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The relationship between self-reported sensory impairments and psychosocial health in older adults: a 4-year follow-up study using the English Longitudinal Study of Ageing

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ABSTRACT

Objectives: To explore cross-sectional and longitudinal relationships between self-reported hearing and vision impairments and self-rated health, quality of life (QoL) and depressive symptoms at 4-year follow-up.

Study design: The study involved cross-sectional and longitudinal analyses with 4-year follow-up using data from the English Longitudinal Study of Ageing.

Methods: Community-dwelling adults ($n = 3931$) aged ≥ 50 years from the English Longitudinal Study of Ageing participated in this study. Self-reported hearing and vision were defined as good or poor. Self-rated health was treated as a dichotomous variable (good and poor health). QoL was based on the 19-item Critical Appraisal Skills Programme and treated as a continuous variable (score 0–57). Depressive symptoms were assessed using the eight-item Center for Epidemiologic Studies Depression Scale (CES-D8) and defined as $CES-D \geq 3$. Relationships between sensory impairments and self-rated health and depressive symptoms were analysed using logistic regression. Linear regression was used to assess the relationships between sensory impairments and QoL.

Results: In cross-sectional analyses, both self-reported hearing and vision impairment were positively associated with all outcomes assessed. In longitudinal analyses, self-reported poor hearing and vision were associated with increased risks of poor self-rated health (hearing: odds ratio [OR] 1.65, 95% confidence interval [CI] 1.32, 2.05; vision: OR 1.57, 95% CI 1.16, 2.12) and depressive symptoms (hearing: OR 1.35, 95% CI 1.07, 1.71; vision: OR 1.44, 95% CI 1.09, 1.90) after adjustment for sociodemographic and lifestyle factors, chronic illness, mobility limitations and cognition. Poor hearing and poor vision were not associated with reduced QoL after adjustment for covariates.

Conclusions: The findings stress the importance of identifying and addressing sensory impairments in older adults to improve their health and well-being.

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Introduction

The population of England is ageing due to increased life expectancy.¹ Loss of hearing and vision is common in later life affecting 20% and 11%, respectively, of British adults aged ≥ 60 years.^{2,3} Poor hearing and poor vision have been associated with adverse health outcomes, including disability,^{4,5} frailty^{6,7} and dementia.^{8,9} Hearing and vision impairments have also been associated with poor self-rated health,^{10–12} a strong subjective measure for overall health that encompasses both physical health and psychological well-being, predicting major adverse health outcomes such as chronic illness,¹³ functional decline^{14,15} and depression.¹⁶ There is also evidence from cross-sectional studies of a relationship between impairments in hearing and vision with psychosocial health factors including quality of life (QoL) and depression;^{17–20} however, little is known about such relationships longitudinally. QoL is a broad term that in addition to health also measures perceived sense of control, autonomy, self-realisation and pleasure in a participant's life.²¹ Reporting poor QoL has been shown to be associated with prevalent chronic illness²² and poor physical functioning.¹⁷

Depression is a common condition with prevalence of depression in older adults in England estimated at 10%;²³ however, this percentage may be underestimated because 22% of men and 28% of women aged ≥ 65 years reported depression assessed using the 10-item Geriatric Depression Scale in the cross-sectional Health Survey for England in 2005.²⁴ Older adults are believed to be particularly susceptible to depression because of higher levels of comorbidities and physical and cognitive decline.²⁵ Besides physical and cognitive decline, depression in older age has also been associated with social exclusion, dementia and increased risks of suicide.²⁶ Given the increasing number of older adults, poor psychosocial health in older age has become a growing public health concern due to the associated burden on the individual, their families, the health and social care system and society.²⁷ Investigating longitudinal relationships between sensory impairments and psychosocial health in later life has the potential to provide more insight into the influence of sensory impairments on older adults' health. Such relationships are of importance to examine as sensory impairments often are preventable or treatable.^{8,28} Therefore, this study aims to longitudinally explore associations between impairments in hearing and vision and subsequent low self-rated health, changes in QoL and development of depressive symptoms in older English adults.

Methods

Design and study population

This study used data from the English Longitudinal Study of Ageing (ELSA), a nationally representative cohort of English adults aged ≥ 50 years, drawn from the Health Survey for England in 1998, 1999 and 2001.²⁹ Participants have been followed up every 2 years including additional nurse visits every

4 years. This study used data collected in 2004 (wave 2) as the baseline data and data from 2008 (wave 4) as follow-up data. This study sample was restricted to 3931 individuals with data on all three outcomes at both time points and data on sensory impairments and covariates at the baseline, allowing for complete case analysis. All participants provided written informed consent. Ethical approval for ELSA was obtained from the Multicentre Research and Ethics Committee, the system of approval for multicentre studies in England.

Exposures of interest: hearing impairment and vision impairment

Data on self-reported hearing were collected by asking 'Is your hearing (using a hearing aid if you use one)...' with the answer options 'excellent', 'very good', 'good', 'fair' and 'poor'. For vision, participants were asked 'Is your eyesight (using glasses or corrective lenses if you use them)...' with the same answer options as for hearing. Similar to previous studies,^{6,7,30} reporting 'fair' or 'poor' hearing and vision, respectively, was classified as having poor hearing/poor vision. 'Good', 'very good' or 'excellent' were combined into good hearing and good vision, respectively.

Outcomes of interest

Self-rated health

Data on self-rated health were collected by asking 'Would you say your health is...' with the answer options 'excellent', 'very good', 'good', 'fair' and 'poor'. For the analyses, 'fair' or 'poor' were classified as poor self-rated health and 'good', 'very good' or 'excellent' were classified as good self-rated health.

Quality of life

QoL was assessed using the validated 19-item Critical Appraisal Skills Programme (CASP-19) instrument comprising four domains that measure degrees of the participant's perceived sense of control (four questions), autonomy (five questions), self-realisation (five questions) and pleasure (five questions).³¹ Each of the 19 items were recoded so that the values ranged from 0 to 3 with 0 being 'often', 1 'sometimes', 2 'not often' and 3 'never'. All items were then summed arithmetically to form a score ranging from 0 to 57. QoL was treated as a continuous measure. A higher score referred to greater QoL, whereas a lower score referred to poorer QoL.

Depressive symptoms

Data on depressive symptoms were collected using the Center for Epidemiologic Studies Depression Scale (CES-D8), a validated eight-item questionnaire on feelings of sadness, loneliness and restless sleep.^{32,33} Although CES-D8 can be treated as a continuous measure, clinically, it may be more relevant to categorise participants into depressed and non-depressed.³⁴ In this study, depressive symptoms were defined as having three or more of the eight items, a cut-off used to indicate a clinical diagnosis of depression.^{35–37} CES-D8 has provided 63% sensitivity and 90% specificity using the Euro-D scale as the reference.³⁸

Covariates

Covariates used in the analyses include age, sex, cohabitation, education, wealth, physical activity, body mass index (BMI), smoking, chronic disease, cognitive function and mobility. Individuals were grouped into those with no educational qualifications versus those with secondary education or higher. Wealth referred to the total net non-pension wealth (financial, housing and physical wealth) of the household presented as quintiles. Cohabitation referred to the current living arrangements and included spouse, partner, relatives and caretakers living with the respondent. Physical activity, known for having a positive impact on overall health and depression,³⁹ was based on frequency and intensity of exercise and allowed for four groups: sedentary, mild, moderate and vigorous physical activity carried out on at least a weekly basis. The BMI referred to someone's weight in relation to their height and was considered as a covariate owing to the higher prevalence of overweight and obesity among those who have sensory impairments compared with non-sensory impaired individuals⁴⁰ and its influence on overall health⁴¹ and depression.⁴² Chronic illness was based on self-reported doctor-diagnosed heart attack, stroke and diabetes, where reporting one or more was classified as having chronic illness. Cognitive function and mobility limitations were considered because they have previously been associated with both hearing impairment^{17,43,44} and vision impairment^{45–47} and may be linking sensory impairments with the outcomes explored including self-reported health,⁴⁸ poor QoL⁴⁹ and depression.⁵⁰ Cognitive function was based on a validated 24-item cognitive score,⁵¹ which was calculated by adding participants' scores from the three tests: immediate recall (scored 0–10), delay recall (0–10) and orientation (0–4) to create a final cognition score. For the recall tests, the participants were presented 10 words of which they were asked to recall as many words as possible immediately and again 5 min later. For questions on orientation, the participants were asked to correctly report the day, date, month and year. Having a mobility limitation was defined as reporting difficulty climbing a flight of stairs or walking 100 yards.

Statistical analyses

Sample characteristics (Table 1) in participants with good and poor self-reported hearing and good and poor self-reported vision were calculated using percentages for variables with categorical data; means and standard deviations (SDs) were used for variables with continuous data. Linear regression was used to determine cross-sectional and longitudinal relationships between sensory impairments and continuous measures of QoL. For the longitudinal analyses, the models were adjusted for the baseline QoL. Logistic regression was used to assess cross-sectional and longitudinal relationships between sensory impairments and self-rated health and depressive symptoms (CES-D \geq 3), using good hearing and good vision, respectively, as reference groups. The longitudinal analyses of sensory impairments and self-rated health and depressive symptoms were adjusted for the baseline self-rated health and baseline depressive symptoms, respectively. The baseline weighting was used for all analyses to reduce the risk of bias

caused by non-responses. All models were adjusted for age and sex followed by further adjustment for additional covariates (cohabitation, education, wealth, physical activity, BMI, smoking and chronic illness). Fully adjusted models also included adjustment for cognitive function and mobility limitations. The analyses were conducted using R and its default statistical packages.

Results

Of 3931 participating individuals (55% women) aged \geq 50 years (mean age 64 years [SD 8.4]), 19% self-reported poor hearing and 10% self-reported poor vision (Table 1). Compared with participants who self-reported good hearing, participants who self-reported poor hearing were more likely to be older, male and less wealthy with no educational qualifications, lead a sedentary lifestyle and have a chronic illness, poorer cognitive function and mobility limitations. Compared with participants who self-reported good vision, those with poor self-reported vision were more likely to be older, female and less wealthy with fewer educational qualifications, were less likely to be living with someone and a current smoker, lead a sedentary lifestyle and have chronic illness, poorer cognitive function and mobility limitations.

Cross-sectional associations

Cross-sectional findings are presented in Table 2 and show that compared with participants who self-reported good hearing, participants with poor self-reported hearing were nearly three times as likely to report poor self-rated health (age- and sex-adjusted odds ratio [OR] 2.89, 95% confidence interval [CI] 2.39, 3.49). Poor hearing was also associated with poorer QoL (age- and sex-adjusted β -3.57, 95% CI -4.26, 2.87) and depressive symptoms (age- and sex-adjusted OR 2.07, 95% CI 1.69, 2.53). All associations remained after further adjustment for cohabitation, education, wealth, physical activity, BMI, smoking, chronic illness, cognition and mobility limitation.

Compared with good self-reported vision, self-reported poor vision was associated with poorer health outcomes including more than fourfold increased odds of poor self-rated health (age- and sex-adjusted OR 4.42, 95% CI 3.53, 5.54). Self-reported poor vision was also associated with poorer QoL (age- and sex-adjusted β -4.62, 95% CI -5.57, 3.67) and with depressive symptoms (age- and sex-adjusted OR 2.04, 95% CI 1.59, 2.61). The associations remained after further adjustment for covariates.

Longitudinal associations

Findings from the longitudinal analyses are shown in Table 3. Compared with participants who self-reported good hearing, those who self-reported poor hearing were significantly more likely to self-report poor health at 4-year follow-up after adjustment for socio-economic and lifestyle factors, chronic illness, mobility limitation and cognition (OR 1.65, 95% CI 1.32, 2.05). Self-reported poor hearing was furthermore associated

Table 1 – Characteristics of the study sample at the baseline (2004).

	Overall	Hearing			Vision		
		Good	Poor	P-value	Good	Poor	P-value
Totals, n (%)	3931 (100)	3199 (81)	732 (19)		3551 (90)	380 (10)	
Age in years, mean (SD)	64.4 (8.4)	63.8 (8.2)	66.9 (8.8)	<0.001	64.1 (8.3)	66.8 (9.5)	<0.001
Female, n (%)	2145 (55)	1851 (58)	294 (40)	<0.001	1914 (54)	231 (61)	0.012
Cohabiting, n (%)	2915 (74)	2366 (74)	549 (75)	0.594	2672 (75)	243 (64)	<0.001
Smoker, n (%)	509 (13)	415 (13)	94 (13)	0.973	441 (12)	68 (18)	0.003
No educational qualifications, n (%)	609 (15)	521 (16)	88 (12)	0.005	576 (16)	33 (9)	0.001
Wealth quintiles, n (%)							
1 (least wealthy)	465 (12)	354 (11)	111 (15)	<0.001	370 (10)	95 (25)	<0.001
2	645 (16)	492 (15)	153 (21)		561 (16)	84 (22)	
3	816 (21)	659 (21)	157 (21)		754 (21)	62 (16)	
4	935 (24)	787 (25)	148 (20)		859 (24)	76 (20)	
5 (most wealthy)	1070 (27)	907 (28)	163 (22)		1007 (28)	63 (17)	
Body mass index in kg/m ² , mean (SD)	27.9 (4.8)	27.87 (4.8)	27.93 (4.6)	0.725	27.9 (4.7)	28.2 (5.2)	0.262
Physical activity (intensity on a weekly basis), n (%)							
0 (sedentary)	148 (4)	95 (3)	53 (7)	<0.001	109 (3)	39 (10)	<0.001
1 (mild)	452 (11)	349 (11)	103 (14)		386 (11)	66 (17)	
2 (moderate)	1987 (51)	1612 (50)	375 (51)		1795 (51)	192 (51)	
3 (vigorous)	1344 (34)	1143 (36)	201 (27)		1261 (36)	83 (22)	
Chronic illness (heart attack, stroke and/or diabetes), n (%)	507 (13)	378 (12)	129 (18)	<0.001	293 (8)	87 (23)	<0.001
Cognitive function (0-24), mean (SD)	14.7 (1.2)	14.9 (3.2)	13.7 (3.2)	<0.001	14.8 (3.2)	13.8 (3.4)	<0.001
Mobility (difficulty taking stairs and/or walking 400 yards), n (%)	474 (12)	325 (10)	149 (20)	<0.001	377 (11)	97 (26)	<0.001
Prevalence of outcome measures by sensory function							
Poor self-reported health, n (%)	762 (19)	504 (16)	258 (35)	<0.001	582 (16)	180 (47)	<0.001
Quality of life (0-57), mean (SD)	43.8 (8.1)	44.5 (7.9)	40.84 (8.4)	<0.001	44.3 (7.9)	39.5 (8.8)	<0.001
Depressive symptoms (≥3), n (%)	708 (18)	520 (16)	188 (26)	<0.001	596 (23)	112 (29)	<0.001

SD, standard deviation

with odds of depressive symptoms (adjusted for age, sex and the baseline depressive symptoms OR 1.52, 95% CI 1.21, 1.91), and the association remained after further adjustments. Self-reported poor hearing was not associated with poorer QoL at 4-year follow-up.

Compared with participants who self-reported good vision, participants who self-reported poor vision were nearly twice as likely to self-report poor health at 4-year follow-up (adjusted for age, sex and the baseline self-reported health

OR 1.76, 95% CI 1.33, 2.33), and the association remained after further adjustment (OR 1.75, 95% CI 1.16, 2.12). Compared with good vision, poor vision was associated with poorer QoL at 4-year follow-up (adjusted for age, sex and the baseline QoL β -0.93, 95% CI -1.64, 0.22). However, the association diminished after further adjustment for covariates. Participants who self-reported poor vision were more likely to report depressive symptoms at 4-year follow-up (adjusted for age, sex and the baseline depressive symptoms OR 1.82, 95% CI

Table 2 – Cross-sectional associations between sensory impairments and self-rated health, QoL and depressive symptoms in a sample of 3931 adults aged ≥50 years in 2004 (baseline).

Models	Self-rated health			QoL		Depressive symptoms		
	Good hearing [OR]	Poor hearing [OR (95% CI)]	P-value	Poor hearing [β (95% CI)]	P-value	Good hearing [OR]	Poor hearing [OR (95% CI)]	P-value
Adjusted M1 ^a	1.00	2.89 (2.39, 3.49)	<0.001	-3.57 (-4.26, -2.87)	<0.001	1.00	2.07 (1.69, 2.53)	<0.001
Adjusted M2 ^b	1.00	2.65 (2.16, 3.26)	<0.001	-2.89 (-3.54, -2.24)	<0.001	1.00	1.93 (1.56, 2.38)	<0.001
Adjusted M3 ^c	1.00	2.39 (1.92, 2.98)	<0.001	-2.47 (-3.11, -1.83)	<0.001	1.00	1.77 (1.42, 2.19)	<0.001
	Good vision [OR]	Poor vision [OR (95% CI)]	P-value	Poor vision [β (95% CI)]	P-value	Good vision [OR]	Poor vision [OR (95% CI)]	P-value
Adjusted M1 ^a	1.00	4.42 (3.53, 5.54)	<0.001	-4.62 (-5.57, -3.67)	<0.001	1.00	2.04 (1.59, 2.61)	<0.001
Adjusted M2 ^b	1.00	3.45 (2.70, 4.41)	<0.001	-3.16 (-4.08, -2.23)	<0.001	1.00	1.60 (1.23, 2.09)	<0.001
Adjusted M3 ^c	1.00	3.45 (2.65, 4.48)	<0.001	-2.75 (-3.66, -1.84)	<0.001	1.00	1.49 (1.13, 1.96)	0.004

BMI, body mass index; OR, odds ratio; CI, confidence interval; QoL, quality of life.

^a M1 (model 1) = adjusted for age and sex.^b M2 (model 2) = M1 + cohabitation, education, wealth, physical activity, smoking, BMI and chronic illness.^c M3 (model 3) = M2 + mobility limitations and cognition.

Table 3 – Longitudinal associations between sensory impairments in 2004 (baseline) and self-rated health, QoL and depressive symptoms at 4-year follow-up (2008) in a sample of 3931 adults aged ≥ 50 years in 2004.

Models	Self-rated health			QoL		Depressive symptoms		
	Good hearing [OR]	Poor hearing [OR (95% CI)]	P-value	Poor hearing [β (95% CI)]	P-value	Good hearing [OR]	Poor hearing [OR (95% CI)]	P-value
Adjusted M1 ^a	1.00	1.71 (1.39, 2.12)	<0.001	-0.41 (-0.93, 0.11)	0.124	1.00	1.52 (1.21, 1.91)	<0.001
Adjusted M2 ^b	1.00	1.70 (1.37, 2.11)	<0.001	-0.33 (-0.85, 0.18)	0.207	1.00	1.40 (1.11, 1.77)	0.004
Adjusted M3 ^c	1.00	1.65 (1.32, 2.05)	<0.001	-0.26 (-0.78, 0.26)	0.322	1.00	1.35 (1.07, 1.71)	0.011
	Good vision [OR]	Poor vision [OR (95% CI)]	P-value	Poor vision [β (95% CI)]	P-value	Good vision [OR]	Poor vision [OR (95% CI)]	P-value
Adjusted M1 ^a	1.00	1.76 (1.33, 2.33)	<0.001	-0.93 (-1.64, -0.22)	0.010	1.00	1.82 (1.39, 2.38)	<0.001
Adjusted M2 ^b	1.00	1.57 (1.17, 2.11)	0.002	-0.68 (-1.39, 0.03)	0.061	1.00	1.48 (1.12, 1.95)	0.005
Adjusted M3 ^c	1.00	1.57 (1.16, 2.12)	0.003	-0.63 (-1.34, 0.08)	0.083	1.00	1.44 (1.09, 1.90)	0.009

BMI, body mass index; OR, odds ratio; CI, confidence interval; QoL, quality of life.

^a M1 (model 1) = adjusted for age, sex and outcome of interest at the baseline: self-rated health/QoL/depression, respectively.

^b M2 (model 2) = M1 + cohabitation, education, wealth, physical activity, smoking, BMI and chronic illness.

^c M3 (model 3) = M2 + mobility limitations and cognition.

1.39, 2.38) compared with their counterparts who self-reported good vision, and the association remained after further adjustments.

Discussion

The cross-sectional analyses showed that self-reported poor hearing and poor vision were associated with poor self-rated health, poorer QoL and depressive symptoms. In the longitudinal analysis, compared with individuals who self-reported good hearing, self-reported poor hearing was associated with increased risk of poor self-rated health and depressive symptoms. Self-reported poor hearing was also associated with subsequent poorer QoL; however, the association was attenuated after adjustment for covariates. Self-reported poor vision was associated with subsequent poor self-rated health and depressive symptoms and the associations remained after adjustment for covariates. Self-reported poor vision was also associated with poorer QoL; however, the association disappeared after adjustment for covariates.

Analyses of the influence of self-reported sensory impairments on self-rated health is of interest because self-rated health is a subjective measure of both physical health and well-being¹⁰ and known for being a strong predictor of mortality.¹⁴ Our longitudinal finding supports previous cross-sectional studies reporting an association between both subjectively and objectively assessed hearing impairment and self-rated health.^{10,12,52,53} Similarly, the observed association between self-reported poor hearing and reporting depressive symptoms 4 years later supports recent research showing an association between objectively assessed hearing impairment and clinically diagnosed depression in older adults.⁵⁴ In our study, self-reported poor hearing was not associated with subsequent poorer QoL at 4-year follow-up. The lack of association observed is inconsistent with previous studies reporting an association between hearing impairment and poorer QoL,^{55–57} however, these previous studies were of cross-sectional design. Indeed, our cross-sectional analysis showed an association between self-reported poor hearing

and QoL. Addressing hearing problems has been shown to positively influence QoL,⁵⁸ and it is possible that participants who reported poor hearing at the baseline had addressed their hearing problems 4 years later. However, most older adults with hearing problems do not seek help,²⁸ and therefore, the lack of association between self-reported poor hearing and poor QoL may not be due to action taken on their hearing loss. Instead the lack of association may be explained by the socio-economic status and physical health, factors of importance previously shown to influence QoL.^{49,59,60} Less wealth and poor physical health might outweigh the impact of poor hearing on QoL in older age.^{58,61–67}

Similar to self-reported poor hearing, cross-sectional analyses showed associations between self-reported poor vision and poor self-rated health, poorer QoL and depressive symptoms. Self-reported poor vision was also associated with subsequent poor self-rated health and depressive symptoms at 4-year follow-up. Our longitudinal findings support previous studies reporting a relationship of age-related vision impairment (self-reported and objectively assessed) with poor self-rated health^{10–12} and with depression.^{68,69} Contrary to existing literature,^{70,71} self-reported poor vision was not associated with poorer QoL. In our study, QoL was measured using the validated CASP-19. However, using a vision-related measure such as the Activities of Daily Vision Scale, concerned exclusively with measuring specific activities related to eyesight, might have captured poor QoL related to vision more successfully.⁷² However, the Activities of Daily Vision Scale has not been used in ELSA. Furthermore, the severity of uncorrected vision impairment has been shown to negatively influence QoL with greater vision impairment having worse negative impact on QoL.⁷³ Using more than two categories of vision function (good and poor vision) might, therefore, have been useful. However, because of the small number of participants reporting 'poor' vision ($n = 62$ [2% of the study sample]), this answer option was combined with 'fair' vision ($n = 318$). It is possible that the lack of association is due to low statistical power.^{74,75}

The associations observed in this study may be explained by unmeasured factors such as hypertension and anxiety.

Hypertension is a modifiable risk factor for cardiovascular disease (CVD) and highly prevalent in the older population.⁷⁶ Hypertension was, however, not included as a possible confounder because previous research has reported inconsistent findings, with some studies showing no association between sensory impairments and hypertension.^{77–79} In ELSA, data on anxiety refer to a single-item self-reported question likely to highly correlate with the measures of depression and therefore not necessarily appropriate to be considered as a covariate. Furthermore, social isolation due to communication problems may link sensory impairments to poor self-rated health, poorer QoL and depression.^{80,81} The associations observed may also be explained by poorly assessed conditions including self-reported doctor-diagnosed CVD and the limited aspects of cognition included.

Strengths and limitations

A major strength of this study is that it uses prospective data collected from a large nationally representative sample of English adults aged ≥ 50 years. Validated standard measures of self-rated health, QoL and depression were used to assess the outcomes.^{31,33} Participants were followed up for 4 years, and the relationships explored were adjusted for a multiple covariates.

Limitations include that ELSA participants without complete data on the variables investigated were removed from our study, causing potential selection bias. Non-respondents were older (<0.001), less wealthy (<0.001) and had worse health outcomes including more chronic illness (<0.001), worse cognitive function (<0.001) and poorer mobility (0.001), suggesting the associations observed may be even stronger among non-respondents. Hearing and vision function were self-reported. However, the questions on hearing and vision used have been validated against objective measures,^{82,83} and this study's prevalence rates are similar to national estimates.^{2,3} Self-reported data on hearing and vision were collected at the baseline with no information on changes overtime. Furthermore, the outcome measures' self-rated health, QoL and depressive symptoms were only assessed at the baseline and again at 4-year follow-up with no record of changes in any direction during the follow-up period. Furthermore, the cognitive score adjusted for referred only to orientation and immediate and delayed recall. Other aspects of cognition were not included proposing the role of cognition has not been fully accounted for. Another limitation is that the data used for the analyses are from 2004 to 2008 and may be considered dated. Finally, the ELSA cohort comprised predominantly white English adults, making it difficult to generalise the findings to other ethnic groups. No effort was made to oversample groups with small numbers such as the oldest-old and those from ethnic minority backgrounds.

Conclusions and implications

This study shows that self-reported hearing and vision problems are associated with greater odds of poor self-rated health and depressive symptoms at 4-year follow-up. The findings stress the importance of identifying and addressing sensory

impairments in older adults to potentially reduce their risk of experiencing worse general health and depressive symptoms overtime. It is possible that poor hearing in older adults to some extent can be corrected by provision and use of hearing aids as population-based data have shown that only 15% of adults aged 48–92 years with objectively assessed hearing impairment use a hearing aid.⁸⁴ Similarly, it is estimated that 20–50% of older adults have undetected reduced vision and that the majority of these cases are due to refractive errors or cataract and thus correctable.⁸⁵ Provision and use of spectacles or lenses of the appropriate prescription, or cataract extraction, respectively, might have the potential to address most of the vision problems experienced in older adults.⁸ Finally, research replicating the study using objectively assessed hearing and vision is needed to evaluate whether the observed relationships of self-reported sensory impairments with adverse health outcomes are consistent with objectively measured sensory function.

Author statements

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Ethical approval

Ethical approval for ELSA was obtained from the Multicentre Research and Ethics Committee.

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Competing interests

The authors have no competing interests to declare.

REFERENCES

1. National population projections: 2016-based statistical bulletin, ONS (Office for National Statistics). 2017. Available at: <https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/bulletins/>

- nationalpopulationprojections/
2016basedstatisticalbulletin#a-growing-number-of-older-
people. [Accessed 29 January 2018].
2. Akeroyd MA, Foreman K, Holman JA. Estimates of the number of adults in England, Wales, and Scotland with a hearing loss. *Int J Audiol* 2014;53:60–1.
 3. Sightloss UK 2013. *The latest evidence.*, RNIB (Royal National Institute of Blind People). 2013. Available at: https://www.rnib.org.uk/sites/default/files/Sight_loss_UK_2013.pdf. [Accessed 29 January 2018].
 4. Liljas AE, Wannamethee SG, Whincup PH, Papacosta O, Walters K, Iliffe S, et al. Hearing impairment and incident disability and all-cause mortality in older. *British community-dwelling men Age and ageing* 2016;45:662–7.
 5. West SK, Munoz B, Rubin GS, Schein OD, Bandeen-Roche K, Zeger S, et al. Function and visual impairment in a population-based study of older adults. The SEE project. *Salisbury Eye Evaluation. Invest Ophthalmol Vis Sci* 1997;38:72–82.
 6. Liljas AE, Carvalho LA, Papachristou E, De Oliveira C, Wannamethee SG, Ramsay SE, et al. Self-reported vision impairment and incident prefrailty and frailty in English community-dwelling older adults: findings from a 4-year follow-up study. *J Epidemiol Community Health* 2017;71:1053–8.
 7. Liljas AE, Carvalho LA, Papachristou E, Oliveira C, Wannamethee SG, Ramsay SE, et al. Self-reported hearing impairment and incident frailty in English community-dwelling older adults: a 4-year follow-up study. *J Am Geriatr Soc* 2017;65:958–65.
 8. Bowen M, Edgar DF, Hancock B, Haque S, Shah R, Buchanan S, et al. The Prevalence of Visual Impairment in People with Dementia (the PROVIDe study): a cross-sectional study of people aged 60–89 years with dementia and qualitative exploration of individual, carer and professional perspectives. *Health Serv Deliv Res* 2016;4.
 9. Davies HR, Cadar D, Herbert A, Orrell M, Steptoe A. Hearing impairment and incident dementia: findings from the English longitudinal study of ageing. *J Am Geriatr Soc* 2017;65:2074–81.
 10. