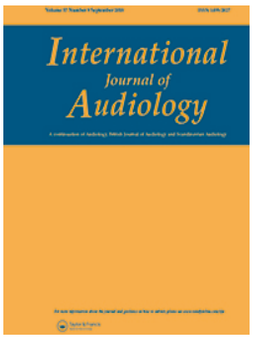

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ORIGINAL ARTICLE

Hearing loss and work participation: a cross-sectional study in Norway

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ABSTRACT

Objective: To study work participation of persons with hearing loss, and associations with hearing disabilities, self-reported workability, fatigue and work accommodation.
Design: Cross-sectional internet-based survey.
Study sample: A total of 10,679 persons with hearing loss within working-age were invited to answer the survey, where 3330 answered (35.6%).
Results: Degree of hearing loss was associated with low workability, fatigue and work place accommodation, while sick leave was associated with fatigue. Degree of hearing loss was positively associated with being unemployed ($p < .001$) and having part-time work ($p < .01$) (often combined with disability benefits) for women. Work place accommodation was more frequently provided among respondents working with sedentary postures, high seniority, long-term sick leave or low workability. Additional unfavourable sensory conditions were associated with decreased employment ($p < .001$) and workability, and an increase in sick leave ($p < .01$) and fatigue ($p < .001$).
Conclusions: Hearing loss seemed to influence work participation factors negatively; particularly, for moderate hearing loss and for women, even though the degree of employment was high. A lack of work place accommodation when there was a need for such was found. This implies increased attentiveness towards individual needs concerning the experienced disability a hearing loss may produce. A more frequent use of hearing disability assessment is suggested.

Abbreviations: WHO: World Health Organization; HLF: The Norwegian Association of the Hearing Impaired; NSD: The Norwegian Centre for Research Data; HDHS: Hearing Disability and Handicap scale; WRF: Work Role Functioning; WRFQ: Work Role Functioning Questionnaire; CI: Confidence interval; SD: Standard deviation; OR: Odds ratio; HL: hearing loss

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Hearing loss; work; participation; disability; accommodation; hearing impairment

Introduction

Participation in working life is a major concern for the individual and for the society as a whole, and a working life accessible to everybody is a major aim. However, individuals with disabilities are associated with a lower degree of working life participation than the population at large (WHO 2011). Hearing loss is associated with unfavourable conditions, such as low educational attainment (Emmett and Francis 2015), increased unemployment/underemployment rate (Emmett and Francis 2015; Hogan et al. 2009; Jung and Bhattacharyya 2012) and higher odds of low income (Jung and Bhattacharyya 2012; Emmett and Francis 2015). At the same time, hearing loss is a highly prevalent chronic condition. According to WHO (2017), more than 5% (360 million) of the world population has disabling hearing loss, of which 328 million are adults. In the United States, an estimated prevalence in 40–49-year olds is 12.9%, and 28.5% in the age group 50–59 (Lin, Niparko, and Ferrucci 2011), while the prevalence of hearing loss in Norway is approximately 11% in the age group 45–64 years (Engdahl 2015).

Studies have found a high degree of exhaustion or need for recovery after work among employees with hearing loss (Nachtegaal et al. 2009; Kramer, Kapteyn, and Houtgast 2006), increased risk of sick leave (Kramer, Kapteyn, and Houtgast 2006) and an increased risk of early retirement (Helvik, Krokstad, and Tambs 2013a, 2013b). Other unfavourable conditions are less job control (Kramer, Kapteyn, and Houtgast 2006) and reduced quality of life (Ringdahl and Grimby 2000; Carlsson et al. 2015). Such unfavourable conditions may influence the work capacity and increase the risk of work disability. At the same time, Grimby and Ringdahl (2000) found that individuals with severe-profound hearing loss who worked fulltime had less energy than their hearing counterparts, but they scored better on health-related quality of life than hearing-impaired individuals working part time or those who were retired. This might be an indication of the potential positive impact on mental health that employment may have (Blustein 2008).

A major consequence of hearing loss is oral communication challenges, which may influence the access to education and oral communication demanding work. Progress in technology has improved the hearing compensation possibilities through improved hearing aids, cochlear implants and assistive listening devices. Still, such compensative measures cannot fully recover the hearing capacity. For instance, Bjarnason (2011) described how assistive

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listening devices were valuable but not sufficient in workplace accommodation among Swedish employees with hearing loss. Moreover, technical advancements are followed by increased demands in the labour market. In addition to a reduction in the number of jobs in high-income countries, communication skills are, according to Ruben (2000), more important in working life than ever. In this case, people with hearing loss are vulnerable employees.

There has not been, to our knowledge, any large-scale studies in Norway on working life participation among people with hearing loss and to what extent the above-mentioned challenges are present. In addition, the Norwegian labour market has been influenced by what is called "The Norwegian Employment Model", which builds upon a democratic foundation and an extensive employee engagement (Levin 2012). The model is characterised by a high degree of employee involvement and co-determination both in decision-making and in daily work. Thus, studies from other countries with different employment cultures may not be directly generalisable to the situation in the Norwegian labour market. A large-scale study would provide knowledge on the level and characteristics of working life participation among employees with hearing loss, and elucidate potential barriers for participation. Such data would also provide information on the risk of work disability for hearing-impaired employees in Norway. Thus, the aim was to study work participation of persons with hearing loss in Norway, and associations between degree of hearing loss and hearing disabilities, self-reported workability, fatigue and work accommodation. Hearing disability is understood as "any restrictions or lack of ability to perform an activity in the manner or within the range considered normal for a human being in terms of hearing and communication" (Manchaiah and Stephens 2013; p. 8).

Methods

Design

The study used a cross-sectional design and it was collected through an internet-based survey.

