Dual sensory impairment and healthcare use: Findings from a nationally representative sample

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Introduction

There is an ongoing process of demographic aging in numerous industrialized countries. Increases in age are associated with numerous adverse health outcomes such as frailty, reduced health-related quality of life or functional decline.1–4 An increase in age is also associated with dual sensory impairment (DSI), which characterizes combined hearing problems and visual impairment. DSI is a common phenomenon in older adults and can lead to difficulties in performing different physical and cognitive activities.4 It is also associated with reduced quality of life, reduced cognitive function and increased loneliness.5–7 However, thus far, it remains almost unknown whether DSI is associated with healthcare use (HCU) among older adults.8,9 Therefore, the aim of our study was to clarify whether DSI is associated with increased HCU based on a nationally representative sample of community-dwelling individuals aged ≥40 years in Germany. Knowledge about the link between DSI and HCU may help to reduce the economic burden for the healthcare system because hearing and vision problems are often avoidable in late life.10,11 This is also important because, similar to other industrialized countries, most hospital stays and visits to outpatient physicians are caused by individuals in later life in Germany.12 Therefore, these individuals cause a tremendous burden for the healthcare system, particularly in light of the demographic aging.

Concerning existing research, a recent study showed an association between DSI and increased odds of hospitalization in the United States.8 This has also been supported by another American study.9 Furthermore, it has been shown that individuals with DSI had higher healthcare spending compared with individuals with no sensory impairment.8

Some key characteristics of the current healthcare system in Germany are worth describing. There is a quite comprehensive protection against healthcare expenses in the German healthcare system. While about nine of 10 individuals are insured by statutory health insurance (SHI), approximately one in 10 is insured via private health insurance (PHI). Most of the membership to SHI is compulsory because their earnings are below a certain income threshold. In particular, employees above this income threshold, civil servants and self-employed individuals can opt for PHI. While contributions to PHI mainly depend on age and health status at the time of making the contract, contributions to SHI are income-related and do not depend on health status. Most expenses (e.g., pharmaceuticals as well as inpatient and outpatient treatment) are covered by both SHI and PHI. Individuals have access to general practitioners (GPs) and specialist visits (without
additional requirements). In case of emergency and with referral from an outpatient physician, hospital care can be used (€10 copayment per day). It has been shown that the waiting times for appointments with outpatient physicians is quite short.13

Methods

Sample

For our study, data from the most recent sixth wave of the German Ageing Survey (DEAS) were used. In this study, individuals living in private households who are ≥40 years are included. The DEAS, which started in 1996 (first wave), covers several topics such as voluntary activities, occupational factors, caregiving, social ties or subjective well-being. The most recent sixth wave took place in 2017 and only included individuals who already took part in former waves. The response rate in the sixth wave was 63%. In total, 5081 observations were in our analytical sample (see section “Sample characteristics” for more details). With regard to the DEAS, further details are available in Klaus et al.14

Written informed consent was given by all individuals. For the DEAS, an ethics committee was not required because the criteria for such a vote was not needed (e.g., use of invasive methods or risk for the respondents).

Dependent variables

The frequency of GP visits was measured using the number of GP visits (based on self-reports) in the preceding 12 months. In the same vein, the frequency of specialist visits was measured using the number of self-reported specialist visits in the past 12 months. More precisely, the questions regarding the frequency of GP and specialist visits were introduced as follows: “Did you visit one of the following doctors in the past twelve months? If yes, please state how often. Please include house calls. Collecting prescription is not considered as a visit.” They could provide information about whether and how often they visited the “General practitioner” and the “Specialist.”

Furthermore, the number of hospital days in the past 12 months was recorded. It was introduced as follows: “How many nights during the past 12 months have you spent in the hospital on an inpatient?” The hospital stays were dichotomized into 0 = no hospital stay in the past 12 months; 1 = one or more hospital stays in the past 12 months.

Independent variables

The self-reported presence of physical illnesses was measured in the DEAS. Thereby, the presence of hearing problems and visual impairment (no; yes) was included. Based on these variables, we generated a variable for DSI:

(0) neither reporting hearing problems nor visual impairment
(1) either reporting hearing problems or visual impairment
(2) reporting both hearing problems and visual impairment.

