RESEARCH ARTICLE

# Dual sensory impairment among a cohort of older adults living in Ireland: A nested case-control study of the Irish Longitudinal Study on Ageing cohort [version 1; peer review: 1 approved, 1 approved with reservations]

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## Abstract

**Background:** Little information is available on the implications of hearing loss, visual impairment and dual sensory impairment among older adults with an intellectual disability (ID) living in Ireland and this paper aims to address the health concerns associated with sensory impairment among this population.

**Methods:** A representative sample of 753 persons aged 40 years and older at all levels of ID and full range of residential circumstances from the Intellectual Disability Supplement to the Irish Longitudinal Study on Ageing (IDS-TILDA) participants were matched with general older population TILDA participants on age, sex and geographic location within Ireland. Demographic data on samples included age, sex, visual impairment (yes/no), hearing impairment (yes/no) and dual sensory impairment (yes/no). For those with intellectual disability (ID) data was also gathered on level of intellectual disability, residence, needing assistance with activities of daily living (ADL) and instrumental activities of daily living, self-rated health, loneliness, doctor's diagnosis of endocrine disease and of dementia and doctor's report of two or more chronic health conditions. Bivariate analysis of associations between visual, hearing and dual sensory impairment with the measures of physical and mental health was completed and logistic regression analysis to generate adjusted odds ratios for associations between sensory impairment and physical and mental health conditions.

**Results:** As compared to the matched general population participants, in participants with ID dual sensory impairment was more often associated with poor self-rated health, limitations with two or more ADLs, loneliness and multimorbidity. People with ID were 4.4 times more likely to be multimorbid if they were visually impaired compared

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with an odds ratio of 2.4 in TILDA participants.
**Conclusion:** Previous studies found significant associations between hearing and visual impairment among older populations. Analysis here also suggests the burden of sensory impairment increases both with ID and then with level of ID

**Keywords**
intellectual disability, sensory, visual, hearing, multi-morbid

This article is included in the TILDA gateway.

This article is included in the Ageing Populations collection.

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## Introduction

Age associated degeneration of hearing and vision has been well established (Attebo *et al.*, 1996; Van Eyken *et al.*, 2007; Walling & Dickson, 2012) and the extent of sensory impairment and associations with physical and mental health, cognition and functional activities in an increasingly ageing population is of growing importance. In 2010, the burden of visual impairment and blindness among people aged 50 years and older accounted for 65% and 82% of an estimated global prevalence of 285 million people of all ages who are blind or visually impaired (Pascolini & Mariotti, 2012); while the global burden of adult onset hearing loss in the year 2000 was 420.5/100,000 years lived with disability (YLDs) for males and 403.7/100,000 YLDs for females (Mathers *et al.*, 2000). Hearing impairment has also been found to be significantly associated with hypertension (Agrawal *et al.*, 2008; Genther *et al.*, 2013), cardiovascular disease, (Genther *et al.*, 2013) diabetes and smoking (Agrawal *et al.*, 2008) as well as increased number of hospitalisations and poor self-reported physical health and mental health (Genther *et al.*, 2013).

Compounding the concerns, dual sensory impairment in older populations is associated with depression (Capella-McDonnall, 2005), limitations of instrumental activities of daily living (IADLs) (Brennan *et al.*, 2005), an increase in risk of mortality (Lee *et al.*, 2007) and poor outcomes of mental health, and physical and social functioning, (Chia *et al.*, 2006; Kiely *et al.*, 2013).

More recent data has also highlighted sensory impairments as a longitudinal risk among older adults for suicidal ideation (Cosh *et al.*, 2018). Further, a recent review of post 2009 literature has highlighted growing evidence confirming a link between sensory impairment and cognitive decline (Humes & Young, 2016). Finally, in a qualitative study, dual sensory impairment among individuals in long term care was reported to be associated with feelings of not belonging, inability to be included in care planning, a lack of control of one's belongings, and impaired quality of life (Roets-Merken *et al.*, 2017).

Recent research suggests that auditory and visual commands share a common neurological motor pathway (Caruso *et al.*, 2017), and hearing impairment and visual impairment are also associated with having an intellectual disability (ID) (Herer, 2012; Hey *et al.*, 2014; Krinsky-McHale *et al.*, 2014; Van Splunder *et al.*, 2006; Warburg, 2001), with an increase in prevalence of hearing impairment associated with increased severity of level of ID (Evenhuis *et al.*, 2001). Despite these findings, hearing loss and ear conditions are thought to be underreported and underdiagnosed in this population (Herer, 2012; Hey *et al.*, 2014). In a literature review, Warburg highlighted rates of blindness, and cataracts as well as distance vision concerns higher than the general population and also cited literature confirming a decided lack of screening and responses to treatable vision conditions in people with ID (Wartburg, 2008). Little information is available on the implications of hearing loss, visual impairment and dual sensory impairment among older adults with an intellectual disability living in Ireland and this paper aims to address the health concerns associated with sensory impairment among this population.

