Severe to profound hearing impairment: quality of life, psychosocial consequences and audiological rehabilitation

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Abstract

Purpose: To study the quality of life (QoL) and psychosocial consequences in terms of sick leave and audiological rehabilitation given to patients with severe to profound hearing impairment. Method: A retrospective study of data on 2319 patients with severe to profound hearing impairment in The Swedish Quality Register of Otorhinolaryngology, followed by a posted questionnaire including The Hospital Anxiety and Depression Scale (HADS). Results: The results indicate greater levels of anxiety and depression among patients with severe or profound hearing impairment than in the general population, and annoying tinnitus and vertigo had strong negative effects on QoL. The proportion of sick leave differed between the studied dimensions in the study. The proportion of patients who received extended audiological rehabilitation was 38% in the present study. Conclusions: Treatment focused on anxiety, depression, tinnitus and vertigo must be given early in the rehabilitation process in patients with severe or profound hearing impairment. Because sick leave differs greatly within this group of patients, collaboration with the regional Social Insurance Agency is crucial part of the rehabilitation. The study also shows that presently, only a small proportion of patients in Sweden with severe to profound hearing impairment receive extended audiological rehabilitation.

Keywords

EuroQol 5D, sick leave, the hospital anxiety and depression scale, the problems impact rating scale, tinnitus, vertigo

History

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Implications for Rehabilitation

- Greater levels of anxiety and depression have been found among patients with severe or profound hearing impairment than in the general population, and annoying tinnitus and vertigo have strong negative effects on QoL in this group of patients.
- Only a small proportion of patients with severe to profound hearing impairment receive extended audiological rehabilitation today, including medical, technical and psychosocial efforts.
- Extended audiological rehabilitation focused on anxiety, depression, tinnitus and vertigo must be given, together with technical rehabilitation, early in the rehabilitation process in patients with severe or profound hearing impairment.

Introduction

Severe to profound hearing impairment is defined as an average air conducted threshold of above 70 decibel (dB) hearing level (HL) in the better ear across frequencies 0.5, 1, 2 and 4 kHz [1]. The Swedish Social Insurance Agency [2] has the following functional definition of severe to profound hearing impairment: Individuals who cannot follow speech with hearing aids and within 1 m of the speaker in almost quiet environmental conditions. While a hearing impairment of this degree often leads to several consequences in daily life, it has been shown [3] that the emotional impact of acquired profound hearing loss may not be much greater than that of moderate to severe hearing impairment. However, in Hallam’s study [3] certain subgroups appeared to be deeply affected by their hearing impairment. It is important to identify factors that could explain differences in quality of life (QoL), psychosocial consequences and audiological rehabilitation among hearing impaired patients. Therefore, in this study, we studied various dimensions in 2319 patients with severe to profound hearing impairment.

The prevalence of patients with severe to profound hearing impairment reported in the literature is unclear, and the figures available are based on various definitions and age ranges.
In a recently published article [4], Turton and Smith found a prevalence of 0.7% in the UK, based on a clinical population of 2199 patients with thresholds >70 dB HL averaged over the frequencies 0.5, 1 and 2 kHz. In a Finnish study [5], Hannula et al. estimated the prevalence to be 0.2% for thresholds >70 dB HL averaged across 0.5, 1, 2 and 4 kHz based on 850 patients between 54 and 66 years of age.

In Sweden, there is a Quality Register for patients with severe to profound hearing impairment [6]. The Quality Register have estimated the number of patients in Sweden with a severe to profound hearing impairment to be between 10 000 and 15 000, which corresponds to a prevalence of 0.10–0.15%. In the majority of cases, severe or profound hearing impairment is of cochlear origin and can be congenital or acquired later in life. The onset of a hearing impairment might be an important factor for QoL and psychosocial consequences, but only a few studies have directly compared congenital and acquired hearing impairment later in life. In this study, we compared the effects of late- and early-onset of hearing impairment on different dimensions. In most studies, the progression of the hearing impairment is slow [3,6]. However, in the British study [3], Hallam et al. found that hearing decreased to a profound level over a week in 17% of the patients in the study population. We previously studied the consequences of a hearing impairment in connection with sudden sensorineural hearing loss [7]. In the present study, we also compare these patients with patients who have severe to profound hearing impairment.