Participants

The target population was people with hearing loss of working-age (18 to 67 years of age). Data on degree of hearing loss and work participation of people with hearing loss in working-age are not available in registers in Norway. Thus, the survey was launched through the Norwegian Association of the Hearing Impaired (HLF), which has 60,000 members and is, according to the association, the world's largest association for people with hearing loss. Traditionally, the members of HLF are individuals with hearing loss who have a spoken language approach to communication. Thus, we anticipate that the participants were users of spoken Norwegian and not sign language, as their first language. The study was approved by The Norwegian Centre for Research Data, NSD.

Data collection

Using the HLF membership list, an e-mail that included a link to questionnaires was sent to the 10,679 respondents aged between 18 and 67 registered with an e-mail address (out of 20,000 members in this age range). Women accounted for 48.8% of members while 1.1% had not registered their gender.

Two reminders to answer the survey were sent, after four and eight weeks. A total number of 3330 questionnaires were completed, while 824 declined participation. Reports on not delivered e-mails equaled 1336, decreasing the study population to 9343. Thus, the response rate was 35.6%.

Those who did not respond to the survey after two reminders (non-responders) received a survey with two questions on hearing status and vocational affiliation in order to consider possible systematic differences between the groups. The two-question-survey was sent to those who had not answered the first questionnaire and who had not declined participation. Mail addresses which returned mails undelivered were not excluded in the non-responder survey. A total of 6525 mails were sent to non-responders, and 1644 answered the survey, while 1168 were returned undelivered, corresponding to a response rate of 30.7%.

Survey

The survey was mainly based on validated instruments used in previous studies on employees with work disability, while basic questions, such as background, duration of present position and reasons for part time position were developed for this survey.

Information on background and participation

In addition to gender, age and geographical region, the survey consisted of questions on education level (primary, secondary or higher education) and working life factors. The latter included the following items: employed (yes/no), temporary or fixed employment, vocational experience in total and in present position, and full time or part time employment. The part time workers were asked about the degree of and reasons for working part time (own choice, health condition, too strenuous workload, not being offered a greater percentage of employment, private caregiver tasks). Multiple answers were possible. Questions concerning the work place comprised size, public or private sector, and type of tasks. The latter was retrieved from a large Norwegian cohort study, the HUNT study (www.ntnu.no/hunt/). Two questions on adaptation of work situation to accommodate hearing loss and the need of such were included together with items on doctor certified sick leave at present and the extent of sick leave during the last 12 months. Items with degree of concern of losing one's position ("not concerned", "a little concerned", "very concerned" and "no opinion") .

Hearing loss, its impact and additional conditions

Questions on the presence and duration of hearing loss, and the kind of listening devices in use were developed for this survey, while the degree of hearing loss was established using the WHO classification (none, mild, moderate, severe, profound) assessed through the better ear without use of amplification. The explanatory descriptions of the different levels were included in the question, such as "slight impairment – able to hear and repeat words spoken in normal voice at one metre" and "severe impairment – able to hear some words when shouted into better ear". Suffering from tinnitus was determined by self-reporting "are you bothered by tinnitus" with the options being "yes, often", "yes, occasionally", "seldom" and "never". Hyperacusis and Ménière's disease were established through "'have you been diagnosed with". To measure hearing disability, the Hearing Disability and Handicap scale (HDHS) was used, which is an instrument developed to assess the most important consequences

of hearing loss, including auditory incapacities and psychosocial disadvantages (Hétu et al. 1994). HDHS has been adapted to Norwegian and psychometrically evaluated by Helvik et al. (2007). It consists of 20 questions and can be divided into four subscales (speech perception, non-speech perception, participation restrictions, activity limitations). This study, however, has used the total scale based on all items only. The participants were instructed to answer the questions as experienced using hearing aids. Two examples of questions asked are "Do you have difficulty following a conversation normally in any of the following situations: at work, in a bus or a car, or when shopping?" and "Do you have a difficulty hearing in group conversation?" The answers were given on a four-point ordinal scale [never (1), sometimes (2), often (3), always (4)] within a range of 20–80. A high score indicates a high degree of hearing disability. The reported Cronbach's alpha for the entire scale was 0.89 (Helvik et al. 2007). Visual function was included delimited to visual impairment that cannot be corrected with glasses ("do you have visual difficulties which cannot be corrected with glasses"). Other conditions could also affect fatigue and workability, but we considered visual function as the most important condition affecting communication abilities.

Fatigue, workability and work role functioning

We measured the degree of fatigue by the means of Chalder's fatigue scale (Chalder et al. 1993), which has been adapted to Norwegian and used in a study on the general Norwegian population (Loge, Ekeberg, and Kaasa 1998). Two examples of questions in the eleven-item questionnaire are "Do you need to rest more?" and "Do you have difficulty concentrating?" The responses were given on a four-point Likert scale [better than usual (0), no more than usual (1), worse than usual (2), much worse than usual (3) within a range of 0–30]. A high score indicates a high degree of fatigue. The reported Cronbach's alpha was 0.89 (Chalder et al. 1993).

Assessment of workability were included using a single-item question (scale 0–10) (Ahlstrom et al. 2010). Work Role Functioning Questionnaire 2.0 (WRFQ) was used to measure difficulties with performing work. It consists of 27 items divided in four subscales (work scheduling and output demands, physical demands, mental and social demands, flexibility demands) (Abma, van der Klink, and Bultmann 2013), while a total scale based on all items were applied in this study. WRFQ has been translated to Norwegian by Johansen et al. (2018). Two examples of questions asked are "the last four weeks, to what extent have you had problems working fast enough due to your physical or mental health" and "the last four weeks, to what extent have you had problems speaking with people in-person, in meetings or on the phone due to your physical or mental health". The answers were given on a five-point Likert scale (0–4) measuring the amount of time the employee perceived as difficult meeting work demands. Each scale is scored from 0 to 100, and the sums are multiplied by 25 to obtain percentages between 0 and 100. A high score indicates a good work functioning. Psychometric testing is ongoing in Norway (Johansen et al. 2018).