## Methods

*Samples*: The sample of people with ID was drawn from the National Intellectual Disability Database (NIDD) which collates information on all people with an ID in the Republic of Ireland eligible for receiving services (Kelly, 2012; Kelly & Kelly, 2011). A representative sample of this population includes persons aged 40 years and older at all levels of ID and full range of residential circumstances is being longitudinally followed in the Intellectual Disability Supplement to the Irish Longitudinal Study on Ageing (IDS-TILDA). The TILDA study began in 2007 and is currently ongoing. Age 40 years and over was selected to reflect the lower longevity of people with ID and the original recruited, consented, and completed sample was 753 persons; an overall response rate of 46% from the NIDD drawn sample (McCarron *et al.*, 2011).

To be able to compare the lives of people with ID with the general population, questions used and timely of waves of data collection is tied to the Irish Longitudinal Study on Ageing (TILDA) which established a stratified sample of 10,128 households (8,178 individuals aged 50 years and older) drawn from the Irish Geodirectory with 6282 households interviewed, for a 62% response rate. The sample was stratified by socioeconomic group and geography to establish a population representative sample. Each IDS-TILDA and TILDA participant completed an in-person interview at a location of their choosing as well as returning a second questionnaire filled out in their own time (Questionnaire is available from the IDS-TILDA website). Data reported here for comparative analysis were drawn from a matched data set of participants in TILDA and IDS-TILDA.

*Matching strategy*: IDS-TILDA participants were matched with TILDA participants using a propensity score generated for each participant based on age, sex and geographic location of domicile within Ireland. Propensity score matching is a method of generating a single score based on observed covariates in order to match participants in one group in an observational study with participants in a second group (in this case, matching participants with ID to participants from the general population). (Thoemmes, 2012).

Data was cleaned and recoded for uniformity between datasets, and extraneous variables deleted. Datasets were merged in SPSS 20 based on propensity score matching using the R-plugin and "psmatching" custom dialog. Nearest neighbor matching without replacement was used based on a greedy matching algorithm with a caliper of .15 of the standard deviation of the logit of the propensity score (to reduce potential imbalances among matches). A single propensity score was generated for each participant based on a composite of demographic covariates, described above, creating a dataset of participants matched on similar characteristics for whom, as a consequence, presence of an intellectual disability can be viewed as the absolute difference between individuals in both groups. A dataset number of 998 matched participants was generated.

Traditionally, longitudinal datasets are also matched on highest level of education obtained (Savva *et al.*, 2013), however the group participants with an intellectual disability represented here had attained a disproportionately low level of education low level of first and second level education compared with TILDA respondents (73.2% vs 1.5% in those aged 50–59 years, 76% vs 2% in those aged 60–69 years) and this variable was therefore not included in the matching strategy.

### Measures

Visual impairment was defined as the presence of either glaucoma, eye disease, age related macular degeneration, fair or poor self-rated vision or being legally blind. Hearing impairment was defined as difficulty in holding a conversation with one or four people, the presence of fair or poor self-rated hearing or being legally deaf. Self-rated vision and hearing was measured using a five point Likert scale from excellent to poor. Dual sensory impairment was defined as anyone who satisfied both the criteria for visual impairment and hearing impairment.

Demographic data on both IDS-TILDA and TILDA populations included age, sex, visual impairment (yes/no), hearing impairment (yes/no) and dual sensory impairment (yes/no). For purposes of regression analysis completed only with the IDS-TILDA cohort, data was also gathered on level of intellectual disability (mild, moderate or severe/profound), residence (family home/independent, community or residential), needing assistance with two or more activities of daily living (yes/no), needing assistance with two or more instrumental activities of daily living (yes/no), self-rated health which was then categorized as poor health (yes/no); lonely (yes/no), doctor's diagnosis of endocrine disease (yes/no); doctor's diagnosis of dementia (yes/no); doctor's report of multi-morbidity (two or more chronic health conditions yes/no).

### Analysis

Utilizing Statistical Package for the Social Sciences (SPSS) version 20, bivariate analysis of associations between visual, hearing and dual sensory impairment with the measures of physical and mental health was completed and statistical significance ascertained using Pearson's chi-square test set at significance of 95%. Logistic regression analysis was used to generate adjusted odds ratios for associations between sensory impairment and measures of physical and mental health conditions. Statistical analysis was replicated on the matched dataset of IDS-TILDA and TILDA participants using variables found to be significant on regression analysis using the IDS-TILDA datas *et al.* one to discern differences and similarities in associations with sensory impairment.

### Ethical approval

The project and protocols have been reviewed and approved at each wave of data collection by the Faculty of Health Sciences Ethics Committee at Trinity College Dublin (#151208). Consent was obtained for all members of the interviewed cohort.

