered by the same ICF qualifier was summed and a percentage per ICF qualifier was calculated based on the total number of participants who had completed the question.

### RESULTS

The results of Part I are presented in Figure 1. Most of the subjects finished secondary school (54.2%) or obtained a college or university degree (32.8%). In addition, most of the subjects are either employed (41.2%) or retired (34.5%). The subjects that are currently working mostly have a full-time position (34.5%).

**TABLE 1.** WORQ results and their assigned ICF qualifiers

ICF Qualifier	WORQ Result
0 NO problem	0–2
1 MILD problem	3–4
2 MODERATE problem	5–6
3 SEVERE problem	7–8
4 COMPLETE problem	9–10

Subjects that are not working indicated that this is mainly due to ongoing vocational rehabilitation (6.2%) or other reasons such as taking care of children (15.3%). In total 28.3% of participants did not complete question 3.

The results of Part II are presented in Figure 2. Overall, most of the subjects experienced no problem (ICF qualifier 0) on the WORQ questions (53.7%–91%). Sensation of falling (question 6) showed the highest number of subjects experiencing no problem (91%), whereas communication devices and techniques (question 12) showed the lowest number of subjects (53.7%). In addition, communication devices and techniques demonstrated the highest number of subjects (10.9%) experiencing a complete problem (ICF qualifier 4), followed by question 7 on tinnitus (9.6%) and question 13 on community life (4.6%). Besides falling, the highest number of subjects experiencing no problem (ICF qualifier 0) was found in question 14 on family relationships (78.9%) and question 9 on carrying out daily routine (75.1%). Falling (question 6) and family relationships (question 14) showed the highest variance ( $\sigma^2 = 15.7\%$  and  $\sigma^2 = 11\%$  respectively), followed by question 9 on carrying out daily routine ( $\sigma^2 = 9.7\%$ ) and dizziness including question 8 on vertigo ( $\sigma^2 = 9.4\%$ ) and question 5 on dizziness ( $\sigma^2 = 9\%$ ). The maximum amount of missing data per question was 2.8% (5 participants) and in half the questions ( $n = 7$ ) there was no missing data.

### DISCUSSION

This study aimed to evaluate CI users’ responses on the WORQ questions to describe and generate ICF qualifiers for the revised WORQ in CI users, forming part of a broader framework of CI outcome measures linked to the ICF. The level of education of the CI users included in our study corresponds to the most recent UNESCO Institute for Statistics (UIS) data on mean years of schooling of the general population per participating country, ranging from 10.3 years (Spain) to 14.1 years (Germany), indicating that the majority also either finish secondary school or obtain a college or university degree (18). As information regarding hearing loss onset (prelingual, perilingual or postlingual) was not retrieved for our sample of CI users, it is not clear whether CI contributed to the education level of our participants. However, current literature does state that children with pre-, peri- as well as postlingual profound sensorineural hearing loss (SNHL) growing up with a CI generally obtain an education level similar to the normalhearing population nowadays (19,20).

Most of the experienced CI users in our sample are employed and work full-time, suggesting that many people with severe-to-profound hearing loss integrate or reintegrate in professional life after implantation. This finding concurs with Kos et al. (21) who reported that their adult subjects with postlingual profound SNHL were able to retain their jobs and develop their professional skills after CI. Huber et al. (19) indicated that their young adult CI users with prelingual profound SNHL

**TABLE 2.** WORQ Part I and Part II questions and their corresponding ICF component, ICF categories and ICF codes

ICF Component	Code	ICF Category	WORQ Question Part I
<i>Activities and Participation</i>	d820	<b>School education</b> ĈGaining admission to school, education; engaging in all school- related responsibilities and privileges; learning the course material, subjects and other curriculum requirements in a primary or secondary education program, including attending school regularly; working cooperatively with other students, taking direction from teachers, organizing, studying and completing assigned tasks and projects, and advancing to other stages of education.	What is the highest level of education that you have completed?
	d850	<b>Remunerative employment</b> ĈEngaging in all aspects of work, as an occupation, trade, profession or other form of employment, for payment, as an employee, full or part time, or self-employed, such as seeking employment and getting a job, doing the required tasks of the job, attending work on time as required, supervising other workers or being supervised, and performing required tasks alone or in groups.	Which best describes your current work status, or if currently not working your last work status? Which of the following describes your current work status best?
ICF Component	Code	ICF Category	WORQ Question Part IIĈOverall in the past week, to what extent did you have problems with...
<i>Body Functions</i>	b130	<b>Energy and drive functions:</b> Mental functions that produce vigour and stamina.	...not feeling rested and refreshed during the day?
	b152	<b>Emotional functions:</b> Specific mental functions related to the feeling and affective components of the processes of the mind	...your usual daily activities because you felt sad or depressed?Ĉ...your usual daily activities because you felt worried or anxious? ... tinnitus? <sup>a</sup>
	b2400	<b>Associated sensations:</b> tinnitus <b>Ring in ears or tinnitus</b> ĈSensation of low-pitched rushing, hissing or ringing in the ear.	... dizziness? <sup>a</sup> ...Ĉvertigo? <sup>a</sup>
	b2401	<b>Associated sensations:</b> dizzinessĈSensation of motion involving either oneself or one's environment; sensation of rotating, swaying or tilting.	... falling? <sup>a</sup>
	b2402	<b>Sensation of falling:</b> Sensation of losing one's grip and falling	... keeping your balance while maintaining a position or during movement?
<i>Activities and Participation</i>	b235	<b>Vestibular functions</b> ĈSensory functions of the inner ear related to position, balance and movement	... carrying out your daily routine or day to day activities?
	d230	<b>Carrying out daily routine</b> ĈCarrying out simple or complex and coordinated actions in order to plan, manage and complete the requirements of day-to-day procedures or duties, such as budgeting time and making plans for separate activities throughout the day.	... handling stress, crises, or conflict?
	d240	<b>Stress</b> ĈCarrying out simple or complex and coordinated actions to manage and control the psychological demands required to carry out tasks demanding significant responsibilities and involving stress, distraction, or crises.	... starting and maintaining a conversation?
	d350	<b>Conversation</b> ĈStarting, sustaining and ending an interchange of thoughts and ideas, carried out by means of spoken, written, sign or other forms of language, with one or more persons one knows or who are strangers, in formal or casual settings	... using communication devices such as using a telephone, telecommunication devices, and computers?
	d360	<b>Communication device and techniques</b> ĈUsing devices, techniques and other means for the purposes of communicating, such as calling a friend on the telephone	... relationships within your family?
	d760	<b>Family relationships</b> ĈCreating and maintaining kinship relationships, such as with members of the nuclear family, extended family, foster and adopted family and step-relationships, more distant relationships.	... activities in your community life?
	d910	<b>Community life</b> ĈEngaging in aspects of community social life, such as engaging in charitable organizations, service clubs or professional social organizations.	

<sup>a</sup>Indicates that this WORQ question and its assigned ICF code and category are not taken verbatim from the original WORQ.

were employed and reported high satisfaction with their job. However, they were more restricted in the realization of their career aspirations than normal-hearing peers. Due to the high number of missing values in question 3, current work status and cause of unemployment were hard to identify in our study. Therefore, it is difficult to determine whether the retirement or unemployment of the participants might be due to constraints attributable to their severe-to-profound hearing loss, due to hearing loss

comorbidities such as vestibular loss or due to other causes. The great amount of missing values for this particular question could partly be attributed to question 3 including two parts of which participants have to fill in the one which is the most applicable. This might have been confusing for some participants, causing them to skip the question. In addition, "retirement" or "student" are not explicitly mentioned response alternatives in question 3. Retired participants or students have to tick