Statistical analyses

The data were analysed by means of Stata IC 14.0 (StataCorp, College Station, TX). Descriptive statistics (frequencies, means and standard deviations) were used to describe respondent characteristics, hearing status, working life participation and functioning. Severe and profound hearing loss were merged into one group due to a limited number of participants. The vocational analyses were done for women and men separately for those variables where there are known systematic gender differences in the general population. Other possible gender differences were explored where appropriate. Duration of sick leave in the last 12 months was collapsed into a binary variable of 0–7 weeks and 8 weeks or more since case managers in the Norwegian welfare system at this point assess if sick leave benefits still can be granted. Chi-square tests were performed to compare groups on categorical variables, and Fischer's exact test when there were few observations in some categories reporting Chi-square when the results were not contradictory. The *t*-test was run to compare the means of two groups, while test for trend across ordered groups was used instead of one-way ANOVA to compare group means when Bartlett's test showed that the assumptions for ANOVA were not met.

Logistic regression analyses were performed to explore possible associations between the different vocational variables and the variables describing hearing loss and its impact. Demographic and socio-economic variables may influence the vocational functioning, and the analyses were adjusted for the potential confounders: age, gender, education and geographical regions. The latter relates to potential differences in the Norwegian labour market between the regions. Regarding workplace accommodation, "degree of hearing loss" was considered as a potential confounder, and added as a potential confounding variable. For the association between sick leave and fatigue, the variables "degree of hearing loss", "part-time work", "job characteristics" and "workplace accommodation" were examined for confounding effects in addition to the demographic and socio-economic variables. Continuous or categorical variables were dichotomised according to the respective median, and the scores of the Hearing Disability and Handicap scale were divided in four categories with 25% in each category. The significance level was $p < .05$.

Additional medical conditions were explored through three strata: (1) Hearing loss together with hyperacusis, Ménière's disease or visual impairment, (2) Hearing loss and tinnitus (frequently troubled), (3) Hearing loss only.

Results

A total number of 3330 participants completed the survey. The average age in the sample was 54.7 years (SD = 10.7). The proportion of responders between 50 and 67 years of age was 74.3%. Nearly 60% had completed education after secondary school and 76.6% were employed (Table 1). Among the non-responders ($n = 1644$), 39.3% worked full-time while 13.4% worked part time. Furthermore, 43.4% assessed their hearing loss as mild, 32.2% as moderate, 3.8% as severe and 1.1% as profound. Another 4.5% reported no hearing loss and 14.9% did not answer the question. This was not statistically significantly different from the hearing loss reported by the responders ($p > .05$).

Hearing status

The responders mainly reported a bilateral, mild or moderate hearing loss (77.9%, $n = 2506$, Table 2). In addition to the 3216 responders with a hearing loss, 93 individuals (2.8%) reported having no hearing loss, and were not included in the analysis. Tinnitus was frequent as 45.0% were frequently troubled, while 17.6% were troubled occasionally. Among those without hearing

loss, 76 individuals reported being frequently troubled by tinnitus.

There was a long-term experience of hearing loss among the responders as 54.5% had suffered from hearing loss for more than 10 years, either acquired or pre-lingual. Hearing aids were used by 92.4% of the participants, and 39 responders used a combination of hearing aid and cochlear implant. The proportion of responders using an assistive listening device was 18.9%, while 5.3% used no amplification.

Work participation

Degree of hearing loss was associated with being without employment for women, but not for men (Table 3). The association was also statistically significant in a logistic regression analysis adjusted for age, education, geographical region and fatigue [odds ratios compared to mild hearing loss for women were 1.32 (CI 1.01–1.74) for moderate hearing loss and 2.14 (1.45–3.17) for severe hearing loss, and the corresponding odds ratios for men were 1.01 (CI 0.78–1.30) and 1.18 (CI 0.71–1.97)]. Explained variance (R^2) was 0.08 and 0.09 for women and men, respectively. Duration of hearing loss was statistically significantly associated with being without employment only for hearing loss exceeding 10 years of duration as compared to less than two years in a logistic regression analysis adjusted for age, gender, fatigue, education and geographical region [odds ratio 1.85 (CI 1.01–3.39) for acquired hearing loss and 2.19 (CI 1.16–4.11) for early onset hearing loss, R^2=0.11].

Among the employed responders ($n=2475$), a vast majority (94.5%) had a permanent job position, and there were no statistically significant gender differences. Men worked more frequently in the private sector than women (58.8% vs. 27.8%, $p<.001$). More women (33.8%) than men (14.2%) worked part time ($p<.001$), and the degree of hearing loss was statistically significantly associated with degree of job position for women ($p=.006$) but not for men ($p=.072$). The part time workers did so by their own choice in 28.3% of the cases ($n=169$), 39.5% ($n=236$) did so because of their health condition, while 20.9% ($n=125$) reported that the workload was too strenuous in a full time position. Not being offered a greater percentage of employment applied for 11.2% ($n=67$), while 4.2% ($n=25$) had private caregiver tasks as reason for their part-time position. The possibility to combine work with disability pension was used by 37.0% ($n=221$) with no statistically significant gender differences.

Vocational functioning

There were statistically significantly negative associations between an increase in degree of hearing loss and workability and work role functioning, especially when comparing mild to moderate hearing loss (Table 4). The negative association was statistically significant in a logistic regression analysis for workability, but not for work role functioning for severe/profound hearing loss (Table 5).

The mean fatigue score was 15.4 (SD 5.4), while the corresponding hearing disability score was 43.5 (SD 9.2). Logistic regression analyses showed a statistically significantly increased likelihood of obtaining a high score in fatigue (>13) and hearing disability (>42) with increased degree of hearing loss (Table 5).