## Results

Population demographics are detailed in Table 1 and shows distribution of age, level of intellectual disability, residential setting and prevalence of visual, hearing and dual sensory impairment stratified by gender. Visual impairment was found to be significantly associated with gender with a prevalence of 40.7% among females compared with 27.5% of males ($p \leq .001$) Hearing impairment was positively associated with increase in an level of ID ($p \leq .001$) and level of support in residential setting ($p \leq .001$). Dual sensory impairment was higher among people with severe or profound ID ($p \leq .001$), people in a residential setting compared with community or independent dwelling participants ($p \leq .001$) and among the female population ($p \leq .01$), (Table 2).

**Table 1. Population demographics Intellectual Disability Supplement to the Irish Longitudinal Study on Ageing (IDS-TILDA) : Total N = 752.**

| | IDS-TILDA | |
|---|---|---|
| | **Male** | **Female** |
| | **N (%)** | |
| Age Group | | |
| 40 – 49 | 134 (39.8) | 140 (33.7) |
| 50 – 59 | 145 (43.0) | 199 (48.0) |
| ≥60 | 58 (17.2) | 76 (18.3) |
| Level of ID | | |
| Mild | 72 (23.3) | 94 (24.4) |
| Moderate | 141 (45.6) | 182 (47.2) |
| Severe/Profound | 96 (31.1) | 110 (28.5) |
| Residential Setting | | |
| Home/Independent | 61 (18.2) | 68 (16.5) |
| Community | 121 (34.6) | 143 (34.6) |
| Residential | 154 (45.8) | 202 (48.9) |
| Visual Impairment | 93 (27.5) | 169 (40.7) |
| Hearing Impairment | 94 (27.8) | 131 (31.6) |
| Dual Sensory Impairment | 29 (8.6) | 74 (17.8) |
| **Total** | **337** | **415** |

**Table 2. Associations of hearing impairment, visual impairment and dual sensory impairment with population demographics: Total N = 752.**

| | Visual Impairment | Hearing Impairment | Dual Sensory Impairment |
|---|---|---|---|
| | N (%) | | |
| Sex | | | |
| Male | 93 (27.5) | 94 (27.8) | 29 (8.6) |
| Female | 169 (40.7)*** | 131 (31.6) | 74 (17.8)** |
| Age Group | | | |
| 40 – 49 | 91 (33.2) | 80 (29.2) | 34 (12.4) |
| 50 – 59 | 118 (34.3) | 105 (30.5) | 53 (15.4) |
| ≥60 | 53 (39.6) | 39 (29.1) | 16 (11.9) |
| Level of ID | | | |
| Mild | 63 (38.0) | 22 (13.3) | 12 (7.2) |
| Moderate | 112 (34.7) | 89 (27.6) | 41 (12.7) |
| Severe/Profound | 69 (33.5) | 101 (49.0)*** | 45 (21.8)*** |
| Residential Setting | | | |
| Home/Independent | 45 (34.9) | 28 (21.7) | 12 (9.3) |
| Community | 88 (33.3) | 65 (24.6) | 24 (9.1) |
| Residential | 128 (36.0) | 132 (37.1)*** | 67 (18.8)*** |

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$, ID – intellectual disability

People in the IDS-TILDA study population with visual impairment were 2.2 times more likely to have a hearing impairment ($p \leq .01$) when adjusted for age, sex, level of ID and residential setting. Visual impairment in the same group was associated with fair or poor self-rated health (OR = 1.9; $p \leq .01$), having two or more limitations with activities of daily living (ADLs) (OR = 1.6; $p \leq .05$), endocrine disease (OR = 1.7; $p \leq .01$), loneliness (OR = 1.8; $p \leq .01$) and multimorbidity (OR = 2.3; $p \leq .001$). Hearing impairment was significantly associated with two or more ADL limitations (OR = 2.1; $p \leq .01$). Dual sensory impairment was found to be associated with endocrine disease (OR = 1.9; $p \leq .01$), loneliness (OR = 2.4; $p \leq .05$) and multimorbidity (OR = 2.4; $p \leq .01$), (Table 3).

Among IDS-TILDA and TILDA participants in a dataset matched on age, sex and geographic location of domicile, visual impairment was found to be associated with hearing impairment among the IDS-TILDA cohort (OR = 2.1; $p \leq .001$) but not among the TILDA cohort when adjusted for age and sex. Among the IDS-TILDA cohort, hearing impairment was associated with poor self-rated health (OR = 1.9; $p \leq .05$) and multimorbidity (OR = 4.4; $p \leq .001$) which was also found in the TILDA group (OR = 2.6; $p \leq .001$; OR = 2.4; $p \leq .001$, respectively). Hearing impairment was found to be significantly associated with loneliness among the TILDA cohort (OR = 2.2; $p \leq .01$) but not among the IDS-TILDA participants. Among the IDS-TILDA cohort, hearing impairment was associated with limitations in two or more ADLs (OR = 3.1; $p \leq .001$) but not among the TILDA group. Among both IDS-TILDA and TILDA matched participants, hearing impairment was also associated with poor self-rated health (OR = 1.8; $p \leq .05$; OR = 2.3; $p \leq .01$, respectively) and multimorbidity (OR = 1.8; $p \leq .001$; OR = 2.1; $p \leq .01$, respectively). Loneliness was associated with hearing impairment among both cohorts in the matched dataset, however IDS-TILDA participants who had a hearing impairment were less likely to be lonely (OR = 0.4; $p \leq .01$). TILDA participants were less likely to have hearing loss (OR = 2.5; $p \leq .01$). Among the IDS-TILDA group, dual sensory impairment was associated with poor-self rated health (OR = 1.9; $p \leq .05$), limitations with two or more ADLs (OR = 3.3; $p \leq .001$), limitations with two or more instrumental activities of daily living (IADLs) (OR = 4.9; $p \leq .05$) and multimorbidity (OR = 4.1; $p \leq .001$). Similar associations were not exhibited in the TILDA cohort. Dual sensory impairment was associated with loneliness among TILDA participants (OR = 2.6; $p \leq .05$) but not among the IDS-TILDA participants in the matched dataset (Table 4).

## Discussion

Previously reported high rates of visual, hearing and dual sensory impairments are confirmed here and the matched comparison with the general population TILDA participants reaffirm that rates of these conditions are higher for people with ID as they age, when compared to older adults in the general population. Results of this analysis found that that prevalence of hearing and dual sensory impairment among the participants with ID were double and almost triple that of the general population. Evidence from this analysis also suggests association of these visual and auditory impairments among people with ID with more chronic conditions and functional concerns than is true for the general population. Among the cohort of people with ID aged 40 years and older, 29.9% of participants were hearing impaired with adjusted odds ratios indicating an increase in level of ID, as has been found in previous studies (Herer, 2012; Hey *et al.*, 2014). Those among IDS-TILDA and TILDA study cohort with hearing impairment were more likely to have fair or poor self-rated health, be lonely or multimorbid, but only the IDS-TILDA

**Table 3. Associations of visual, hearing and dual sensory impairment adjusted for sex, age level of intellectual disability (ID) and residential setting: Total N = 752.**

| | Visual Impairment | Hearing Impairment | Dual Sensory Impairment |
|---|---|---|---|
| | Adjusted OR (95% CI) | | |
| Sex | 0.6 (0.4 – 0.8) | 0.8 (0.6 – 1.1) | 0.4 (0.2 – 0.6) |
| Level of ID<br>Mild<br>Moderate<br>Severe/profound | <br>1.0<br>0.8 (0.5 – 1.2)<br>0.8 (0.5- 1.2) | <br>1.0<br>2.5 (1.5 – 4.1)***<br>6.0 (3.4 – 10.5)*** | <br>1.0<br>1.8 (0.9 – 3.7)<br>3.1 (1.5 – 6.6)** |
| Visual Impairment | --- | 2.2 (1.5 – 3.1)*** | --- |
| Hearing Impairment | 2.2 (1.5 – 3.1)** | --- | --- |
| Poor self-rated health | 1.9 (1.2 – 3.0)** | 1.5 (1.0 – 2.5) | 1.8 (1.0 – 3.2) |
| ADLs ≥2 | 1.6 (1.0 – 2.3)* | 2.1 (1.3 – 3.4) ** | 1.8 (1.0 – 2.4) |
| IADLs ≥2 | 1.0 (0.6 – 1.7) | 1.3 (0.6 – 2.6) | 3.4 (1.0 – 11.8) |
| Endocrine disease | 1.7 (1.1 – 2.4)** | 1.4 (0.9 – 2.1) | 1.9 (1.2 – 3.1)** |
| Loneliness | 1.8 (1.2 – 2.9)** | 1.7 (1.0 – 3.0) | 2.4 (1.1 – 5.4)* |
| Dementia | 1.7 (0.7 – 4.0) | 1.7 (0.7 – 4.0) | 2.3 (0.9 – 5.9) |
| Multimorbidity | 2.3 (1.6 – 3.4)*** | 1.3 (0.9 – 1.9) | 2.4 (1.3 – 4.5)** |

All variables are adjusted for sex, age, level of ID and residential setting.

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$, ADL – activities of daily living, IADLs - instrumental activities of daily living

**Table 4. Demographics of a population of Intellectual Disability Supplement to the Irish Longitudinal Study on Ageing (IDS-TILDA) & TILDA participants matched on sex, age and geographic location of dwelling: Total N in paired dataset = 956.**

| | IDS-TILDA N (%) | TILDA N (%) |
|---|---|---|
| Gender<br>Male<br>Female | <br>203 (42.5)<br>275 (57.5) | <br>190 (39.7)<br>288 (60.3) |
| Age<br>50 – 59<br>60 – 69<br>≥70 | <br>266 (55.6)<br>151 (31.6)<br>61 (12.8) | <br>259 (54.2)<br>151 (31.6)<br>68 (14.2) |
| Visual Impairment | 171 (35.8) | 120 (25.1) |
| Hearing Impairment | 144 (30.1) | 70 (14.6) |
| Dual Sensory Impairment | 69 (14.4) | 25 (5.2) |
| Total | 478 | 478 |

participants reported being more likely to have limitations with two or more ADLs.

An important limitation of the study is that presence of sensory impairment was self-reported and was not independently verified other than that any reported diagnoses were confirmed from records in the self-completed initial questionnaire.

Prevalence of visual impairment was 10% higher among individuals with ID when compared to the general population and 14.4% of individuals satisfied the criteria for dual sensory impairment. Among the ID group, dual sensory impairment was more often associated with poor self-rated health, limitations with two or more ADLs, loneliness and multimorbidity, than in the matched group of general population participants. While both visually impaired cohorts reported poor self-rated health and being mutltimorbid, people with ID were 4.4 times more likely to be multimorbid if they were visually impaired compared with an odds ratio of 2.4 in the general population.

Associations of dual sensory impairment suggested a greater burden of negative outcomes among persons with ID as compared to the general population. Participants with ID who were both visually and hearing impaired were more likely than their peers with ID to have fair or poor self-rated health, limitations with two or more ADLs and IADLs and to be multimorbid. These same patterns of association were not found among the general population with whom they were matched. Loneliness was the only association that highlighted differences for persons with dual sensory impairment in the TILDA population.

Previous studies have found significant associations between hearing and visual impairment among older populations and have suggested shared risk factors for sensory impairment independent of ageing (Chia *et al.*, 2006). Analysis here also suggests the burden of sensory impairment increases both with ID and then with level of ID. The higher prevalence of dual sensory impairment and associated physical and mental health burdens have to date

**Table 5. Associations of visual and hearing among a cohort of people with an intellectual disability matched on age, gender and geographic location with a population of people from the general population: Total N in paired dataset = 956.**

| | Visual Impairment | | Hearing Impairment | | Dual Sensory Impairment | |
|---|---|---|---|---|---|---|
| | IDS-TILDA | TILDA | IDS-TILDA | TILDA | IDS-TILDA | TILDA |
| | Adjusted OR (95% CI) | | Adjusted OR (95% CI) | | Adjusted OR (95% CI) | |
| Visual Impairment | -- | -- | 2.1 (1.4 – 3.1)*** | 1.7 (1.0 – 3.0) | --- | --- |
| Hearing Impairment | 2.1 (1.4 – 3.1)*** | 1.7 (1.0 – 2.9) | -- | -- | --- | --- |
| Poor self-rated health | 1.9 (1.1 – 3.2)* | 2.6 (1.6 – 4.3)*** | 1.8 (1.1 – 3.0)* | 2.3 (1.3 – 4.0)** | 1.9 (1.0 – 3.7)* | 2.1 (0.9 – 5.1) |
| ADLs ≥2 | 1.4 (0.9 – 2.0) | 3.6 (1.2 – 10.4)* | 3.1 (2.0 – 4.8)*** | 1.0 (0.2 – 4.9) | 3.3 (1.8 – 5.9)*** | 1.2 (0.1 – 10.9) |
| IADLs ≥2 | 0.9 (0.5 – 1.7) | 1.1 (0.4 – 3.0) | 1.9 (0.9 – 3.9) | 0.7 (0.1 – 3.3) | 4.9 (1.2 – 20.9)* | 0.9 (0.1 – 8.2) |
| Diabetes | 1.4 (0.8 – 2.5) | 1.9 (0.9 – 4.1) | 0.7 (0.4 – 1.5) | 2.0 (0.9 – 4.7) | 1.0 (0.4 – 2.3) | 2.3 (0.7 – 7.6) |
| Loneliness | 1.2 (0.8 – 1.9) | 2.2 (1.3 – 3.6)** | 0.4 (0.3 – 0.7)** | 2.5 (1.4 – 4.5)** | 0.5 (0.3 – 1.1) | 2.6 (1.0 – 6.4)* |
| Multimorbidity | 4.4 (2.7 – 7.0)*** | 2.4 (1.6 – 3.9)*** | 1.8 (1.2 – 2.9)*** | 2.1 (1.2 – 3.6)** | 4.1 (2.2 – 7.8)*** | 1.9 (0.8 – 4.7) |

All variables adjusted for gender & age.