Several studies have measured QoL among patients with hearing impairment. For example, Grimby and Ringdahl [8] studied 311 Swedish adults with severe to profound hearing impairment. The Swedish study indicated greater distress and a higher degree of social isolation in the study group than in the reference population with normal hearing. Patients with depressive and/or anxiety disorders often have a significant QoL impairment [9], and anxiety and depression are also known to be more common in patients with severe to profound hearing impairment [3,10]. Using the Hospital Anxiety and Depression Scale (HADS), Hallam et al. [3] showed that a significantly higher proportion of patients with acquired profound hearing impairment scored above the cut-off value (>10) for anxiety and depression, compared to a reference population in the UK. In most studies, 8 points is defined as the threshold for anxiety and depression [11]. In a Swedish reference population, the prevalence of individuals with ≥8 points was found to be 12% and 9% for HADS-Anxiety and HADS-Depression, respectively, and the corresponding figures for HADS >10 were 8% and 6% in Sweden [12].

Another QoL instrument, EuroQoL 5D (EQ-5D) [13], has been used in several studies that evaluated clinical and economic perspectives of health care. In a Swedish reference population, the mean value was found to be 0.8 [14]. EQ-5D has also been used, together with The Problems Impact Rating Scale (PIRS), in studies regarding audiological rehabilitation [15]. The value 100 (see “Material and methods” section) indicates that the hearing impairment has a completely negative effect on daily life [15]. Persson et al. [15] showed that, in an unslected group of hearing impaired patients, the mean value for PIRS was 38 prior to audiological rehabilitation and 23 after rehabilitation. In patients with sudden sensorineural hearing loss, the corresponding mean value for PIRS was 38 [7]. HADS, EQ-5D and PIRS are used as QoL instruments in the present study.

Tinnitus is frequently associated with hearing impairment and sometimes, together with vertigo. Sindhusake et al. [16] showed that hearing impairment and vertigo increased the risk for severe tinnitus. In a previous study, we showed that annoying tinnitus, defined as affecting daily life often or always, and remaining vertigo were the strongest predictors of negative effects on QoL after sudden sensorineural hearing loss [7].

The Swedish study by Grimby and Ringdahl [8] indicated that full-time employment improved QoL among patients with severe to profound hearing impairment, compared to those who were pensioned, either partly or full time. The authors stated that the results should be taken with caution, due to the small sample size. However, Kerr and Cowie [17] also showed that the psychosocial impact of the hearing impairment was strongly related to employment status. Furthermore, sick leave due to distress has been shown to occur significantly more often among hearing impaired employees [18,19]. This demonstrates a significant relationship between hearing ability and sick leave, which partly could be explained by the higher need for recovery among hearing impaired individuals. In the present study, we analyzed the proportion of sick leave in correlation with the studied dimensions.

Audiological rehabilitation consist a variety of interventions. Technical rehabilitation including hearing aid fitting and cochlear implant is an important part of audiological rehabilitation, and several studies, for example, Appollonio et al. [20] have shown that uncorrected hearing impairment can affect QoL negatively. A cochlear implant is a small, complex electronic device that can help to provide a sense of sound to a person with severe to profound hearing impairment. The implant consists of an external part and a part that is surgically placed under the skin, including an electrode that is inserted into the cochlea. Grimby and Ringdahl [8] stressed the importance of extended support and rehabilitation in improving QoL in hearing impaired individuals. In the British study by Hallam et al. [3], among patients with profound hearing impairment, 61% were receiving the week long intensive group rehabilitation program described by Sherbourne et al. [21]. The corresponding figure in Sweden for intensive or extended-audiological rehabilitation was calculated in the present study.

The general aim in the present study was to study QoL, psychosocial consequences in terms of sick leave and the audiological rehabilitation given to patients with severe to profound hearing impairment. The specific questions were as follows: How do the studied dimensions; onset of hearing impairment, tinnitus, vertigo and audiological rehabilitation, influence QoL and sick leave.