In other words, when hearing problems and visual impairment were both present, individuals were classified as dual sensory impaired. Because vision is particularly important for activities of daily living and hearing is particularly important for communication, DSI was replaced by single variables, which quantified hearing problems as well as visual impairment in an additional analysis. With the help of Andersen’s behavioral model, covariates for regressions were selected. As regards predisposing characteristics, we included age, sex, family status (distinguishing between divorced, widowed, single, married and living separated from spouse as well as married and living together with spouse), employment status (employed; retired; other: not employed), the number of important people in regular contact, loneliness (De Jong Gierveld scale, six-item version; ranging from 1 to 4, with higher values indicating higher loneliness scores).

Regarding enabling resources, the household net equivalent income was included.

Regarding need factors, physical functioning (subscale physical functioning of the SF-36);18 from 0 = worst to 100 = best), depressive symptoms (Center for Epidemiologic Studies Depression Scale [CES-D])19, 15-item version, ranging from 0 to 45, with higher values corresponding to more depressive symptoms), self-rated health (from 1 = very good to 5 = very bad) and the number of physical illnesses (e.g., cardiac and circulatory disorders; ranging from 0 to 9) were included.

Statistical analysis

Sample characteristics are reported stratified by: (i) individuals without sensory impairment; (ii) with either hearing or visual problems; and (iii) individuals with DSI. Afterwards, regression analysis was performed with: (i) frequency of GP visits; (ii) frequency of specialist visits; and (iii) presence of hospitalization as outcome measures. Negative binomial regressions were performed when the frequency of GP or the frequency of specialist visits served as outcome measures, while logistic regressions were used when hospitalization served as the outcome measure.20 The significance level was set at \( P < 0.05 \).

Results

Sample characteristics

In Table 1, sample characteristics for the analytical sample (n = 5081) are reported stratified by individuals without sensory impairment, with either hearing or visual problems, and individuals with DSI (2533 individuals who were not sensory impaired; 1746 individuals who reported either hearing or visual problems; 802 individuals with DSI). The analytical sample refers to individuals included in the regression analysis with hospital visits as the outcome measure. The analytical samples for individuals included in regression analysis with the frequency of GP visits (n = 4809 individuals) and frequency of specialist visits (n = 4638) only slightly differed from the analytical sample reported here. Therefore, the sample characteristics for these analytical samples were not displayed here (but are available upon request).

In the total sample, 49.2% were female, and mean ± SD age was 66.9 ± 10.6 years. There were differences between the groups in nearly all variables (except for the number of important people in regular contact). Further details are given in Table 1.

Among individuals with DSI, the mean ± SD number of GP visits in the past 12 months was 4.4 ± 4.7, number of specialist visits in the past 12 months was 3.7 ± 5.0, and 23.2% were hospitalized in the past 12 months. In contrast, among individuals without sensory impairment, the mean ± SD number of GP visits in the past 12 months was 3.0 ± 3.6, number of specialist visits in the past 12 months was 2.4 ± 3.4, and 17% were hospitalized in the past 12 months. Differences between individuals with DSI and individuals without sensory impairment regarding the three HCU outcomes were significant at \( P < 0.001 \).
Table 1  Sample characteristics stratified by dual sensory impairment (n = 5081)

|                          | Neither reporting hearing nor visual problems (n = 2533) | Either reporting hearing or visual problems (n = 1746) | Dual sensory impairment: reporting both hearing and visual problems (n = 802) | P-value |
|--------------------------|----------------------------------------------------------|--------------------------------------------------------|------------------------------------------------|---------|
| Age (years), mean ± SD   | 64.5 ± 10.1                                              | 68.1 ± 10.5                                             | 71.9 ± 10.3                                        | <0.001  |
| Gender (female), n (%)   | 1233 (48.7%)                                             | 906 (51.9%)                                            | 359 (44.8%)                                        | <0.01   |
| Education (ISCED-97), n (%) |                                            |                                                        |                                                  | <0.01   |
| Low education            | 94 (3.7%)                                                | 89 (5.1%)                                              | 51 (6.4%)                                         |         |
| Medium education         | 1231 (48.6%)                                            | 899 (51.5%)                                            | 378 (47.1%)                                        |         |
| High education           | 1208 (47.7%)                                            | 758 (43.4%)                                            | 373 (46.5%)                                        |         |
| Marital status, married, living together with spouse, n (%) | 1812 (71.5%)                                            | 1206 (69.1%)                                           | 518 (64.6%)                                       | <0.001  |
| Employment status, n (%) |                                                          |                                                        |                                                  | <0.001  |
| Employed                 | 1035 (40.9%)                                             | 466 (26.7%)                                            | 148 (18.5%)                                        |         |
| Retired                  | 1326 (52.3%)                                             | 1169 (66.9%)                                           | 616 (76.8%)                                        |         |
| Other: not employed      | 172 (6.8%)                                               | 111 (6.4%)                                             | 38 (4.7%)                                         |         |
| Household net equivalent income (in Euros), mean ± SD | 2258.5 ± 1433.9                                 | 2007.7 ± 1381.9                                        | 1955.5 ± 1054.2                                   | <0.001  |
| Number of important people in regular contact, mean ± SD | 5.3 ± 2.8                                               | 5.2 ± 2.7                                              | 5.1 ± 2.8                                         | 0.17    |
| Loneliness (from 1 to 4; with higher values indicating higher loneliness), mean ± SD | 1.7 ± 0.5                                               | 1.8 ± 0.5                                              | 1.8 ± 0.5                                         | <0.001  |
| Self-rated health, from 1 = very good to 5 = very bad, mean ± SD | 2.3 ± 0.8                                               | 2.6 ± 0.8                                              | 2.7 ± 0.8                                         | <0.001  |
| Physical functioning, from 0 (worst) to 100 (best), mean ± SD | 86.4 ± 19.3                                            | 78.3 ± 24.5                                            | 74.3 ± 25.8                                       | <0.001  |
| Depressive symptoms, ranging from 0 (no depressive symptoms) to 45 (severe depressive symptoms), mean ± SD | 5.7 ± 5.5                                               | 7.1 ± 6.0                                              | 7.5 ± 5.9                                         | <0.001  |
| Number of physical illnesses, mean ± SD | 1.5 ± 1.3                                               | 2.2 ± 1.5                                              | 2.7 ± 1.7                                         | <0.001  |

P-values: analyses of variance were used for continuous variables, and chi-squared tests for all other variables; column percentages are reported.

Table 2  Determinants of the number of GP visits, number of specialist visits and hospital stays

| Independent variables | Number of GP visits | Number of specialist visits | Hospital stay (0 = no; 1 = yes) |
|-----------------------|---------------------|-----------------------------|---------------------------------|
| Sensory impairment (reference category: neither reporting hearing nor visual problems): | | | |
| Either reporting hearing or visual problems | 1.10 (1.02–1.18)** | 1.13 (1.05–1.22)** | 0.91 (0.77–1.07) |
| Dual sensory impairment: reporting both hearing and visual problems | 1.03 (0.94–1.13) | 1.17 (1.06–1.28)** | 0.83 (0.67–1.03)+ |
| Potential confounders | ✓✓✓✓ | ✓✓✓✓ | ✓✓✓✓ |
| Observations | 4809 | 4638 | 5081 |
| Pseudo R² | 0.05 | 0.05 | 0.08 |

GP, general practitioner.

Results of negative binomial regressions (columns 2 and 3) and logistic regressions (column 4). Second and third column: incidence rate ratios were reported (95% confidence intervals in parentheses); third column: odds ratios were reported (95% confidence intervals in parentheses); ***P < 0.001, **P < 0.01, *P < 0.05, +P < 0.10; potential confounders include age, sex, marital status, educational level, household net equivalent income, number of important people in regular contact, loneliness, self-rated health, depressive symptoms, physical functioning and number of physical illnesses.
Regression analysis

In Table 2, the results of multiple negative binomial regressions (second and third column) and multiple logistic regressions (fourth column) are displayed. Initially, we checked whether multicollinearity is an issue in our study. However, mean variance inflation factor was 1.35 (highest was 1.75), indicating that multicollinearity is not a problem in our study.

Adjusting for various predisposing characteristics, enabling resources and need factors as covariates, regressions showed that individuals with DSI have a higher number of specialist visits compared with individuals with no sensory impairments (incidence rate ratio [IRR] = 1.17 [95% CI: 1.06–1.28]), whereas there were no significant differences when the frequency of GP visits (IRR: 1.03 [0.94–1.13]) and hospitalization (odds ratio [OR]: 0.83 [0.67–1.03]) served as outcome measures. Moreover, individuals with either visual or hearing problems have higher GP visits (IRR: 1.10 [1.02–1.18]) and higher specialist visits (IRR: 1.13 [1.05–1.22]) compared with individuals with no sensory impairments.

