Dual Sensory Impairment and Cognitive Decline: The Results From the Shelter Study

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Abstract

Objectives. To examine whether nursing home residents with concurrent vision and hearing impairment, dual sensory impairment (DSI), have a greater cognitive decline over time than do those without sensory impairment and whether social engagement modifies this association.

Methods. Based on the Services and Health for Elderly in Long TERm Care study, 1,989 nursing home residents who were assessed using the interRAI LTCF at 6-month intervals over 1 year were included. Multivariate linear regression models with time-variant exposure variables of sensory impairment and social engagement using generalized estimating equations were performed to predict cognitive function measured by the Cognitive Performance Scale (range 0–6).

Results. Residents with DSI had a greater cognitive decline [changes in Cognitive Performance Scale over 1 year = 1.12 (95% confidence interval = 0.81:1.42)] compared to those with either vision or hearing impairment [0.67 (0.53:0.64)] and those without sensory impairment [0.56 (0.48:0.64)]. A lower level of social engagement was also associated with a greater cognitive decline. The combined exposure variable of sensory impairment and social engagement revealed the greatest cognitive decline for socially disengaged residents with DSI [1.87 (1.24:2.51)] and the potential effect modification of social engagement on the association between DSI and cognitive decline; DSI was not associated with a greater cognitive decline among socially engaged residents, while it was associated among socially disengaged residents.

Discussion. Cognitive function declines faster in nursing home residents with DSI only when residents were not socially engaged. Therefore, residents with DSI might cognitively benefit from interventions to improve involvement in social life at nursing homes.

Key Words: Cognitive ageing—Social engagement—Dual sensory impairment—Nursing home.
Vision and hearing impairments are known to be associated with cognitive abilities (1). Many studies have shown that hearing (2–7) and visual impairment (4,8,9) are independently associated with accelerated cognitive decline in community-dwelling older adults. For example, a study on well-functioning older adults aged 70–79 years reported that the rates of cognitive decline over 6 years were linearly associated with the severity of baseline hearing impairment (2). Another study on older people aged 65 years or older demonstrated that visual impairment was associated with cognitive decline over 7 years (9). The predictive association of sensory impairment on subsequent cognitive decline was further found to be greater when vision and hearing impairments were combined (10). The correlation between sensory impairment and cognitive decline is thus well-documented for community-dwelling older people, but evidence for more frail institutionalized older people is scarce.

Several hypotheses have been proposed to account for the correlation between sensory impairment and cognitive decline: the common cause hypothesis, the sensory deprivation hypothesis, the information degradation hypothesis, and cognitive load or resource allocation hypothesis (11,12). The sensory deprivation hypothesis is that prolonged reductions in the quality or quantity of sensory input leads to cognitive deterioration due to neuronal atrophy (4). This hypothesis agrees with a common notion that sensory-impaired individuals are likely to experience increased isolation arising from the loss of essential information and social interaction like conversation (13). In fact, reduced social engagement in sensory-impaired older people has been reported in several studies in different settings, including nursing homes (14–19). Given that decreased social engagement itself is a known risk factor of cognitive decline (20,21), it is presumable that social engagement could modify the association between sensory impairment and cognitive decline; however, this possibility has not been demonstrated. This study therefore aimed at examining if nursing home residents with concurrent vision and hearing impairment, dual sensory impairment (DSI), have a greater cognitive decline over time than do those without sensory impairment and whether social engagement modifies this association.

Methods
Sample and Study Setting
This study was based on data from the Services and Health for Elderly in Long TERm Care (SHELTER) study conducted from 2009 to 2011, which has been described in detail elsewhere (22). Briefly, the study sample consisted of 4,156 older people residing in 59 nursing homes in eight countries (the Czech Republic, England, Finland, France, Germany, Israel, Italy, and the Netherlands). In each country, study partners identified nursing homes that were willing to participate in the study; thus, participating nursing homes were not intended to be representative of all nursing homes in each country. Older people residing in the participating nursing homes at the beginning of study and those admitted in the 3-month enrollment period following the initiation of study were assessed using the interRAI instrument for Long Term Care Facilities (interRAI LTCF)—a comprehensive assessment instrument for long-term care facilities containing over 330 items (23). Study researchers who were trained in a previously validated procedure (24) completed the interRAI LTCF on the basis of a variety of information sources, such as direct observation; interviews with the person under care such as informal and formal care providers; and review of clinical records, both medical and nursing. Residents who remained in the same nursing home were assessed again after 6 and 12 months. Ethical approval for the study was obtained in all countries according to local regulations.

