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ORIGINAL PAPER

Prevalence and characteristics of self-reported physical and mental disorders among adults with hearing loss in Denmark: a national survey

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Abstract
Purpose Existing research shows that people with hearing loss have a high risk of additional physical and mental disorders. However, only a few population-based studies have been conducted. This study assesses the prevalence and characteristics of additional disorders among adults with hearing loss in Denmark and thereby contributes a population-based study to this area of research.
Method Data on self-reported physical and mental disorders from a national survey of 772 adults with hearing loss were compared to corresponding data from a national survey of 18,017 adults from the general population.
Results People with hearing loss reported more physical and mental disorders than the general population. Specifically, they reported higher incidences of visual impairment, cerebral palsy, intellectual impairment, and "other mental disorders".
Conclusion Adults with hearing loss have a greater risk of additional physical and mental disorders. It is important for clinicians to have some understanding of the communication needs and characteristics of deaf and hard-of-hearing patients, so that they can recognize and treat symptoms and provide appropriate support.

Keywords Deaf · Hearing loss · Mental disorder · Physical disorder

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Introduction

Previous research has reported that hearing loss is often coupled with additional mental or physical disorders. In a Norwegian study, Kvam et al. [1] used three items from the Hopkins Symptom Checklist to compare the prevalence of symptoms of anxiety and depression in a sample of 431 deaf adults with the prevalence of the same symptoms in a sample of 42,815 adults without hearing loss. The deaf sample reported significantly higher rates of preponderant levels of "feeling fearful" (10%), "feeling hopeless about the future" (21%) and "feeling blue" (20%) than the hearing sample, for which the figures were 1, 4 and 2% respectively. Similarly, in a study in the Netherlands, de Graaf and Bijl [2] found that about 1 in 3 of the 523 adults with severe to profound hearing loss reported mental distress, which was significantly more than for adults from the general population, for whom the figure was about 1 in 4. Unfortunately, prevalence studies of mental health among adults with hearing loss that include comparisons with the general population are rare. More common are comparative studies for children with hearing loss. These studies suggest that the prevalence rates of mental health problems among deaf and hard-of-hearing children are two to four times higher than the rates among children without hearing loss [3–6]. For example, Fellinger et al. [3] reported that the overall point and lifetime prevalence rates for psychiatric disorders were 32.6 and 45.3%, respectively, for a sample of 95 Austrian students aged 6–16 years with a hearing loss of minimum 40 decibel (dB).

In addition to the few population studies, a handful of clinical sample studies have looked at the prevalence of mental disorders among adult mental health patients with hearing loss. In a UK study, Appleford [7] compared the diagnoses of 238 mental health patients with hearing loss

with the diagnoses of patients without hearing loss. Overall, the patients with hearing loss were more likely to be diagnosed with a psychotic, neurotic, stress-related and somatoform disorder than the patients without hearing loss. However, the patients with hearing loss were less likely to have a depressive or bipolar disorder. In a US study, Diaz et al. [8] compared the diagnoses of 241 patients with hearing loss with the diagnoses of 345 patients without hearing loss. Impulse control, attention deficit disorder, pervasive developmental disorder and intellectual disability were found to be more prevalent among the patients with hearing loss, while anxiety disorders, bipolar disorders and substance use disorder were found to be less prevalent. Similar findings were reported by Pollard [9], who compared 544 psychiatric outpatients with hearing loss with a group of psychiatric outpatients without hearing loss. The patients with hearing loss had significantly fewer substance use disorders and childhood mental disorders, but higher rates of intellectual impairment and antisocial personality disorder. Further, the study found that significantly more patients with hearing loss were categorized with "deferred diagnosis" or "no diagnosis", which, according to the study, indicated that clinicians were less sure about the right diagnosis.

Regarding physical disabilities, there are no studies providing an overview among adults with hearing loss, to our knowledge. However, studies among children with hearing loss have reported high prevalence of additional physical disabilities. A Finnish study [10] among 214 children with hearing loss found that 47.2% had an additional disability: 16.8% had an intellectual disability; 9.8% had a developmental neurocognitive condition; 10.8% had a motor impairment; 10.3% had visual deficits; 11.2% had craniofacial anomalies; and 7.5% had other physical anomalies. A general high prevalence of additional physical disabilities among children with hearing loss has also been reported in other studies [11].

Two explanations for a higher prevalence of physical and mental disorders among individuals with hearing loss have been discussed. The first is that a medical etiology causes both hearing loss and an additional disorder. One example is Usher syndrome, which is a common cause of congenital deafness and is also associated with the eye disease retinitis pigmentosa [12] and (possibly) increased risk of mental health disorder [13]. The second explanation is that hearing loss might cause a multifactorial developmental effect. Hearing loss leads to risks of language delay and communication difficulties, which can lead to social-emotional difficulties [14] and cognitive difficulties [15] and, in turn, a higher risk of mental disorders. In support of this explanation, studies have found that communication and language skills are one of the most important factors explaining mental health problems among children with hearing loss. Dammeyer [16] studied 334 Danish children with hearing loss to assess their mental health and identify explaining variables. First, the study found the rates of mental health problems to be almost four times higher than those of the general population. Second, it found that the child's communicative abilities (either speech or signs) were significantly associated with having mental health problems or not. If the child's spoken or sign language abilities were sufficient (i.e., able to take part in communication with others without difficulties), the prevalence of mental health problems was found to be at the level of the general population.

A number of other factors have been considered with respect to communication abilities and the mental health of individuals with hearing loss. One factor discussed is having a parent with hearing loss. Some studies have found that having a parent with hearing loss is a protective factor, while other studies have not found this to be the case [16]. Another factor discussed is the mode of communication used (i.e., sign language versus spoken language). Some studies have reported that the use of spoken language has better outcomes than the use of sign language, whereas other studies have reported no difference with regard to risk of additional disabilities (for a review see Theunissen et al. [6]). Finally, the degree of hearing loss has also been discussed with regard to risk of additional disorders. Whereas some studies have shown the degree of hearing loss to be associated with a higher risk of additional disorders, other studies have not been able to find this association (for a review see Bøttcher and Dammeyer [17]).

Study aim

Previous studies have reported a higher prevalence of physical and mental disorders among people with hearing loss. However, only a few national surveys exist, particularly among the adult populations. Further, few studies include relevant comparison groups. Thus, the aim of this study is to use data from a Danish national survey among adults with hearing loss to map out the prevalence and characteristics of physical and mental disorders and make comparisons with corresponding data from a national survey of the general population.

Method

Participants

In 2014, the Danish National Centre for Social Research [18] completed a Danish national survey among adults with severe to profound hearing loss. Data for this study were drawn from this survey. The survey aimed to invite all

people aged 16–65 years with severe to profound hearing loss to participate. Approximately, 2600 people were invited through social media (for instance, Facebook groups), hard-of-hearing/deaf associations, service/health service centers for people with hearing loss and sign language interpreting services, which resulted in a total of 839 individuals who completed the survey. The study population was estimated as comprising 25% of the Danish population with profound hearing loss [18].

If the participant had difficulties completing the questionnaire, for instance because of reading difficulties, support was available through hard-of-hearing/deaf associations. The support included sign language interpretation and reading the questions aloud. Those providing the support offered help initially for the questions only and did not know participants' responses, thereby ensuring confidentiality and addressing some issues of disclosure in the presence of others. This study used data from the 774 participants who completed the survey section on physical and mental disorders (and thus excluded those who did not respond). The mean age of these individuals was 43.1 with a standard deviation of 14.3 years. Of the 774, 47.9% ($n = 371$) were men.

The comparison data were from a national survey of 18,957 randomly selected Danish citizens, conducted by the Danish National Centre for Social Research [19]. This survey included the same questions about physical and mental disorders. Of those surveyed, 18,017 responded to the section on physical and mental disorders. The respondents were aged 16–65 years. The mean age was 43.3 years with a standard deviation of 14.1 years. Of the 18,017 respondents, 46.8% ($n = 8431$) were men. The two samples were not significantly different with regard to gender and age distribution.

Measures

The study analyzed the survey responses to the following questions regarding physical and mental disorders. The population of adults with hearing loss was asked: "In addition to hearing loss, do you have a physical impairment or disorder/disability?" For the general population, the equivalent question was: "Do you have a physical impairment or disorder/disability?" The response categories were "yes" and "no". If the response was "yes", a further question was asked of both samples: "What is your most serious physical impairment or disorder/disability?" A list of 17 categories was provided (see Table 1).

Another question asked for both samples was: "Do you have a mental disorder/disability?" The response categories were "yes, one"; "yes, more than one"; and "no". If the response was "yes, one", the following question was asked: "What is your most serious mental disorder/disability?" A list of nine categories was provided (see Table 1). A further following question was asked: "Do you receive treatment for your mental disorder/disability?" The response categories were "yes" and "no". For the population of adults with hearing loss, one further question was asked: "Have you received treatment by use of sign language or a sign language interpreter?" The response categories were "yes" and "no". It should be noted that each of the follow-up questions in both surveys was only asked to those reporting one mental disorder, and not to those reporting having more than one mental disorder. A final question for both samples was: "Does at least one of your children have a physical or mental disorder/disability?" The response categories were "yes" and "no".

This study included data for a number of demographic variables from the survey among adults with hearing loss, to the compare the following four subgroups: those with an additional physical disorder; those with an additional mental disorder; those with both an additional physical and mental disorder; and those without any additional disorders. The demographic variables selected were gender; age; parents' hearing loss; preferred mode of communication (response categories "spoken language", "sign language" and "other"); age at which hearing loss was diagnosed (recorded in years and categorized here as "younger than 4 years of age: congenital or early acquired hearing loss"; and "4 years of age or older: acquired hearing loss"); and degree of hearing loss [1 = profound (>90 dB), 2 = severe (70–90 dB), 3 = moderate to severe (55–69 dB), 4 = moderate (40–54 dB)]. Finally, data for a question regarding overall satisfaction with life was included: "Overall, how satisfied or dissatisfied are you with your life nowadays?" The response categories were on a 5-point Likert scale comprising 1 = very dissatisfied, 2 = dissatisfied, 3 = neither dissatisfied nor satisfied, 4 = satisfied, and 5 = very satisfied (adopted from World Values Survey [20]). The variables were treated as categorical or ordinal.

Data analysis

Firstly, the data were analyzed using descriptive statistics to compare the sample of adults with hearing loss with the general population sample. Second, the data from the sample of adults with hearing loss were analyzed for comparison between the four subgroups. The analysis used *t* test statistics for continuous variables, Kendall's Tau-*b* test for ordinal variables and Fisher's exact text or Chi square statistics for categorical variables. Secondly, three logistic regression analyses were carried out with the following dependent variables: having one/more physical disorder/s; having one/more mental disorder/s; and having one/more physical and mental disorder/s. The independent variables were: gender; age; parents' hearing loss; preferred mode of communication; age at which hearing loss was diagnosed; and degree of hearing loss. The level of significance was

Table 1 Frequencies and type of physical and mental disorders among adults with hearing loss compared with the general population

	Adults with hearing loss ($N = 774$), % (n)	General population ($N = 18{,}017$), % (n)
Have a physical disorder/s, % (n)	33.7 (261)	25.1 (4519)*
Most serious physical disability		
Problems with arms or hands	5.0 (13)	7.9 (356)
Problems with legs or feet	10.0 (26)	15.3 (693)
Problems with bag or neck	20.3 (53)	25.2 (1138)
Vision impairment or blindness	6.9 (18)	1.5 (67)*
Speech problems	2.3 (6)	0.2 (10)*
Skin problems	1.9 (5)	1.9 (87)
Allergy	3.1 (8)	3.1 (140)
Respiratory problems	2.3 (6)	6.3 (286)
Problems heart, blood pressure or circulation	8.4 (22)	9.0 (408)
Digestive problems (stomach, liver, kidney)	3.8 (10)	3.9 (177)
Diabetes	3.4 (9)	5.7 (257)
Epilepsy	1.5 (4)	0.9 (39)
Intellectual impairment	2.3 (6)	0.0 (2)*
Cerebral palsy	2.7 (7)	0.8 (35)*
Dyslexia	1.5 (4)	0.4 (18)
Other progressive disorders, e.g., cancer, multiple sclerosis, HIV, Parkinson disease	2.7 (7)	3.2 (145)
Other health disorder	19.9 (52)	12.8 (577)*
Do not know or did not respond	1.9 (5)	1.9 (84)
Have one mental disorder	10.2 (76)	6.1 (1098)*
Have more than one mental disorders	5.9 (44)	1.7(300)*
Most serious mental disorder (among those with one mental disorder)		
Drug and alcohol related	1.3 (1)	0.9 (10)
Psychosis	1.3 (1)	2.6 (28)
Depression and bipolar disorders	34.2 (26)	41.3 (453)
Stress and anxiety disorders including OCD and PTSD	25.0 (19)	37.8 (415)
Personality disorders	1.3 (1)	1.1 (12)
Autism spectrum disorders	1.3 (1)	1.4 (15)
ADHD	3.9 (3)	3.3 (36)
Eating disorder	1.3 (1)	1.6 (18)
Other mental disorder	27.6 (21)	9.7 (107)*
Do not know or did not respond	2.6 (2)	0.4 (4)
Receives treatment for mental disorder (for those with one mental disorder) (yes)	57.9 (44)	67.9 (746)
Have one or more children with physical or mental disorder/s (yes)	13.7 (47)	10.8 (1253)

* $p < 0.01$

$p < 0.01$ to balance the risk of type one and type two errors [21]. The statistical software SPSS 22.0 was used.

Results

As shown in Table 1, adults with hearing loss were significantly more likely than those from the general population to report an (additional) physical disorder. One out of three (33.7%) of the population of adults with hearing loss reported a physical disorder, compared to one out of four (25.1%) of the general population sample. Some differences were found with regard to the type of physical disorder reported. Adults with hearing loss were significantly more likely than those in the general population to report vision impairment or blindness, speech problems, intellectual impairment and cerebral palsy. Also, significantly more individuals with hearing loss compared to the

general population reported "other" types of physical disorder.

Regarding mental disorders, adults with hearing loss were significantly more likely than those in the general population to report one and more than one mental disorder. Regarding types of mental disorders, among those with one mental disorder one significant difference was found between the two samples. Individuals with hearing loss were significantly more likely to respond with "other mental disorder". No significant difference between the two samples was found with respect to whether or not the participants reported receiving treatment for their mental disorder. There was also no significant difference found between the two samples regarding having one or more children with a physical or mental disorder or not.

Among the adults with hearing loss who reported both one mental disorder and receiving treatment for that disorder, 50% ($n = 22$) reported that they received treatment by use of sign language or a sign language interpreter. Of the 15 individuals who reported using sign language as their primary form of communication and who also reported one mental disorder, 46.7% ($n = 7$) reported that they did not receive mental health treatment in sign language or by use of a sign language interpreter.

Table 2 shows the comparisons among the subgroups of the sample of adults with hearing loss. Adults with hearing loss and a physical disorder were significantly older and significantly more likely to report that their hearing loss was diagnosed at an older age than adults with hearing loss and no additional disorders. Those without any additional disorders reported significantly higher levels of life satisfaction than each of the other groups. No significant differences were found among the four subgroups with respect to gender, degree of hearing loss, preferred mode of communication and parents' hearing loss. Results from the three logistic regression models revealed no significant findings.

Discussion

The study's overall finding—that adults with hearing loss were at greater risk of both physical and mental disorders—is in line with existing literature [10, 22].

Vision loss or blindness was one of the physical disabilities that adults with hearing loss were significantly more likely to report. A number of genetic disorders are known to cause dual sensory loss, with Usher syndrome being one of the most typical causes [23]. This study found a similar rate of prevalence of vision loss (7.0%) compared to other studies of this issue. For instance, in their cohort study, Häkli et al. [10] found a prevalence rate of 10.3% of "visual deficits" among children with hearing loss.

The significantly higher prevalence of cerebral palsy and intellectual disability among the population of adults with hearing loss is similarly often associated with medical etiologies of hearing loss that carry a risk of neurological impairments/disorders. These include postnatal infections (e.g., meningitis), prematurity, brain injuries and genetic disorders [24].

No other significant differences were found with regard to type of mental disorder. This contrasts with previous studies [7–9], all of which used case record or archival clinical data. This study's use of self-reported data from a

Table 2 Comparison of adults with hearing loss with and without physical or mental disorder with regard to general characteristics

	Physical disorder/s ($n = 261$)	Mental disorder/s ($n = 120$)	Both mental and physical disorder/s ($n = 71$)	No disorders ($n = 463$)
Gender (men), % (n)	47.9 (125)	44.2 (53)	46.5 (33)	48.6 (225)
Age, M (SD)	45.8 (13.2)*	42.1 (13.9)	42.6 (13.7)	41.6 (14.7)
Satisfaction with life (range 1 = very satisfied to 5 = very dissatisfied), M (SD)	2.3 (0.9)*	2.5 (0.9)*	2.4 (1.0)*	1.9 (0.8)
Age at which hearing loss was diagnosed, M (SD)	11.9 (15.5)*	8.0 (12.6)	9.9 (14.3)	6.5 (11.3)
<4 years, % (n)	38.3 (100)*	46.7 (56)	39.4 (28)	57.7 (267)
Degree hearing loss [range 1 = profound (>90 dB) to 4 = moderate (40–54 dB)], M (SD)	1.8 (0.8)	1.8 (0.8)	1.8 (0.7)	1.7 (0.8)
Preferred mode of communication				
Speech, % (n)	70.1 (183)	63.3 (76)	67.6 (48)	58.0 (269)
Sign language, % (n)	20.3 (53)	27.5 (33)	21.1 (15)	28.5 (132)
Other, % (n)	9.6 (25)	9.2 (11)	11.3 (8)	13.4 (62)
Parent with hearing loss (yes), % (n)	22.2 (58)	17.5 (21)	18.3 (13)	17.3 (80)

* $p < 0.01$

national survey might explain the different findings. This study included not only people engaged in mental health treatment, but also a broader population of people with mental disorders. The findings might have been affected by different selection and report biases (see also "Limitation" section below). Finally, the finding of no difference might be explained by how the question regarding the type of mental disorder was only asked of those participants reporting one mental disorder and not more than one.

Regarding the type of mental disorder, the population of adults with hearing loss and one mental disorder was significantly more likely than the general population to respond with "other mental disorder". This finding is in accordance with Pollard's study [9] which found that significantly more mental health patients with a hearing loss than those without were categorized in the case records with "deferred diagnoses" and "no diagnosis". One reason for this might be barriers in the mental health service system around communication and deaf cultural minority issues [22]. As a consequence, individuals with hearing loss are at risk of not being provided adequate assessment, information and treatment than people without hearing loss [22]. Patients with hearing loss often experience fear, mistrust and frustration in health-care settings because of communication and cultural issues [25]. Treatment and hospitalization stays are often longer than for patients without hearing loss [26]. Barriers in mental health services might explain why, in this study, only about half of those who communicated primarily by sign language were treated by use of sign language. More research, including qualitative research, is required to gain a better understanding of the potential barriers that are experienced by deaf adults within mental health services.

Like this study, several other studies have not found an association between additional disorders/disabilities and the degree of hearing loss (for a review, see Bøttcher and Dammeyer [17]). Bøttcher and Dammeyer [17] showed that individuals with hearing loss were at higher risk of physical and mental disorders, but that this risk was not associated with the degree of hearing loss.

Häkli et al. [10] found that children with acquired hearing loss were more at risk of additional physical disabilities than children with congenital hearing loss. This is in line with this study's findings that those with an additional physical disability were significantly more likely to be diagnosed with hearing loss at an older age than those without additional disabilities. Again, in incidences of acquired hearing loss, it might be the case that the medical causes of hearing loss also involve additional impairments. However, the regression analysis showed that the age of diagnosis with hearing loss was not significant in explaining additional physical disability. Other factors, including communication and social factors (e.g., level of language abilities), might be important and should also be investigated.

As outlined in "Introduction", physical and mental disorders among adults with hearing loss might be caused by both biological and social psychological factors. More research about risk and protective factors is needed to minimize the risk of additional mental and physical disorders and the resulting negative effects on life outcomes. One negative life outcome is suggested by this study's finding that those with an additional physical and/or mental disorder reported significantly lower levels of satisfaction with life than those without an additional disorder. This has been found in a number of previous studies [16, 27] and underlines the need for special support planning for this vulnerable group.

Limitations

The information on physical and mental disorders in this study was self-reported and therefore carried the risk of response bias. While previous research indicates that people reliably report physical and mental disorders [28], the possibility remains of either over- or underreporting. Adults with hearing loss might in particular be unaware of having a physical or mental disorder because of barriers to knowledge and treatment. On the other hand, lack of knowledge and treatment might lead to overreporting of physical and mental disorders.

Another limitation of this study, also associated with the use of surveys, might be participation bias. For example, even though different kinds of support for completing the survey were provided (see "Method"), it might well be the case that people with a severe physical and/or mental disorder were underrepresented in both samples due to difficulties in filling out the questionnaire. Issues of disclosing conditions in the presence of others might also have excluded participation by some, although this may have been alleviated by assurances of confidentiality by those offering support, such as those who offered help initially for the questions only and did not know participants' responses. Further, it is important to note that the recruitment of participants for the two samples included in this study did not follow the same procedure (see "Method"). It can be recommended that future studies combine survey studies with registered data, for example from mental health services, to minimize response and participation biases.

A third limitation of this study was its cross-sectional design. Longitudinal studies would be useful in providing further knowledge about risk and protective factors and how vulnerable deaf adults with additional health issues can best be supported.

Conclusion

The overall finding from this study was that deaf adults have a greater risk of additional physical and mental disorders than the general population. No specific differences were found with regard to type of mental disorders. However, for physical disorders, the deaf population reported higher incidences of visual impairment, speech problems, cerebral palsy and intellectual impairment than the general population.

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Compliance with ethical standards

Ethical standards The study was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. All persons gave their informed consent prior to their inclusion in the study.

Conflict of interest The authors declare that they have no conflict of interest.

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