Table 1. Respondent characteristics.

	n (%)
Age groups ($n=3326$)	
18–29	129 (3.9)
30–39	219 (6.6)
40–49	507 (15.2)
50–59	1031 (31)
60–67	1440 (43.3)
Gender ($n=3326$)	
Female	1654 (49.7)
Male	1672 (50.3)
Education ($n=3234$)	
Not completed elementary school	29 (0.9)
Elementary school	229 (7.1)
Upper secondary school	1033 (31.9)
Higher education 1–4 years	1288 (39.8)
Higher education >4 years	655 (20.3)
Geographical region ($n=3322$)	
South	696 (21.0)
East	1171 (35.3)
West	640 (19.3)
Mid-Norway	391 (11.8)
North	424 (12.8)
Employment ($n=3234$)	
Employed	2477 (76.6)
Not employed	757 (23.4)

Table 2. Hearing status and use of amplification devices.

		Degree of hearing loss			
	Total *n*	Mild *n* (%)	Moderate *n* (%)	Severe *n* (%)	Profound *n* (%)
Hearing loss	3216	1513 (47.1)	1396 (43.4)	220 (6.8)	87 (2.7)
Bilateral	2790	1233 (44.2)	1273 (45.6)	206 (7.4)	78 (2.8)
Unilateral	426	280 (65.7)	123 (28.9)	14 (3.3)	9 (2.1)
Tinnitus	3213				
Often	1410	673 (47.7)	613 (43.5)	94 (6.7)	30 (2.1)
Occasionally	578	253 (43.8)	264 (45.7)	44 (7.6)	17 (2.9)
Seldom	499	226 (45.3)	218 (43.7)	41 (8.2)	14 (2.8)
Never	726	361 (49.7)	299 (41.2)	40 (5.5)	26 (3.6)
Duration of hearing loss	3214				
0–5 years	686	471 (68.7)	197 (28.7)	13 (1.9)	5 (0.7)
6–10 years	775	403 (52.0)	343 (44.3)	23 (3.0)	6 (0.8)
>10 years	1180	471 (39.9)	579 (49.1)	91 (7.7)	39 (3.3)
All my life	573	168 (29.3)	275 (48.0)	93 (16.2)	37 (6.5)
Use of amplification devices	3214				
Hearing aids	2971	1386 (46.7)	1341 (45.1)	205 (6.9)	39 (1.3)
Cochlear implant	92	1 (1.1)	5 (5.4)	24 (26.1)	62 (67.4)
Assistive listening device	606	129 (21.3)	329 (54.3)	107 (17.7)	41 (6.8)
None	169	111 (65.7)	49 (29)	6 (3.6)	3 (1.8)

Women reported slightly higher mean scores of hearing disability and fatigue than men ($p < .001$). The mean scores of HDHS and fatigue for women were 44.6 (SD = 9.2, $n = 1613$) and 16 (SD = 5.6, $n = 1560$) and for men 42.4 (SD = 9.1, $n = 1631$) and 14.8 (SD = 5.1, $n = 1577$). There were only small gender differences in workability [mean score 6.3 (SD 2.6) for women and 6.6 (SD 2.5, $p = .003$) for men and work role functioning (mean score 81.5 (SD 19) for women and 83 (SD 19.1) for men, $p = .238$].

Sick leave according to the degree of hearing loss is presented in Table 4. The prevalence of long-term sick leave (8 weeks or more during the last 12 months) was 17.0% ($n = 212$) for women and 11.8% ($n = 144$) for men. Women had a prevalence of part time or full time sick leave at present of 12.5% ($n = 156$), while the corresponding results for men were 7.9% ($n = 96$). Regression analyses revealed no statistically significantly increased likelihood of being at sick leave at present or for more than eight weeks during the last 12 months, neither for women nor for men, according to the degree of hearing loss.

Fatigue was strongly associated with sick leave, both at present and for long-term sick leave during the last 12 months. Logistic regression analysis, adjusted for age, gender, level of education,

Table 3. Work participation and degree of hearing loss stratified according to gender.

	Women Degree of hearing loss				Men Degree of hearing loss			
	Mild *n* (%)	Moderate *n* (%)	Severe to pro-found *n* (%)	Chi-square	Mild *n* (%)	Moderate *n* (%)	Severe to pro-found *n* (%)	Chi-square
Employment								
Yes	559 (81.8)	530 (72.3)	132 (68.4)	17.3***	611 (76.6)	504 (74.1)	76 (72.4)	1.7
No	124 (18.2)	165 (23.7)	61 (31.6)		187 (23.4)	176 (25.9)	29 (27.6)	
Sector								
Private	143 (25.6)	137 (25.9)	37 (28)	1.3	340 (55.8)	297 (59.1)	40 (52.6)	5.4
Public	397 (71.2)	370 (69.8)	90 (68.2)		236 (38.8)	172 (34.2)	28 (36.8)	
Self-employed	18 (3.2)	23 (4.3)	5 (3.8)		33 (5.4)	34 (6.8)	8 (10.5)	
Size of workplace								
1–19 employees	162 (29)	167 (31.5)	34 (25.8)	2.2	153 (25.1)	135 (26.8)	26 (34.2)	8.6
20–99 Employees	212 (38)	197 (37.2)	55 (41.7)		137 (22.5)	132 (26.2)	22 (29)	
>100 employees	184 (33)	166 (31.3)	43 (32.6)		319 (52.4)	236 (46.9)	28 (36.8)	
Duration of present position								
0–3 years	87 (15.6)	88 (16.6)	25 (18.9)	1.9	81 (13.3)	79 (15.7)	11 (14.5)	1.5
4–8 years	93 (16.7)	96 (18.2)	25 (18.9)		106 (17.4)	90 (17.9)	13 (17.1)	
>8 years	378 (67.7)	345 (65.2)	82 (62.1)		421 (69.2)	333 (66.3)	52 (68.4)	
Degree of position								
Full time	397 (71)	333 (62.8)	80 (60.6)	10.4**	535 (87.7)	417 (82.9)	66 (86.8)	5.3
Part time	162 (29)	197 (37.2)	52 (39.4)		75 (12.3)	86 (17.1)	10 (13.2)	
Task characteristics								
Sedentary	300 (53.8)	253 (47.8)	73 (55.3)	8.3[a]	413 (67.9)	290 (57.7)	48 (63.2)	15.2[a]
Walk demanding	167 (29.9)	172 (32.5)	31 (23.5)		116 (19.1)	129 (25.7)	15 (19.7)	
Walk and lift demanding	90 (16.1)	102 (19.3)	28 (21.2)		67 (11)	67 (13.3)	9 (11.8)	
Heavy manual labour	1 (0.2)	2 (0.4)	0 (0)		12 (2)	17 (3.4)	4 (5.3)	

Chi-square tests were used to test for statistical differences related to degree of hearing loss.
[a]Fischer's exact test.
**$p < .01$; ***$p < .001$.

Table 4. Degree of functioning according to degree of hearing loss.

		Mild	Moderate	Severe – profound	Chi-square or *z* (test for trend)
Work ability Mean (SD)	Scale 0–10 $n = 3139$	6.9 (2.4)	6.1 (2.6)	6.1 (2.8)	8.7**,[a]
Work role functioning Mean (SD)	Scale 0–100 $n = 2093$	85.4 (17.5)	79.2 (19.7)	81.2 (21.0)	6.4***,[a]
Hearing disability Mean (SD)	Scale 20–80 $n = 3164$	39.6 (7.7)	46.6 (8.4)	51.2 (8.9)	24.8***,[a]
Sense of fatigue Mean (SD)	Scale 0–44 $n = 3059$	14.7 (5.1)	15.9 (5.4)	16.3 (6.1)	6.2***,[a]
Sick leave at present *n* (%)	Yes, full time	40 (3.4)	44 (4.3)	9 (4.3)	8.5b
	Yes, partly	56 (4.8)	67 (6.5)	19 (9.1)	
	No	1069 (91.8)	919 (89.2)	180 (86.5)	
Sick leave last 12 months *n* (%)	0–7 weeks	1018 (87.5)	871 (84.7)	175 (84.5)	4.2b
	8 weeks or more	145 (12.5)	158 (15.4)	32 (15.4)	
Concerned about losing job *n* (%)	Not concerned	870 (74.8)	663 (64.4)	131 (63.3)	33.0***,[b]
	Some concern	216 (18.6)	267 (26.0)	53 (25.6)	
	Very concerned	44 (3.8)	52 (5.1)	14 (6.8)	
	No opinion	33 (2.8)	47 (4.6)	9 (4.4)	
Workplace accommodation *n* (%)	Yes	197 (16.9)	260 (25.2)	109 (52.4)	126.5***,[b]
	No	969 (83.1)	771 (74.8)	99 (47.6)	

Test for trend across ordered groups and Chi-square tests were used to test for statistical differences related to degree of hearing loss.
[a]Test for trend across ordered groups.
[b]Chi^2-test.
**$p < .01$; ***$p < .001$.

Table 5. Degree of hearing loss and vocational functioning. Logistic regression analyses showing odds ratios (OR) and 95% confidence intervals (95% CI) adjusted for gender, age, education and geographical region.

	Low work ability score OR (95% CI)	R^{2c}	Low WRF[a] score OR (95% CI)	R^{2c}	High fatigue score OR (95% CI)	R^{2c}	High HDHSb score OR (95% CI)	R^{2c}	Received work place accommodation OR (95% CI)	R^{2c}
Mild hearing loss	1.0	0.04	1.0	0.02	1.0	0.03	1.0	0.11	1.0	0.05
Moderate HL	2.01 (1.72–2.35)***		1.47 (1.25–1.72)***		1.42 (1.22–1.66)***		3.95 (3.37–4.62)***		1.64 (1.33–2.02)***	
Severe HL	2.11 (1.63–2.74)***		0.99 (0.75–1.31)		1.29 (0.99–1.67)		7.58 (5.51–10.41)***		5.00 (3.63–6.87)***	

[a]Work Role Functioning.
[b]Hearing Disability and Handicap Scale.
[c]Pseudo R^2.
***$p < .001$.

Table 6. Workplace accommodation varies according to job characteristics and functioning. Logistic regression analyses adjusted for age, gender, education, geographical region and degree of hearing loss.

		Received workplace accommodation Odds ratio (95% CI)	Pseudo *R*-squared
Sector	Private	1.0	0.06
	Public	1.29 (1.03–1.61)*	
Working hours	Full time	1.0	0.05
	Part time	1.50 (1.19–1.87)***	
Seniority	<1 year	1.0	0.06
	1–3 years	1.54 (0.86–2.76)	
	4–8 years	1.68 (0.97–2.92)	
	>8 years	2.29 (1.35–3.87)**	
Working postures	Sedentary	1.0	0.05
	Walking	0.76 (0.60–0.96)*	
	Walking and lifting	0.61 (0.45–0.84)**	
Doctor certified sick leave last 12 months	Sick leave <8 weeks	1.0	0.05
	Sick leave >8 weeks	1.71 (1.32–2.22)***	
Work ability	High score	1.0	0.06
	Low score	1.66 (1.36–2.04)***	

*$p < .05$, **$p < .01$, ***$p < .001$.

degree of hearing loss, part-time work, job characteristics and accommodation of work place, showed odds ratios of 1.17 (CI 1.14–1.20) for sick leave at present and 1.14 (CI 1.11–1.16) for long-term sick leave for each unit of increase on the fatigue scale.

There was an increased percentage of responders reporting concern for losing their job with increased hearing loss (Table 4).

Workplace accommodation

The association between degree of hearing loss and having a workplace, which was adapted to accommodate the hearing loss, was statistically significant (Table 4). The likelihood of having workplace accommodation was increased with increasing degree of hearing loss, especially for severe/profound hearing loss compared to mild (Table 5).

Work place accommodation was more frequent in the public sector than in the private sector, among part time workers, and workers with more than eight years of seniority (Table 6). Additionally, men were less likely to have workplace accommodation compared to women (odds ratio 0.78 (CI 0.64–0.95)). There was a decreased likelihood of work place accommodation in walk demanding positions compared to positions where sedentary postures were dominant. Doctor certified sick leave for eight weeks or more was associated with an increased likelihood of having an adapted work place, and so was a low workability score.

Furthermore, 30.7% ($n = 579$) of the respondents reported to be in need of work place accommodation without receiving it. Among respondents without accommodation ($n = 893$), the need of such according to degree of hearing loss was reported by 29.7% (mild), 45.1% (moderate) and 60.7% (severe-profound) of the women ($p < .001$), while for men ($n = 944$) the corresponding figures were 16.6, 31.1 and 52.6%, respectively ($p < .001$).

Additional sensory conditions

Sensory conditions additional to hearing loss had a prevalence of 21.1% ($n = 632$). In addition to the 1410 participants with hearing loss who were frequently troubled by tinnitus (43.9%), hyperacusis was present in 9.3% ($n = 308$) of the participants, 6.8% ($n = 223$) suffered from Ménière's disease and 7.7% ($n = 255$) had an additional visual impairment which could not be corrected with glasses. Statistically significant differences in vocational characteristics were observed among participants with hearing loss only and those with severe tinnitus and those with other additional sensory conditions (Table 7). There were decreased employment rates, an elevated rate of doctor certified long-term sick leave, a decreased workability and an increased fatigue score for these groups. The difference was strongest for those with other additional sensory conditions than tinnitus in addition to hearing loss. A larger proportion of the participants had workplace accommodation according to their hearing loss when they had additional conditions. However, the reported need of accommodation when it was not arranged for was also higher than for those without additional conditions.

Table 7. Additional sensory conditions and vocational functioning.

		Hearing loss	Hearing loss and frequent tinnitus without other conditions	Hearing loss and hyperacusis/Meniere's disease/visual impairmenta	Chi-square or *z* (test for trend)
Employment rate *n* (%)	$n = 3234$	1308 (79.8)	741 (76.0)	428 (69.0)	29.4***,b
Sick leave >7 weeks last 12 months *n* (%)	$n = 2464$	167 (12.8)	105 (14.3)	84 (19.8)	12.5**,b
Work ability Mean (SD)	Scale 0–10	6.9 (2.4) $n = 1632$	6.3 (2.6) $n = 971$	5.5 (2.8) $n = 616$	11.4***,c
Sense of fatigue Mean (SD)	Scale 0–44	14.5 (5.0) $n = 1593$	15.6 (5.3) $n = 944$	17.5 (6.0) $n = 600$	10.0***,c
Workplace accommodation *n* (%)	$n = 2470$	281 (21.6)	153 (20.7)	147 (34.4)	34.3***,b
In need of accommodation when not arranged for	$n = 1887$	277 (27.1)	188 (32.1)	114 (40.9)	20.3***,b

Test for trend across ordered groups and Chi-square test were used to test for statistical differences related to additional sensory conditions.
[a]Prevalence: Hyperacusis, $n = 308$ (9.3%), Meniere's disease, $n = 223$ (6.8%), visual impairment, $n = 255$ (7.7%).
[b]Chi-square test.
[c]Test for trend across ordered groups.
$^{**}p < .01$; $^{***}p < .001$.

Discussion

The participants had mainly a bilateral mild or moderate hearing loss of long duration. They were mainly hearing aid users, and they were frequently troubled by tinnitus. Furthermore, most participants were senior workers (74.3% in the range of 50–67 years) with high seniority in their present position. They were highly educated compared to the population at large according to numbers from Statistics Norway (2015) (39.8% vs. 30.1% for university education of 1–4 years and 20.3% vs. 10.0% for university education exceeding 4 years).

The employment rate was high [76.6% versus 74.3% in the population at large (Statistics Norway 2015)], and we found a part-time job rate consistent with the rate in the general population (13.3% for men and 35.5% for women) (Statistics Norway 2015). The reason for working part-time was to a large extent due to the health condition (39.5%) and/or a full time position being too strenuous (20.9%). Among the part-time workers, 37.0% combined the part-time work with disability pension. Helvik, Krokstad, and Tambs (2013b) found that hearing loss was seldom the main cause for disability pension in Norway, but the risk of being granted disability pension due to other diagnoses than hearing loss increased with degree of hearing loss. Additional strain and an unfavourable working situation among hearing-impaired employees have been found in other studies (Danermark and Gellerstedt 2004; Kramer, Kapteyn, and Houtgast 2006; Nachtegaal et al. 2009) implying that working full time may be too strenuous. McDonough and Amick (2001) found an increased risk of job exit among part-time workers in the general population in the US. However, reducing working hours may be a protective measure against developing fatigue for people with hearing loss. Thus, an increased use of a combination of work and disability pension in the senior working population with long-term experience of hearing loss may contribute to securing labour market participation.

Participation characteristics

We found a high mean score of fatigue (15.4), and it was positively associated with an increase in the degree of hearing loss. In a study of fatigue in the general Norwegian population, Loge, Ekeberg, and Kaasa (1998) found a mean fatigue score of 12.2, while participants with health problems had a mean score of 14.2, and in the age group 60–80 years the score was 15.1. Working life conditions may have changed since the 1990s, but our findings indicate a considerable presence of fatigue among employees with hearing loss. Thus, our study confirms previous studies regarding fatigue among people with hearing loss such as Nachtegaal et al. (2009) and Kramer, Kapteyn, and Houtgast (2006).

Kramer, Kapteyn, and Houtgast (2006) found that employees with hearing loss perceived the background noise as louder than their normal-hearing colleagues did. This is in line with the study of Hua et al. (2013), who found that people with mild–to- moderate hearing loss used more effort in noise typical to open plan offices than normal-hearing peers. The high mean score of hearing disability (43.5) in this study despite the large number of responders with mild and moderate hearing loss indicates that even moderate hearing loss might have a negative impact on function. Earlier studies such as Chang, Ho, and Chou (2009) and Kim et al. (2017) have also found a moderate correlation between measured hearing loss and perceived hearing disability. Due to this lack of correspondence between the degree of hearing loss and the perceived difficulties, the loss may inflict an increased attentiveness to hearing disability assessment in audiological follow-up.

Furthermore, we found that the degree of hearing loss was negatively associated with workability and work role functioning, and the strongest association was from mild to moderate hearing loss. Additionally, degree of hearing loss was associated with work task characteristics for men only ($p < .05$). That is, men with moderate hearing loss tended to have a larger proportion in walk demanding positions than in sedentary postures compared to those with mild or severe to profound hearing loss. Acquired hearing loss tends to develop and augment over the years, and it takes time to discover and to become familiar with the change in condition. Going from mild to moderate hearing loss might imply a transition period where it takes time to discover and familiarise oneself with new communication needs. In this process, people with moderate hearing loss might be more inclined to endure a job situation based on their remaining auditory function and by such risking a strenuous daily life. People with severe and profound hearing loss may need more time to adapt and will not have prerequisites to do their job without any accommodation. The differences in task characteristics could also explain some of the reduced workability and work role functioning since

walk demanding positions would typically be teaching, health care, social work and service trades, which would be communication-demanding occupations. Participants with mild hearing loss and severe to profound loss had a larger proportion of jobs with sedentary postures, which would typically be clerical work, which potentially requires less verbal communication. However, the weaker association among the employees with severe/profound hearing loss may be caused by a healthy worker effect, where employees still working were those with the healthiest constitutions or most suitable jobs for hearing-impaired employees.

We found a prevalence of 12.5% doctor certified sick leave at present for women and 7.9% for men as compared to 6.9% for women and 4.0% for men in the general population (fourth quarter 2015, Statistics Norway). There was no statistically significant associations between sick leave and degree of hearing loss, but it was highly associated with fatigue. Kramer, Kapteyn, and Houtgast (2006) found a significant difference in sick leave among employees with hearing loss compared to normal hearing employees. Sick leave due to distress occurred significantly more often among workers with hearing loss. Hearing loss, job demands and requirement to recognise/distinguish between sounds were the strongest risk factors for stress-related sick leave. In addition to the extra effort used in noise by employees with mild-to-moderate hearing loss, Hua et al. (2013) also found that their general health was lower than their normal-hearing controls. With the argumentation of Ruben (2000) that communication skills are more important in work-related tasks than ever, we can assume that employees with hearing loss are more vulnerable than normal hearing employees. We do not know the reason for sick leave in this study, but the strong association with fatigue together with the strong association between fatigue and severity of hearing loss indicates that it should be further examined whether hearing loss is a factor contributing to sick leave. The perceived reason for sick leave may be fatigue, but hearing loss may be the main contributing factor to fatigue.

Work place accommodation

The degree of hearing loss was positively associated with both having workplace accommodations according to the hearing loss and being in need of such when no accommodation measures were taken. Hearing loss is often described as an invisible disability and might provide an explanation for the apparently insufficient prevalence of accommodation measures in this group. Hearing aids are small and almost invisible and only 18.9% of the participants reported use of assistive listening devices, which could have provided visible cues. Service provision towards hearing loss in Norway has been described as fragmentary and limited in terms of extent and content (Helsedepartementet & Sosialdepartementet 2002) and might provide an additional explanation in lack of accommodation measures.

We do not know if the participants in our study had requested accommodation or not. Baldridge and Swift (2016) found a reluctance to request accommodation, especially in for-profit organisations and this reluctance increased with age. The lack of accommodation when being in need of such in this study might be due to such a tendency, with our study population being the older part of the workforce and accommodation was found to be more frequent in public sector.

We also found that accommodation was less frequent in walk demanding work compared to work mainly involving sedentary postures, and that seniority exceeding eight years was associated with an increased accommodation rate. The difference in accommodation measures according to types of position/task characteristics may be due to differences in measures needed and how these are perceived by co-workers and managers. Walk demanding positions are typically teaching, various health care positions, and manual labour while sedentary postures are typically clerical work. Baldridge and Swift (2016) argued that employees with disabilities are less likely to request accommodation if they believe that co-workers would not approve of it. Necessary accommodation measures in walk demanding positions, like reduced amount of teaching, smaller classes or less shift-work might be perceived as expensive and inappropriate special treatment, which would feel awkward to request. Requesting accommodation may be easier when requiring commonplace measures and individual actions with little effect on co-workers, which might be the case in typical office-work.

We found that accommodation was more frequent among the part-time workers, which is contrary to the findings of Dong and Guerette (2013). They argued that less accommodation among part-time workers might be due to lower access to organisational resources and people with disabilities being more likely to be placed in part-time positions. With only 11.2% reporting not being offered more working hours together with the high proportion of health-related reasons for part-time work, this is not the case in this study. Furthermore, reduced workability and having been on long-term sick leave in our study increased the likelihood of having an accommodated work situation. These results indicated an accordance between needs and accommodation, and that vulnerable employees to a larger extent tend to get their workplace adjusted to their needs. Carlsson et al. (2015) found comparable results in Sweden, where patients on sick leave received extended audiological rehabilitation significantly more often, which indicated that those with the highest needs received the rehabilitation offer. In Norway, there is a follow-up plan of people on sick leave, which should be effectuated when an employee has been on sick leave for 4–8 weeks. Measures should also be considered in co-operation with the employer, the general practitioner and the social insurance system in order to prevent long-term sick leave, and in this process accommodation needs could be revealed and measures taken.

The high number of employees without accommodation measures when reporting needing it, together with the high fatigue score and the number of employees finding full-time positions too strenuous, emphasise the importance of having the working situation assessed and accommodated according to individual needs to support labour market participation. Both employees with moderate and severe/profound hearing loss seem to be vulnerable.

Gender differences

In the present study, women reported lower workability scores, higher fatigue scores and higher hearing disability scores than men, and the severity of hearing loss was statistically significantly associated with the employment rate and the extent of part-time work in women only. Additionally, men were more concerned of losing their position and were less likely to have workplace accommodation, while women had a larger proportion with need for such accommodation without receiving it. Still, women worked more frequently in the public sector, where accommodation was more usual. On this basis, it seems that the hearing loss and factors associated with hearing loss have a greater impact on women than men. In addition, they seem to be disconnected from the labour market to a larger extent even though they do

not feel insecure in their position. Gender differences in the labour market are known from the general population, both in employment, part-time work and the degree of sick leave. Differences in work and working conditions have been used as an explanation for these gender differences (Mastekaasa 2016). For employees with hearing loss it may be particularly relevant that some of the female-dominated jobs, in health care and social work, may require more communication skills and are more emotionally demanding than other jobs. Mastekaasa (2016) argued that women choose absence instead of presence when they are confronted with health problems to a larger degree than men. If this line of argument is plausible, it is likely that the gender differences found among employees with hearing loss, in the present study, could be attributed to the same mechanisms implying that women with hearing loss experience their health condition as more severe and that they choose to stop working earlier than their male counterparts. Furthermore, it is well known that social circumstances also contribute negatively to health and work participation in women. Voss et al. (2008) reported that family conflicts and living alone with children increased the risk of sickness absence in municipal female workers. In a study by Vaananen et al. (2004), the double burden of domestic and paid work was associated with distress and poor health in women. For people with disabilities who participated in vocational rehabilitation in the US, women were less likely to be employed than men and earnings were lower (Mwachofi 2009). Gender differences were also present after vocational rehabilitation. Lower work participation among women after occupational rehabilitation in a Norwegian setting has also been reported (Øyeflaten et al. 2014). Thus, the gender differences observed in the present study were in line with previous studies and may be the result of unfavourable conditions for women with hearing loss both at work and in private life. Psychological factors may also be important as gender differences have been reported in the sense of coherence response after participation in a rehabilitation programme, where women with chronic pain showed poorer sense of coherence than men (Lillefjell 2006). Thus, the reasons for gender differences in work participation are not fully understood. If possible, a complex biopsychosocial framework should be used to understand these reasons.

Additional sensory conditions

We found a high prevalence of additional sensory conditions, especially participants frequently troubled by tinnitus (43.9%). High co-morbidity has been found between hearing loss and tinnitus, hearing loss and hyperacusis, and tinnitus and hyperacusis (Hasson et al. 2010; Shargorodsky, Curhan, and Farwell 2010; Andersson et al. 2002). Carlsson et al. (2015) found in a study of patients with severe to profound hearing loss in Sweden that all quality of life parameters were negatively correlated with tinnitus affecting daily life often or always, and the proportion of sick leave was higher than those never or sometimes bothered. Stephens et al. (2010) found that 39% in their study population of people with Ménière's disease experienced activity limitations and 47% experienced participation restrictions, of which one main area was concerning work and employment. In the study of Juris et al. (2013), patients with hyperacusis had a high prevalence of symptoms of depression.

In this study, having an additional audiological condition such as tinnitus, hyperacusis or Ménière's disease or a visual impairment was associated with a lower employment rate, a higher prevalence of long-term sick leave as well as a decreased workability score and increased fatigue score. The proportion of employees with workplace accommodation was larger among employees with additional conditions, but so was the proportion of employees in need of accommodation without receiving it as well. Our results together with earlier studies imply a cumulative effect of an additional sensory condition on the vocational participation parameters. Consequently, a lack of accommodation measures will potentially have an even greater impact on this group than on the group of hearing loss only. Further studies on the impact of additional conditions on the participation factors are needed. Additionally, particular attention should be given to this group within audiological rehabilitation.

Strengths and limitations

Cross-sectional studies are limited in terms of indicating causality. Thus, in this study, we can merely observe associations between the various variables of vocational affiliation. However, a cross-sectional study is well suited to describe vocational characteristics of participants with varying degrees of hearing loss.

Recruiting through a special interest organisation might not produce a study population representative of the target population. One aim of this study was to recruit a large number of participants, as register data are not available on hearing loss in Norway. The HLF has a large number of members, which might be partly due to the compensation arrangement for loss of hearing aids, which they offer members. Newly fitted hearing aid users are routinely informed about this benefit. The high rate of hearing aid use and the high prevalence of mild hearing loss among the participants support the assumption that the HLF organises a wide spectre of citizens with hearing loss.

The low response rate seemed to produce a bias towards employed responders. The non-responders in the survey had a considerably lower degree of working life participation (52.7% in part-time or full-time work), which implies that our responders were not representative for the entire population of people with hearing loss in Norway. Therefore, the results mainly describe the working life characteristics of people with a long-term experience of hearing loss and the extent of problems they may face in working life. Additionally, the results mainly describe the oldest population of employees with hearing loss with a mean age of 54.7 years. Thus, the characteristics of individuals with hearing loss with children at home are less described in this study.

The high employment rate and the low number of participants with severe and profound hearing loss might be due to a healthy worker effect, common in cross-sectional studies, indicating that the responders are those still employed. A healthy worker effect could explain the lack of statistically significantly higher fatigue score for severe and profound hearing loss.

Conclusions

This study found a high degree of employment among individuals with hearing loss. However, the degree of strain was high, and there was a negative association between the degree of hearing loss and workability and work role functioning, particularly for moderate hearing loss. Hearing loss also seemed to have stronger negative implications for women compared to men. Further, there was a lack of work place accommodation when there was a need of such, both for employees with hearing loss only and for employees with additional sensory conditions. These results imply a need for an increased attentiveness to the individual needs concerning the experienced disability a hearing loss

may produce. The attentiveness should produce a more frequent use of hearing disability assessment related to working conditions by audiology professionals, and an increased use of work place accommodation.

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