Measurement of Cognitive Function
The Cognitive Performance Scale (CPS) was used to measure cognitive function (25). The CPS uses four items in the interRAI LTCF, including short-term memory, cognitive skills for decision making, making self-understood, and eating problems, to group residents into seven hierarchical categories: 0 (intact), 1 (borderline intact), 2 (mild impairment), 3 (moderate impairment), 4 (moderate to severe impairment), 5 (severe impairment), and 6 (very severe impairment). Test–retest and interrater reliability of items included in the CPS scale, after translation into languages of countries participating in the SHELTER project, was either adequate or excellent (average weighted k, 0.88 and 0.73, respectively). The CPS has been demonstrated to correspond closely with scores generated by the Mini-Mental State Examination and the Montreal Cognitive Assessment, and with neurological diagnoses of Alzheimer’s disease and other dementias (26–28).

Measurements of Sensory Impairment
Vision and hearing function were each coded on a scale from 0 (adequate) to 4 (no vision or hearing present) in the interRAI LTCF (29). The hearing item was coded as 0 (adequate), suggesting no difficulty in normal conversation with hearing appliance normally used; 1 (minimum impairment) suggesting difficulty in some environments; 2 (moderate impairment) suggesting problem with hearing normal conversation, requiring quiet setting to hear well; 3 (severe impairment) suggesting difficulty in all situations; and 4 (cannot hear anything). The vision item was coded as 0 (adequate) if being able to see details, including regular print in newspapers with glasses or with other visual appliance normally used; 1 (minimum impairment) if able to see large print but not regular print in newspapers; 2 (moderate impairment) if not able to see newspaper headlines but can identify objects; 3 (severe impairment) if object identification is in questions but eyes appear to follow objects; 4 (no vision present) (29). Test–retest and interrater reliability of these items has been reported to be either excellent or adequate (average kappa statistics 0.88 and 0.79, respectively) (22). Sensory impairment was defined as moderate to severe impairment and categorized into three in this study: no impairment, single (vision or hearing) impairment, and DSI (impairment in both senses).

Measurement of Social Engagement
Seven assessment items reflecting social engagement were considered: at ease interacting with others; at ease doing planned or structured activities; accept invitations into most group activities; pursues involvement in life of facility; initiates interactions with others; positive reaction to interactions initiated by others; and adjust easily to change in routine. These items are not identical, but comparable to other common social engagement scales such as that developed by Mor and colleagues (30,31). We assumed social engagement was present if one or more behaviors were observed daily. Test–retest and interrater reliability of these items in the SHELTER database has been reported to be either excellent or adequate (average kappa statistics 0.88 and 0.72, respectively) (22).

Covariate
Baseline information on age, gender, primary diagnoses that could interfere in cognitive trajectory (Alzheimer’s disease, other types of
In sensitivity analyses of the combined effect of DSI and social disengagement, we evaluated potential measurement error by applying different cut-off points to define social disengagement. Further, we assessed potential confounders in two ways. First, because cognitive-impaired people may be more vulnerable to social isolation (37) and the baseline cognitive status may confound the association between social engagement and accelerated cognitive decline, we made the analyses with a restricted sample of those who were initially cognitively intact (CPS = 0, 1) to prevent the reversed causality. Second, we excluded those who were newly admitted (the length of stay was less than 30 days) and those who experienced any acute condition during the follow-up period to address potential confounding by short-term changes in cognition possibly occurred in those residents. All analyses were conducted using IBM SPSS version 22.0.

**Results**

The baseline characteristics of the participants are presented in Table 1. The average age was 83.3 (interquartile range 11.1) years, 72% were women, and average length of stay in the nursing home was 2.4 years. Among 1,989 participants, DSI was present in 122 (6%) participants. Residents with DSI were likely to be older and be experiencing symptoms of depression, dependent in ADL, cognitively impaired, and socially disengaged, compared to those with no impairment and single impairment.

Table 2 shows 1-year change in CPS according to status of sensory impairment and social engagement, separately. Residents with dual impairment had a mean of 1.12 [95% confidence interval (CI) = 0.81:1.42] points decrease in cognitive function per year, while those with no sensory impairment had a mean of 0.36 [95% CI = 0.48:0.64] and those with either vision or hearing impairment had a mean of 0.67 [95% CI = 0.53:0.80]. Fewer numbers of behaviors indicating social engagement observed were associated with a greater decrease in cognitive function. Additional adjustment for potential mediators such as communication problem and the use of sensory did not change the results.

Analyses with the combined exposure variable of sensory impairment (no impairment, single impairment, and DSI) and dichotomized social engagement (none vs one or more) are shown in Table 3. The greatest cognitive decline was seen in residents with DSI and social disengagement: 1.87 [95% CI = 1.24:2.51] point decrease in cognitive function over 1 year. Among socially disengaged residents, the cognitive decline that residents with DSI experienced was significantly greater than that of residents with no impairment [differences between the groups was 1.07 (95% CI = 0.40:1.75)] and marginally greater than that of residents with single impairment [0.68 (95% CI = -0.06:1.42)], while it was not among socially engaged residents. Absence of social engagement was associated with a greater cognitive regardless of the status of sensory impairment, with the largest difference being observed in residents with DSI.