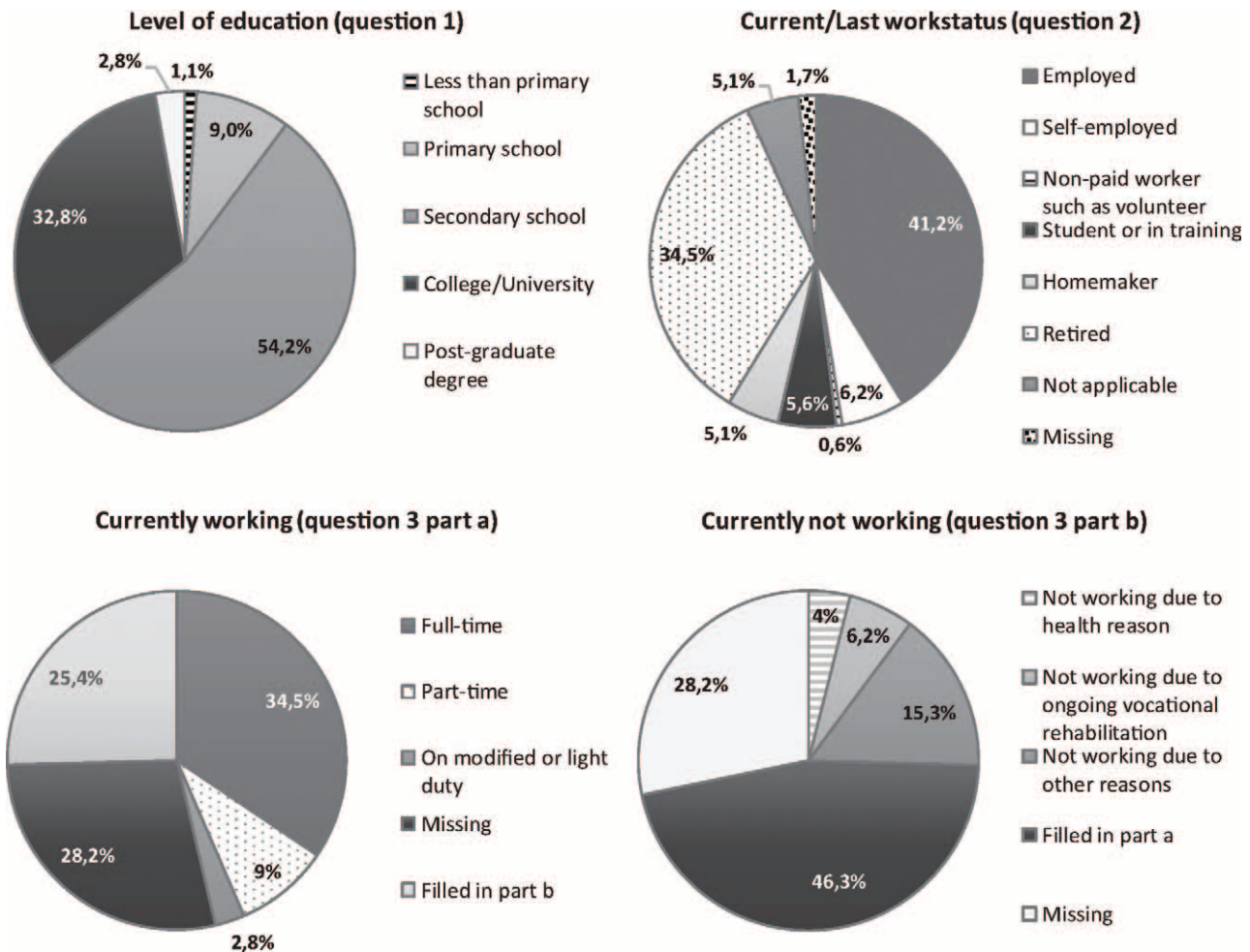


FIG. 1. WORQ Part I frequency results per question.

and complete the following response alternative: “Not working due to other reasons. Please specify: . . .,” which might not have been clear for some participants. More data is being collected in a larger study and question 3 will then be revisited.

Overall, the CI users perceived no problem for the WORQ questions and their assigned ICF categories, indicating that experienced CI users generally encounter no major impairment, restriction or limitation regarding stress, energy, and drive functions, emotional functions, tinnitus, dizziness, falling, vestibular functions, carrying out daily routine, conversation, communication devices and techniques, family relationships and community life. WORQ questions on dizziness and falling had the highest variance, which might be explained by the fact that vestibular loss (and related symptoms such as dizziness, vertigo, and falling) is associated with severe-to-profound hearing loss but might not be present in or perceived by all patients. In addition, older adults with hearing loss have a higher risk of falling, so the variance may also be attributable to the large age range of the CI users in our sample (22). Moreover, vestibular loss has a

significant negative influence on QoL and could therefore have had a negative influence on the WORQ scores in general (23,24). Family relationships also showed high variance, which might be attributable to the differences in willingness and ability of CI users and their relatives to adapt to and cope with hearing loss and relational issues due to reasons other than hearing loss (25). Falling and family relationships were also the categories for which the greatest number of CI users reported no problem.

Handling communication devices such as computers and smartphones caused the most difficulties for the participants. Possibly, age played a role in this result as there is a slight tendency to older adults in our study sample (median age: 58 years, interquartile range: 42.3; 66.5). Older adults generally experience more problems using mobile phones and other technical devices compared to younger individuals due to for example poor readability, compressed keys and hierarchical menus (26,27). Furthermore, telephone communication issues are likely related to the CI users’ hearing impairment. CI users generally struggle with speech understanding on the telephone due to the lack of contextual cues and lip-reading,

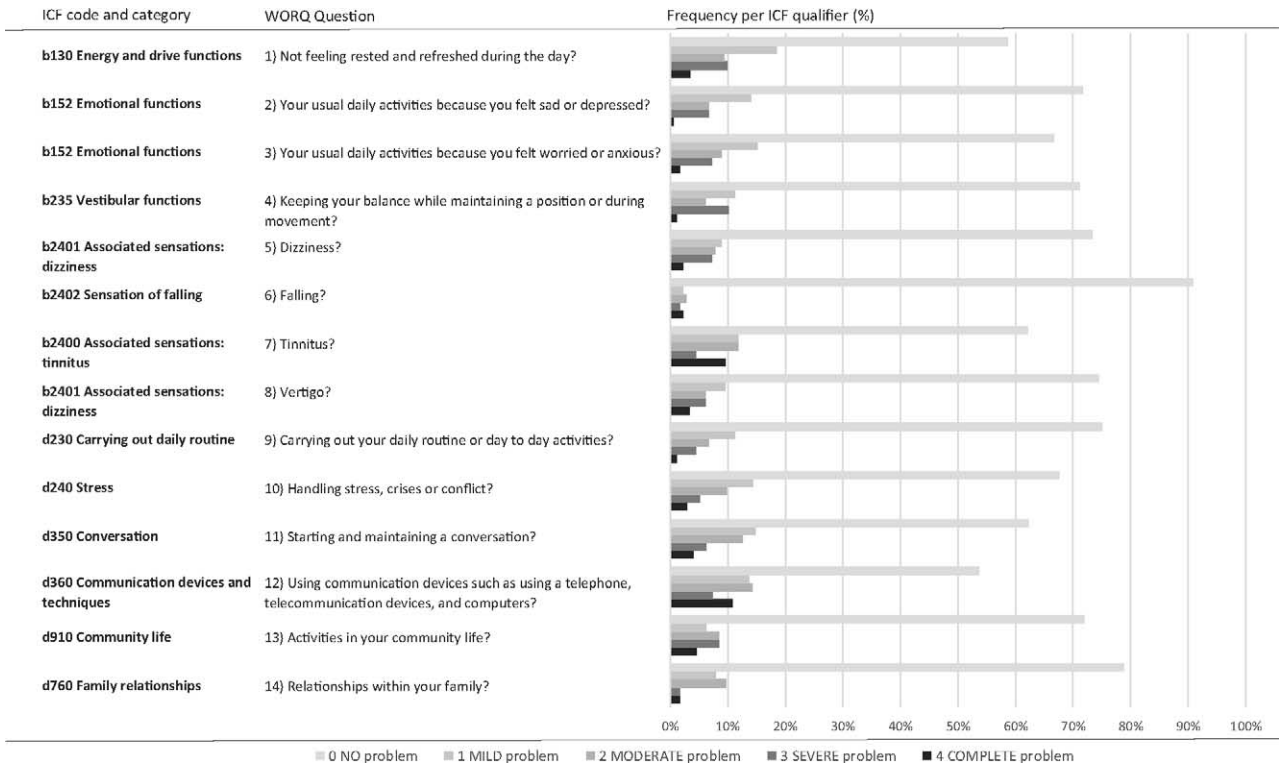


FIG. 2. Frequency per qualifier for WORQ Part II questions with assigned ICF code and category.

potentially unfamiliar topics and speakers and a reduced signal transmission bandwidth (28,29). In our study, 26% of the CI users perceived a moderate to complete impairment for tinnitus, which concurs with the findings of Baguley (2010) stating that approximately 25% of CI users experience or continue to experience troublesome tinnitus after CI (30). Current literature shows that CI generally ameliorates tinnitus symptoms, but it also has a negative impact on tinnitus in some patients (30–32). Klooststra et al. indicate that a round-window surgical approach, a higher preoperative tinnitus handicap, a shorter preoperative tinnitus duration and a more fluctuating type of tinnitus are possible predictive factors for a positive effect of CI on tinnitus (31). Overall, these issues should be taken into consideration during audiological rehabilitation and counseling of CI candidates and CI users. In our study, the sample size of participants with bilateral CI (n = 19) and SSD (n = 15) was too small to obtain representative results regarding the influence of hearing indications and the corresponding device fitting on WORQ scores, which could be an interesting factor to investigate in future studies.

Assessing QoL and other non-audiometric benefits of cochlear implantation is vital and has received considerable attention in recent years. Several studies demonstrated that cochlear implantation has a positive impact on general daily life functioning aspects and not only significantly improves speech perception (33–41). ICF could be a valuable tool to standardize and summarize

nonaudiometric and audiometric CI outcomes, which would facilitate multidisciplinary communication and would increase the focus and knowledge on individual healthcare needs in CI users. The revised WORQ comprises relevant questions for CI users that are not all included nor linked to the ICF in other existing instruments and will, therefore, be used to measure part of the CI outcomes linked to ICF categories that are included in the ICF core set for CI users. Hence, the next step in this project will be to add more relevant ICF categories with appropriate tests or questionnaires to measure and report CI outcome in a standardized way, based on the ICF core set for CI.

CONCLUSION

Experienced CI users generally perceive no impairment, restriction, or limitation for the revised WORQ in CI users' questions and their assigned ICF categories. In addition, the CI users in our sample seem to integrate or reintegrate well in professional life after implantation and their education level is similar to the education level of the general population.

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