Material and methods

The quality register

The Swedish Quality Register of Otorhinolaryngology [6], which was started in 2006, was used as the basis for the present study. The inclusion criteria in the part of the Quality Register that studies severe to profound hearing impairment is having an average air conducted threshold >70 dB HL in the better ear across frequencies 0.5,1,2 and 4 kHz or speech recognition test <30% in the better ear. The speech recognition test was performed in a quiet environment with fixed speech level and the scoring options were presented as correctly identified speech stimuli. The majority of the patients have a sensorineural hearing impairment but patients with mixed hearing impairment who met those criteria were also included in the Register. Professionals are encouraged to register in the Quality Register, but registration is not mandatory. Informed consent is obtained from all patients before they are registered in the Quality Register. The information includes details of that research can be conducted on registry data at the group level. The questionnaire in the Register contains items about family history of hearing loss, civil status, education, working life, sick leave and chronic diseases. The questionnaire also includes an evaluation of the benefits of audiological rehabilitation.
rehabilitation and two QoL measurements, EQ-5D and PIRS. The questionnaires are completed by the patient themselves and, if needed, with help from a professional. The professional also registers what type of audiological rehabilitation the patient receives.

The audiological departments that have registered individuals in the Swedish Quality Register were equally distributed across the country. The patients were registered when they visited the department, or as several clinics have done, identified in the audiometric database and then contacted for registration in the Quality Register.

The demographic characteristics of the 2319 patients registered in the Quality Register at the time of the study are shown in Table 1 together with responders and non-responders to the additional questions (see below). The median age was 72 years (range 19–101 y) and the mean age was 68 years (SD = 17.9) in the Quality Register. Seventy-one percent (71%) of the patients in the Quality Register reached HLs that qualify as severe to profound hearing impairment after 70 years of age. The age and gender characteristics are shown in Figure 1.

The additional questions

In addition to the questions in the Quality Register, questions concerning tinnitus and vertigo were included in the present study, together with HADS. At the start of the study, these additional questions and a stamped reply envelope were mailed to 2319 patients who were registered in the quality register. Written information about the study was given to all patients, and informed consent was obtained from all study participants. After 1 month, a new questionnaire was sent, along with a reminder. After the reminder, 1274 patients (55%) had answered the additional questions. Table 1 shows the differences between the responders and non-responders to the additional questions.

HADS

HADS is a self-assessment scale consisting of 14 items, which is divided into two 7 item subscales for detecting states of anxiety and depression [22]. The validity is good, and results based on the instrument show a high correlation with other instruments measuring psychological illness and health [11]. Each question has four alternatives, which are scored from 0 to 3 points. Thus, for each subscale, the maximum total number of points is 21.

The scores are derived by summing the responses for each of the two subscales or for the scale as a whole, and higher scores indicate greater levels of anxiety or depression.

The items do not measure for somatic symptoms. Five of the 14 items are reverse coded. The Swedish version of the instrument, which was previously described and validated [12], was used in this study. In most studies, eight points is defined as the threshold for anxiety and depression [11], and the same threshold was used here. We also conducted an analysis of the proportion of patients with HADS-Anxiety and HADS-depression >10.

EQ-5D

EQ-5D is a standardized instrument for measuring health outcomes [13]. It is applicable to a range of health conditions and treatments, and provides a descriptive profile and a single index value for ‘QoL’. The EQ-5D describes five dimensions, mobility, self-care, usual activities, pain/discomfort and anxiety/depression. Each dimension has three levels (1, 2 or 3), indicating no-(1), some-(2) and severe-(3) problems. Hence, an index value 1.0 (1,1,1,1,1) indicates no problems in any of the dimensions, while, for example, state 1,1,1,2,3 indicates some problems with pain and severe problems with anxiety/depression. The instrument can be used in the clinical and economic evaluation of health care, as well as in population health surveys. In this study, we used the Swedish version of EQ-5D [14] and calculated the EQ-5D index with the British coefficients [13]. The EQ-5D guidelines do not give an exact threshold for a negative impact on QoL. In the present study, we set the threshold <0.7, which is same value that

Table 1. Demographic characteristics in the total quality register and differences between responders and non-responders to the additional questions.

<table>
<thead>
<tr>
<th></th>
<th>Quality register</th>
<th>Responders (additional questions) n = 1274</th>
<th>Non-responders (additional questions) n = 1043</th>
<th>p Value* responders/ non-responders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years) Mean (SD)</td>
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<tr>
<td>19-40</td>
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<td>41-60</td>
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<td>61-80</td>
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<td>81-110</td>
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<td>Gender</td>
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<td>Women</td>
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<td>Civil status</td>
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<td>Living alone</td>
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<td>Education</td>
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<td>Elementary school</td>
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<td>Training school</td>
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<td>High school</td>
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<tr>
<td>Other education</td>
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<tr>
<td>University</td>
<td></td>
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</tbody>
</table>

*aAll p-values calculated with chi-square test except age where unpaired t-test is performed.

Figure 1. The age and gender characteristics in the Swedish quality register for severe and profound hearing impairment (n = 2319).
we used in a previous study on sudden sensorineural hearing loss [7]. Furthermore, this value is 0.1 lower than the mean value in the Swedish reference population (0.8), a difference that from a clinical perspective, can be considered reasonable for defining a negative impact on QoL in these patients.

PIRS

The PIRS contains the single following question: To what extent does your hearing impairment affect your daily life? The instrument is presented as a thermometer; with a scale ranging from 0 to 100, where 0 indicates that the hearing impairment does not influence daily life and 100 indicates that the impairment has a completely negative effect on daily life [15]. In accordance with the procedure we used for the PIRS in our sudden sensorineural hearing loss study [7], we used the threshold ≥70 in the present study to define the point at which hearing loss has strong negative effects on daily life.

Onset of hearing impairment

The time of onset of the hearing impairment was dichotomized based on the onset before or after 3 years of age. Accordingly, the patients were divided into early onset (before 3 years of age) and late onset of hearing impairment (onset at/or after 3 years of age). late onset of hearing impairment (onset at/or after 3 years of age).

Tinnitus and vertigo

The question concerning tinnitus and vertigo was as follows: Do you have tinnitus/vertigo? The alternatives were as follows: Yes or No. The subsequent question was as follows: If yes – Does tinnitus/vertigo affect your daily life? The answer alternatives were as follows: Yes, always; Yes, often; Yes, sometimes; No, never.

Sick leave

Sick leave was indicated by having received 25%, 50%, 75% and 100% of maximum benefits, which corresponds to 10, 20, 30 and 40 h of reduced work capacity per week, respectively. The data on sick leave were registered for individuals from 20 to 65 years of age. Data were reported by the patients and if there were uncertainties, a professional helped the patients to verify data with the local Social Insurance Agency.

Audiological rehabilitation

Audiological rehabilitation was divided into basic audiological rehabilitation and extended audiological rehabilitation. The data were collected from the patient’s journals. Basic audiological rehabilitation included hearing aid fitting and rehabilitation by an audiologist. Extended audiological rehabilitation was defined as rehabilitation with at least three interventions, e.g. an audiologist, a social worker and a technician or rehabilitation in a group. The proportion of patients with different outcomes, in terms of QoL parameters, was evaluated in relation to the type of audiological rehabilitation they had received. The group that received extended audiological rehabilitation included patients with cochlear implants. However, patients with cochlear implants were also analyzed separately and compared to the rest of the study population.

Other factors

As in many other studies on hearing impairment and its impact on QoL, e.g. Van Oyen et al. [23], analyses were also performed for well-known confounding factors, such as gender, civil status, age classes and education.

The statistical analyses were performed using SPSS version 18 for Windows (Chicago, IL). Mean and standard deviation (SD) were used to summarize continuous data and percentages were used for categorical data. Continuous data were analyzed using unpaired t-tests and categorical data were analyzed using chi-square tests. Logistic regression models were performed to evaluate the association between QoL parameters (HADS, EQ-5D, PIRS) and sick leave with the studied dimensions, specifically, time of onset, tinnitus, vertigo and audiological rehabilitation, including cochlear implants. The QoL parameters and the studied dimensions were dichotomized. Both crude and adjusted models for other potential confounding factors, such as gender, civil status, age classes and education level were fitted. The measure of association was assessed by odds ratios (OR) with 95% confidence intervals (CI). The level of statistical significance was set at p < 0.05.

Ethics

The study was approved by the Medical Ethics Committee at Uppsala University Hospital.

Results

Table 1 shows the numbers of patients in the total Quality Register and the numbers of responders and non-responders to the additional questions. The distribution of the demographic variables in the study and the differences between the responders and non-responders to the additional questions are shown. Statistically significantly differences were found for all demographic variables, except for gender. The responders were somewhat younger, less likely to live alone and had a higher level of education.

Tables 2–5 show that the total numbers differed in the studied dimensions because tinnitus and vertigo are taken from the additional questions, while the rest of the dimensions, including onset of hearing impairment, audiological rehabilitation and cochlear implants, came from the total Quality Register. In the same way, the total numbers differed in the QoL parameters because HADS was taken from the additional questions while EQ5D and PIRS came from the total Quality Register (see section “Material and methods”).

In the present study, the total proportions of patients with thresholds for HADS-Anxiety and HADS-Depression ≥8 were 31.3% and 22.5%, respectively. The corresponding results for HADS-Anxiety/Depression >10 were 14.5% and 8.5%. The mean value for EQ-5D was 0.7, and the mean value for PIRS in the whole study group was 57. Tables 2 and 4 show the proportion of patients in the studied dimensions with thresholds for HADS-Anxiety and HADS-Depression ≥8, EQ5D <0.7 and PIRS ≥70.

There were 2027 individuals (87%) with late-onset hearing impairment and 292 individuals (13%) with early- onset hearing impairment in the Quality Register. Table 2 shows the proportion of patients (%) and ORs comparing late- and early- onset hearing impairment, and their outcomes in the QoL parameters. Late-onset hearing impairment was statistically significantly negatively associated with two of the QoL variables, EQ-5D and PIRS. Further analyses in the group with late-onset hearing impairment showed a proportion of patients with a cut-off value >10 in 14.3% for HADS-Anxiety and 8.6% for HADS-depression.

In total, 704 (58%) of the patients who answered the additional questions experienced tinnitus. In 38% of these patients, tinnitus affected daily life negatively, always or often. All four QoL parameters were strongly negatively and statistically significantly associated with tinnitus affecting daily life always or often, with OR ranging from 1.9 to 3.5 in the adjusted models (Table 3). Table 3 also shows differences of high statistical significance for
Table 2. The proportion of patients (\%), crude and adjusted odds-ratios (OR) with 95% CI for different QoL parameters*, comparing late- and early-onset of hearing impairment.

<table>
<thead>
<tr>
<th>Late onset of hearing impairment, %</th>
<th>HADS anxiety ≥8</th>
<th>EQ-5D &lt;0.7</th>
<th>PIRS ≥70</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude OR (95% CI), p-value</td>
<td>31 (0.54–2.04),</td>
<td>0.92 (0.45–1.91),</td>
<td>3.03 (1.60–5.74),</td>
</tr>
<tr>
<td>Adjusted OR (95% CI), p-value</td>
<td>1.91 (0.90–4.03),</td>
<td>1.06 (0.47–2.36),</td>
<td>2.74 (1.38–5.44),</td>
</tr>
</tbody>
</table>

*The total numbers differ in the QoL parameters because HADS is taken from the additional questions while EQ5D and PIRS come from the total Quality Register (see section on Material and Method).

Table 3. The proportion of patients (\%), crude and adjusted odds-ratios (ORs) with 95% CI for different QoL outcomes comparing tinnitus and vertigo.

<table>
<thead>
<tr>
<th>Vertigo, %</th>
<th>HADS anxiety ≥8</th>
<th>HADS depression ≥8</th>
<th>EQ-5D &lt;0.7</th>
<th>PIRS ≥70</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude OR (95% CI), p-value</td>
<td>3.40 (2.48–4.66),</td>
<td>2.96 (2.09–4.18),</td>
<td>2.57 (1.85–3.57),</td>
<td>1.94 (1.43–2.64),</td>
</tr>
<tr>
<td>Adjusted OR (95% CI), p-value</td>
<td>3.51 (2.51–4.90),</td>
<td>3.10 (2.14–4.47),</td>
<td>2.62 (1.86–3.70),</td>
<td>1.92 (1.39–2.64),</td>
</tr>
</tbody>
</table>

Table 4. The proportion of patients (\%), crude and adjusted odds-ratios (ORs) with 95% CI in groups with different audiological rehabilitation, and outcome in the QoL parameters*.

<table>
<thead>
<tr>
<th>Cochlear implant</th>
<th>HADS anxiety ≥8</th>
<th>HADS depression ≥8</th>
<th>EQ-5D &lt;0.7</th>
<th>PIRS ≥70</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes, %</td>
<td>37</td>
<td>19</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>No, %</td>
<td>30</td>
<td>29</td>
<td>40</td>
<td></td>
</tr>
</tbody>
</table>

*The total numbers differ in the QoL parameters because HADS is taken from the additional questions while EQ5D and PIRS come from the total Quality Register (see “Material and methods” section).

Vertigo affecting daily life always or often as compared to sometimes or never, and the ORs ranged from 1.6 to 3.3 in the adjusted models. In total, 537 (45%) of the patients who answered the additional questions experienced vertigo. Tinnitus and vertigo were the two dimensions that showed the highest ORs in the present study.