We conducted sensitivity analyses to assess the robustness of our findings. Table 4 shows the combined effect of DSI and social disengagement on 1 year changes in cognitive function using different definitions of disengagement and with the restricted two subsets. All the results were similar to the main results in principal; the greatest cognitive decline was seen in residents with DSI and disengagement, and DSI was not associated with greater cognitive decline when social engagement was present.
This study shows that concurrent vision and hearing impairment is associated with an increased risk for a greater cognitive decline among nursing home residents. Further, having social engagement is suggested to modify the association: we found that concurrent vision and hearing impairment was not associated with a greater cognitive decline when at least one behavior indicating social engagement was present.

The correlation between sensory impairment and cognitive function over time is consistent with previous studies conducted in community-dwelling older people (1). In our study, the extent of decline in CPS over 1 year was found to be 1.1 points for residents with DSI and about 0.6 for the other residents. Given that it has been shown to be about 0.4 points in a large U.S. nursing home study (38), the...
cognitive decline that residents with DSI experienced in this study might be considered clinically meaningful. To the best of our knowledge, this is the first study to show cognitive changes according to sensory impairment in nursing home residents. In addition, since most of the previously conducted community-based studies only included initially well-functioning older people, this study adds new evidence to suggest the correlation can be also found in frail older people, though we have excluded the most frail nursing home population. However, we did not find those with single impairment having a greater cognitive decline than those without sensory impairment, which contradicts previous findings that show each impairment having an impact on cognitive decline (2–4,8,9). The discrepancy may be partly due to differences in the definition of sensory impairment, characteristics of sample populations, and the duration of follow-up. Our follow-up duration was substantially shorter than that of other studies—in some of them, it was more than 10 years (2,3).

The beneficial effect of social engagement on cognitive changes is fairly consistent with the existing rich evidence that social interaction decreases the risk of cognitive decline in older people (39–43). Our findings further indicate that social engagement may be particularly beneficial for residents with DSI. Social isolation experienced by residents with DSI stem not only from the loss of social interaction but also from the loss of more solitary leisure activities such as reading, listening to the radio, or watching television (13); consequently, it is conceivable that the most socially isolated individuals reap significant benefits from social engagement. Nursing homes are sometimes associated with a hospital-like routine, where residents have little interaction with others and spent most of their time doing nothing or engaging in passive activities (44). Nevertheless, as we can still find some promising results showing improved social engagement of frail older people through changes in physical environment, staff procedures, and organizational initiatives in nursing homes (45,46), this study emphasizes that residents with DSI should be supported to remain involved in social life at nursing homes in order to prevent avoidable decline in cognition.

Our finding that DSI has an impact on greater cognitive decline when accompanied with reduced social engagement supports the “sensory deprivation” hypothesis in which sensory-impaired individual is isolated socially, leading to cognitive decline. However, it should be also noted that the “common cause” hypothesis, that is, sensory impairment and cognitive decline in old age is caused by a common mechanism that results in widespread neuronal atrophy reducing all aspects of central nervous system functioning (4), cannot be rejected. In an effort to eliminate a possible disadvantage in social engagement among cognitively impaired residents, we included the baseline cognitive function in the analyses and further restricted the sample to be only initially cognitively intact residents in the sensitivity analyses; however, there could be other underlying factors to lead to sensory impairment as well as to accelerate cognitive decline. Although residents’ biological age and gender were controlled for this purpose, factors such as psychological characteristics of individuals (eg, neuroticism) and early life adversity (eg, abuse in childhood), could be related to both cognitive aging and decreased social engagement (43).

There are other possible limitations to this study. First, the findings cannot be applied to nursing home residents with severe cognitive impairment and unstable health condition, since we excluded them from the analyses. Second, the presence of social engagement was defined simply as the observation of at least one measure of social engagement. Although we confirmed that different definitions of social engagement using different cut-off points and different items in the interRAI LTCF would not change the findings of this study, we might have missed some factors that are beyond the clinical assessment of behaviors indicating social engagement. This study has also several strengths. First, it is the first multicenter study to describe the combined effect of DSI and social disengagement on cognitive decline in nursing homes. Second, we used the interRAI LTCF in our study, which is validated in different settings and languages (22) and is widely used to study residents with cognitive impairment in nursing homes (47,48).

### Conclusion

Cognitive function declines faster in nursing home residents with DSI only when residents were not socially engaged. Therefore, residents with dual sensory impairment might cognitively benefit from interventions to improve involvement in social life at nursing homes.

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Conflict of Interest
The authors report no conflict of interest.

References