Regarding the potential confounders, only worse self-rated health, low physical functioning and an increased number of chronic illnesses were associated with all three outcome measures, i.e., increased frequency of GP visits, increased frequency of specialist visits and increased likelihood of hospitalization.

In further multiple linear regression analysis (results not shown, but available upon request), DSI was replaced by single variables assessing hearing problems and visual problems. These regressions showed that the presence of hearing problems was not associated with the outcome measures, whereas the presence of visual problems was associated with an increased frequency of specialist visits (IRR = 1.12 [1.05–1.20]) and a lower likelihood of hospitalization (OR: 0.81 [0.69–0.95]).

Discussion

In summary, the objective of the current study was to clarify the link between DSI and HCU among middle-aged and older adults. Even after adjusting for various covariates, regressions showed that individuals with DSI have a higher number of specialist visits compared with individuals with no sensory impairments, whereas there were no significant differences when the frequency of GP visits and hospitalization served as outcome measures. Moreover, individuals with either visual or hearing problems have higher GP visits and higher specialist visits compared with individuals with no sensory impairments.

In discussing comparisons with existing literature and possible explanations, we found that the positive association between DSI and HCU can be explained by decreased functional skills (see Mueller-Schotte et al.21). Other factors related to DSI such as social isolation, self-esteem or falls are also discussed as underlying reasons for the association between DSI and HCU. For example, factors such as social isolation have been shown to be associated with increased HCU.22 However, we additionally adjusted for all of these factors (i.e., falls, self-esteem, perceived autonomy and social isolation) in a robustness check (results not shown, but available upon request) and our results remained almost the same (for DSI with number of specialist visits as outcome measure, IRR = 1.16 [1.06–1.28], P < 0.01). We also checked whether the association between DSI and HCU is moderated by sex by including respective interaction terms. However, none of the interaction terms achieved statistical significance. In another robustness check, we excluded all individuals with diabetes because there is a well-established link between diabetes and visual impairment. Again, our findings remained almost the same (for DSI with number of specialist visits as outcome measure, IRR = 1.13 [1.02–1.26], P < 0.01). Another possible explanation may be that individuals with DSI may have problems to self-manage chronic illnesses and therefore require the help of physicians. However, this is only a possible explanation, which merits further examination.

It should also be stressed that DSI is associated with various other factors such as decreased mental health, decreased life satisfaction23 and poor general health.24 Worse subjective well-being is in turn associated with increased specialist visits.25 However, future research is required to investigate these associations in further detail.

With regard to hospital use, a link between DSI and hospitalization has been shown by two recent studies from the United States.8,9 In contrast, we did not find such an association in multiple regression analysis. However, more precisely, the study conducted by Huddle et al.5 only revealed an association between DSI and number of hospital days, but like ours, did not find a significant association between DSI and the likelihood of hospitalization. A likely explanation might be that we adjusted for various potential confounders such as physical functioning in our study, whereas the aforementioned studies often did not adjust for it. However, when we removed physical functioning as a covariate from our regression model, there was still no significant link between DSI and the odds of hospitalization. Therefore, future research is needed to shed more light on this issue.

Strengths and limitations need to be acknowledged in this study. To the best of our knowledge, this is one of the first studies analyzing the link between DSI and HCU. For our current study, data were taken from a nationally representative sample of community-dwelling individuals ≥40 years. Self-rated hearing problems and visual impairment were used to define DSI. Covariates were chosen based on the Andersen model. While discrepancies between subjective and clinical assessments of sensory problems were reported,26 these self-reported measures may be more appropriate to depict the role of DSI in daily life.27 However, future studies based on clinical assessments of sensory problems are needed to investigate the link between DSI and HCU.

HCU was quantified using the frequency of GP and specialist visits as well as hospitalization in the preceding 12 months. Therefore, the possibility of a rather small recall bias cannot be entirely dismissed. Nevertheless, it should be emphasized that the recall period used in this study corresponds to current recommendations.28 Previous research has shown that the DEAS has a small sample selection bias.14 It should also be stressed that the reason for HCU was not covered in the DEAS. Furthermore, longitudinal studies are required to validate our findings.

Even after adjusting for several predisposing characteristics, enabling resources and need factors, individuals with DSI had higher specialist visits than individuals without DSI. As the presence of DSI is associated with an increased economic burden, efforts to prevent or delay DSI may be beneficial.

Disclosure statement

The authors declare no conflict of interest.
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