In the Swedish Quality Register, 87% of the patients were fitted with hearing aid/s. Furthermore, of the 13% without hearing aid/s, 42% were rehabilitated with cochlear implant/s. Hence, in total, 92% of the patients in the Quality Register were fitted with hearing aids and/or cochlea implant/s. Extended audiological rehabilitation was given to 848 (38%) of the patients in the Quality Register. Table 4 shows that extended audiological rehabilitation was given significantly more often to patients for whom two of the QoL parameters, HADS – Anxiety and PIRS, were negatively affected.

In the group given extended audiological rehabilitation, patients with cochlear implants were included, but they were also analyzed separately and compared to the rest of the study population. In total, 242 patients (10.4%) in the study group had been rehabilitated with cochlear implants. The results showed that patients with cochlear implants had a significantly lower risk (OR <1) of a negative impact on QoL in two of the QoL parameters (EQ-5D, PIRS).
A total of 806 individuals in the present study were of working age (20–65 years). Of these, 30% were on sick leave (25–100%) associated with their hearing impairment. Table 5 shows the proportion of sick leave (25–100%) associated with hearing impairment in the studied dimensions. Sick leave was significantly associated with three of the studied dimensions, specifically, tinnitus, audiological rehabilitation and cochlear implants.

### Discussion

#### The study population

In Sweden, we have estimated the prevalence of patients with a severe to profound hearing impairment to be 0.10–0.15%, which corresponds to 10,000 to 15,000 patients. In the present study, only 2319 of these patients were studied, which is a limitation of the study. However, the audiological departments in 19 of 25 counties participated in the Swedish Quality Register, and they were equally distributed across the country [6]. Hence, the coverage of the entire country is high. The patients were identified in two different ways, either when they visited the department or from the audiometric database. Thus, patients in both active and inactive rehabilitation phases were registered in the Quality Register. The distributions of age and gender were the same as in the Swedish reference population [12]. The Swedish reference population was from 1997 and younger (mean age 44 years) than the patients in the present study (mean age 68 years). Therefore, as stated above, the proportion of individuals with HADS – Anxiety ≥8 may have been slightly overestimated in the present study.

Logistic regression was performed, and results are given both as crude and adjusted analyses to avoid confounding effects from the background variables. The results show overall small differences between the crude and adjusted ORs, indicating no major confounding factors, and the majority of differences found between the compared groups were highly significant.

#### Onset of hearing impairment

The present study revealed considerable differences in QoL and psychosocial consequences among individuals with a severe to profound hearing impairment. The age of onset of hearing impairment is an important factor. Late-onset hearing impairment was significantly negatively correlated with two of the QoL parameters, EQ-5D and PIRS (Table 2). In the Swedish Quality Register, 71% of the patients reach HLs that qualify as severe to profound hearing impairment after 70 years of age. Hence, most of the patients had experienced functional hearing for several decades. The progression of hearing impairment is most often slow, although same cases show a rapid decrease in hearing that results in a profound hearing loss over the course of a week [3]. Although the progression is most often slow, a negative change in hearing acuity over time may influence QoL negatively in the group with late-onset hearing impairment, which is similar to our findings in individuals with sudden sensorineural hearing loss [7]. In contrast, individuals with early onset severe to profound hearing impairment are more likely to be better adapted to their hearing impairment due to better adaptation to their impaired hearing.

Depressive and/or anxiety disorders often have a negative impact on QoL. The present study revealed considerable differences in QoL and psychosocial consequences among individuals with a severe to profound hearing impairment. The age of onset of hearing impairment is an important factor. Late-onset hearing impairment was significantly negatively correlated with two of the QoL parameters, EQ-5D and PIRS (Table 2). In the Swedish Quality Register, 71% of the patients reach HLs that qualify as severe to profound hearing impairment after 70 years of age. Hence, most of the patients had experienced functional hearing for several decades. The progression of hearing impairment is most often slow, although same cases show a rapid decrease in hearing that results in a profound hearing loss over the course of a week [3]. Although the progression is most often slow, a negative change in hearing acuity over time may influence QoL negatively in the group with late-onset hearing impairment, which is similar to our findings in individuals with sudden sensorineural hearing loss [7]. In contrast, individuals with early onset severe to profound hearing impairment are more likely to be better adapted to their hearing impairment due to better adaptation to their impaired hearing.
that, in some patients, these symptoms could be closely related to other types of trauma. However, the differences between the reference population and the hearing impaired patients were large in the present study ($p<0.001$), indicating greater levels of anxiety and/or depression in patients with severe to profound hearing impairment. Hallam et al. [3] also showed that a significantly higher proportion of patients with acquired profound hearing impairment scored above a cut-off value of $>10$ for anxiety and depression (HADS), compared to the general population in the United Kingdom. In Hallam’s study [3], only patients with profound hearing impairment were included. The present study also included patients with severe hearing impairment, so the two studies are not fully comparable. However, analyzing HADS-Anxiety and HADS-depression $>10$ in the present study revealed the proportions 14% and 8%, hence, also slightly higher proportions than in the Swedish reference population, showing 8 and 6%, respectively [12].

There were no significant differences between the groups with late- and early-onset hearing impairment in terms of the proportion of patients scoring $\geq 8$ or $>10$ on HADS-Anxiety/Depression. Therefore, in the present study, onset of the hearing impairment did not seem to be an important factor for anxiety and depression.

The proportion of sick leave did not differ between patients with late- and early-onset of hearing impairment (Table 5). However, in total, 30% of the patients who were of working age in the Quality Register were on sick leave due to their hearing impairment. Sick leave due to distress has shown to occur significantly more often among hearing impaired employees [18].

Furthermore, Grimby and Ringdahl [8] showed that full-time employment improved QoL among individuals with severe to profound hearing impairment. Hence, the sick leave itself can also negatively affect QoL, and, in the clinical situation, collaboration with The Social Insurance Agency is very important in the rehabilitation process.

### Tinnitus and vertigo

The present results show that annoying tinnitus substantially reduces QoL (Table 3). All studied QoL parameters were negatively correlated with tinnitus affecting daily life always or often. For all parameters, the differences were significant at a $p$-value of $<0.001$, compared to patients with tinnitus affecting daily life sometimes or never. In the present study, differences at high significance levels were also observed for vertigo affecting daily life always or often (Table 3). It is well known that tinnitus is associated with hearing impairment, sometimes together with vertigo. For example, Sindhusake et al. [16] showed that hearing impairment and vertigo increased the risk for severe tinnitus. A previous study also showed that annoying tinnitus and vertigo had very strong negative effects on QoL after sudden sensorineural hearing loss [7], which is similar to the results observed in the present study. Questions concerning tinnitus, vertigo and HADS are not included in The Swedish Quality Register used in clinical practice today, a fact that must be taken into consideration and that should be an issue for future discussion.

In the present study, patients with annoying tinnitus (always, often) had a high proportion of sick leave compared to patients with tinnitus sometimes or never (Table 5). In our previous study on sudden sensorineural hearing loss [7], annoying tinnitus and remaining vertigo were two important factors for sick leave. In contrast, in the present study, vertigo (always/often) did not affect the proportion of sick leave. It is possible that in the group with severe to profound hearing impairment, the slow progression and adaptation to symptoms, such as vertigo, may explain the lack of differences in sick leave between the groups with and without vertigo.
The impact on QoL in the present study, concerning severe or profound hearing impairment, is the same as for sudden sensorineural hearing loss in respect to tinnitus and vertigo. It is also interesting to note that the negative change in hearing acuity, observed in the present group with late-onset hearing impairment, negatively affects QoL in the same way as for patients with sudden hearing loss.

Conclusions

The present results indicate greater levels of anxiety and depression among patients with severe or profound hearing impairment than in the general population. Furthermore, annoying tinnitus and vertigo have strong negative effects on QoL in this group of hearing impaired patients. These symptoms must be analyzed in clinical situations, and treatment that is focused on anxiety, depression, tinnitus and vertigo must be provided early in the rehabilitation process. The proportion of sick leave differs between the studied dimensions in the study, and thus, collaboration with the regional Social Insurance Agency is crucial when working with this patient group. The study also shows that presently, only a low proportion of patients with severe or profound hearing impairment receive extended audiological rehabilitation. Accordingly, the Quality Register plays an important role in the work to improve the audiological rehabilitation in this group of patients. Finally, this study shows the importance of studying patients with severe to profound hearing impairment from different perspectives. Further studies based on the Quality Register are needed, in particular, analyzing those individuals that received no or little benefit from the audiological rehabilitation given.

Declaration of interest

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References