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$, ADL – activities of daily living, IADLs - instrumental activities of daily living, IDS-TILDA - Intellectual Disability Supplement to the Irish Longitudinal Study on Ageing (IDS-TILDA).

received relatively little attention however, and results presented here warrant further investigation.

## Data availability

Because of the size of the sample available, its national nature and both the uniqueness and the vulnerability of the population, there is a high risk that the combining of variables may in effect mean that individuals are identifiable. Therefore a public dataset is not possible or available. The investigators continue to explore the viability of the creation of a limited dataset but this is unlikely to be satisfactory for most individuals wishing to access the data.

It is possible to make a request to access the data in-person at a supervised "hot desk" in the IDS-TILDA office. Individuals may send a request to the project irector HAIGHM@tcd.ie stating the research question they wish to investigate, providing a list of the variables of interest (see questionnaire at http://idstilda.tcd.ie/assets/docs/capiwave2idstilda.pdf), and approximate dates when they would like to access the data. The investigators will review the request and respond within one week.

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## References

Agrawal Y, Platz EA, Niparko JK: **Prevalence of hearing loss and differences by demographic characteristics among US adults: data from the National Health and Nutrition Examination Survey, 1999-2004.** *Arch Intern Med.* 2008; **168**(14): 1522–1530.
PubMed Abstract | Publisher Full Text

Attebo K, Mitchell P, Smith W: **Visual acuity and the causes of visual loss in Australia. The Blue Mountains Eye Study.** *Ophthalmology.* 1996; **103**(3): 357–364.
PubMed Abstract | Publisher Full Text

Brennan M, Horowitz A, Su YP: **Dual sensory loss and its impact on everyday competence.** *Gerontologist.* 2005; **45**(3): 337–346.
PubMed Abstract | Publisher Full Text

Capella-McDonnall ME: **The effects of single and dual sensory loss on symptoms of depression in the elderly.** *Int J Geriatr Psychiatry.* 2005; **20**(9): 855–861.
PubMed Abstract | Publisher Full Text

Caruso VC, Pages DS, Sommer MA, *et al.*: **Similar prevalence and magnitude of auditory-evoked and visually evoked activity in the frontal eye fields: implications for multisensory motor control.** *J Neurophysiol.* 2016; **115**(6): 3162–3173.
PubMed Abstract | Publisher Full Text | Free Full Text

Chia EM, Mitchell P, Rochtchina E, *et al.*: **Association between vision and hearing impairments and their combined effects on quality of life.** *Arch Ophthalmol.* 2006; **124**(10): 1465–1470.
PubMed Abstract | Publisher Full Text

Evenhuis HM, Theunissen M, Denkers I, *et al.*: **Prevalence of visual and hearing impairment in a Dutch institutionalized population with intellectual disability.** *J Intellect Disabil Res.* 2001; **45**(Pt 5): 457–464.
PubMed Abstract | Publisher Full Text

Genther DJ, Frick KD, Chen D, *et al.*: **Association of hearing loss with hospitalization and burden of disease in older adults.** *JAMA.* 2013; **309**(22): 2322–2324.
PubMed Abstract | Publisher Full Text | Free Full Text

Herer GR: **Intellectual disabilities and hearing loss.** *Commun Disord Q.* 2012; **33**(4): 252–260.
Publisher Full Text

Hey C, Fessler S, Hafner N, *et al.*: **High prevalence of hearing loss at the special**

**olympics: is this representative of people with intellectual disability?** *J Appl Res Intellect Disabil.* 2014; **27**(2): 125–33.
PubMed Abstract | Publisher Full Text

Humes LE, Young LA: **Sensory-Cognitive Interactions in Older Adults.** *Ear Hear.* 2016; **37 Suppl 1**: 52S–61S.
PubMed Abstract | Publisher Full Text | Free Full Text

Kelly C: **National Intellectual Disability Database Committee annual report 2011**. 2012.
Reference Source

Kelly F, Kelly C: **Annual report of the National Intellectual Disability Database Committee 2010**. 2011.
Reference Source

Kiely KM, Anstey KJ, Luszcz MA: **Dual sensory loss and depressive symptoms: the importance of hearing, daily functioning, and activity engagement.** *Front Hum Neurosci.* 2013; **7**: 837.
PubMed Abstract | Publisher Full Text | Free Full Text

Krinsky-McHale SJ, Silverman W, Gordon J, *et al.*: **Vision deficits in adults with Down syndrome.** *J Appl Res Intellect Disabil.* 2014; **27**(3): 247–263.
PubMed Abstract | Publisher Full Text | Free Full Text

Lee DJ, Gómez-Marín O, Lam BI, *et al.*: **Severity of concurrent visual and hearing impairment and mortality: the 1986-1994 National Health Interview Survey.** *J Aging Health.* 2007; **19**(3): 382–396.
PubMed Abstract | Publisher Full Text

Mathers C, Smith A, Concha M: **Global burden of hearing loss in the year 2000.** *Global burden of Disease.* 2000; **18**: 1–30.
Reference Source

Pascolini D, Mariotti SP: **Global estimates of visual impairment: 2010.** *Br J Ophthalmol.* 2012; **96**(5): 614–8.
PubMed Abstract | Publisher Full Text

Roets-Merken L, Zuidema S, Vernooij-Dassen M, *et al.*: **Problems identified by dual sensory impaired older adults in long-term care when using a self-management program: A qualitative study.** *PLoS One.* 2017; **12**(3): e0173601.
PubMed Abstract | Publisher Full Text | Free Full Text

Savva GM, Maty SC, Setti A, *et al.*: **Cognitive and physical health of the older populations of England, the United States, and Ireland: international comparability of the Irish Longitudinal Study on Ageing.** *J Am Geriatr Soc.* 2013; **61 Suppl 2**: S291–S298.
PubMed Abstract | Publisher Full Text

Thoemmes F: **Propensity score matching in SPSS [Online]**. 2012.
Reference Source

Van Eyken E, Van Camp G, Van Laer L: **The complexity of age-related hearing impairment: contributing environmental and genetic factors.** *Audiol Neurootol.* 2007; **12**(6): 345–358.
PubMed Abstract | Publisher Full Text

Van Splunder J, Stilma J, Bernsen R, *et al.*: **Prevalence of visual impairment in adults with intellectual disabilities in the Netherlands: cross-sectional study.** *Eye (Lond).* 2006; **20**(9): 1004–1010.
PubMed Abstract | Publisher Full Text

Walling AD, Dickson GM: **Hearing loss in older adults.** *Am Fam Physician.* 2012; **85**(12): 1150–1156.
PubMed Abstract

Warburg M: **Visual impairment in adult people with intellectual disability: literature review.** *J Intellect Disabil Res.* 2001; **45**(Pt 5): 424–438.
PubMed Abstract | Publisher Full Text

# Open Peer Review

## Current Peer Review Status: ? ✓

**Version 1**

Reviewer Report 15 March 2019

https://doi.org/10.21956/hrbopenres.13928.r26537



✓ **Stuart Wark**

School of Rural Medicine, University of New England, Armidale, Australia

This article reports on an under-researched aspect of co-morbidity amongst older people with intellectual disability - that of dual sensory impairment. The paper compares data from the TILDA (a general ageing cohort) study with the IDS-TILDA (intellectual disability specific ageing cohort). While it is situated in Ireland, the nature of the health issues means that the findings are likely to still be relevant to anyone with an interest in the field of ageing with an intellectual disability.

In general, the article is well written and free from typographical or grammatical errors or inconsistencies. While the source data is not available to ensure full reproducibility, this is a consequence of the nature of the datasets (TILDA and IDS-TILDA) and is not a deliberate omission or oversight by the research team. This is well explained by the authors under the heading of Data availability' on page 7.

I have a few observations for the authors that may assist future readers to better understand this paper, and these are detailed below:

- While the Introduction provides a good general overview for the study, I believe that it may be beneficial to include (minimal) additional justification, either in the Introduction or Methodology, for the rationale in choosing the chronological age of 40 in people with intellectual disability. This is not an implied criticism of the decision, but readers outside of the field may not understand the reasons for this approach, in light of the discrepancy where the TILDA data is based on individuals ageing 50 and above.
- In the Methodology section, it is noted that TILDA began in 2007, and is ongoing. What was not clear to me was whether the data being analysed was drawn from the original 2007 survey, that of a subsequent wave, or a combination of waves.
- The second paragraph of the Methodology (page 3) includes a second explanation of the acronym TILDA and is unnecessary.
- The use of propensity score matching is well explained, as is the reason for not matching on educational achievement.
- The acronym SPSS is used in the fourth paragraph of the Methodology (page 3), but the explanation is not provided until the first paragraph under the heading analysis (page 4).

- It may be useful to provide additional explanation for why 'fair' self-rated vision/hearing was included as a measure of impairment (page 4, under the heading of Measures). I assume that 'fair' and 'poor' were the two lowest categories of the five-point Likert scale, and inclusion of 'fair' in that scenario is appropriate, but this was not clear.
- This is more of an observation than an issue that requires a response. Geographic location (i.e. rural versus urban) is noted as one of the dataset matching categories (second paragraph on page 5), but it may be useful in the future to consider whether this is actually a useful point of differential. Differences in the type of residence (i.e. community versus residential) is reported, but any potential impact of the location does not appear to be evaluated. The lack of, or limited access to, appropriate and timely services in rural areas may (or not) result in delayed treatment and therefore an increased severity of symptoms (across both cohorts admittedly).
- Under limitations, it is noted that the self-reporting of sensory impairment was not verifiable, other than through confirmation of existing medical diagnoses. It is not necessary for this paper, but I wonder if there is the potential to report on the cross-matching of self-reported data against relevant diagnosed conditions. If there was a strong correlation between medically recognised sensory conditions and a 'fair' rating (for example), it would help justify the use of those self-rated categories.
- I wonder whether the authors have any additional recommendations (other than the ''results presented here warrant further investigation" on page 7). This is particularly in relation to potential changes to address the identified issues, or specific future research to assist in further understanding the noted issues.
- I have no significant other comments on the Results or Discussion. They are both well presented and follow a logical progression.

Overall, the authors have presented a well developed article that was both comprehensive and easy to read.

**Is the work clearly and accurately presented and does it cite the current literature?**
Yes

**Is the study design appropriate and is the work technically sound?**
Yes

**Are sufficient details of methods and analysis provided to allow replication by others?**
Yes

**If applicable, is the statistical analysis and its interpretation appropriate?**
Yes

**Are all the source data underlying the results available to ensure full reproducibility?**
No

**Are the conclusions drawn adequately supported by the results?**
Yes

***Competing Interests:*** No competing interests were disclosed.

***Reviewer Expertise:*** Ageing issues for persons with an intellectual disability

**I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.**

Reviewer Report 06 March 2019

https://doi.org/10.21956/hrbopenres.13928.r26517



?

**Dawn Guthrie**
Department of Kinesiology & Physical Education and Department of Health Sciences, Wilfrid Laurier University, Waterloo, Canada

The purpose of this paper was to understand the health implications of hearing loss, vision loss or a dual impairment among a group of adults with intellectual disability (ID). The authors used propensity score matching to create a comparison group of individuals without ID from the Irish Longitudinal Study on Aging in order to compare their health and functional status to individuals with ID.

Minor editorial changes:

1. In the first paragraph of the methods the sample from the IDS-TILDA is 753, which is one more than the number cited in the tables. The authors should ensure all the values are correct and consistent or explain if a case was missing for some reason.
2. The use of propensity score matching is a strength of this project. However, I wonder why the authors didn't match on other variables available within the questionnaire, such as cognitive functioning.
3. In the analysis section, the authors should cite whether they are using a one- or two-tailed alpha level and the alpha level itself.
4. I would suggest adding cognitive functioning to table 4 since it will be a potential confounder for the relationship between the level of ID and sensory impairments.
5. There should be a column for the p-value in Table 1 and in Table 4 or some symbols to indicate this as per the other tables.

More major changes/issues:

1. The information on how the sample of individuals with ID was created is unclear. The sample was "drawn" from a larger database, the National Intellectual Disability Database or NIDD. However, it's not clear if this was a random sample or a convenience sample. The authors refer to the sample as being "representative", but later in that section, a response rate of 46% is cited which calls into question whether such a low response rate could generate a truly representative sample.
2. The details on the logistic regression analysis should be more specific and explain what was the dependent measure and which were the independent measures in each model.
3. The way in which the "level of ID" was defined in Table 1 should be described in the

methods.

4. In table 2, why are there multiple asterisks to indicate varying levels of the p-value for a single independent factor? For example, in the first row for sex, there is a p-value of <0.001 for “visual impairment” and a different p-value for “dual sensory impairment”. The methods indicate that this was explored with a chi-square test, which seems appropriate, and implies that a single 2x3 cross-tabulation was conducted which would generate a single p-value. What do these multiple p-values represent?
5. In table 3 for sex, which group is the reference group? It’s impossible to interpret the OR without this information.
    - In this same table, the sample size in each group should be stated (in the column heading). This may help the reader to understand why some of the CIs in the dual sensory impairment group are so wide.
6. I would minimize a repetition, in the discussion section, of the results of the study and only highlight those that are of major importance and/or represent a novel finding. This section would benefit from a more fulsome discussion of other risk factors for sensory impairment beyond aging. There is a rich literature, for example, about the interface between hearing loss and cognitive status which would be very relevant to discuss for a population of individuals with ID. This section could also benefit from reviewing some of the practical implications of this work for health and social service professionals working with individuals with ID and their families.

**Is the work clearly and accurately presented and does it cite the current literature?**
Yes

**Is the study design appropriate and is the work technically sound?**
Partly

**Are sufficient details of methods and analysis provided to allow replication by others?**
No

**If applicable, is the statistical analysis and its interpretation appropriate?**
Partly

**Are all the source data underlying the results available to ensure full reproducibility?**
Yes

**Are the conclusions drawn adequately supported by the results?**
Yes

***Competing Interests:*** No competing interests were disclosed.

***Reviewer Expertise:*** gerontology; health services research; sensory impairment; epidemiology

**I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.**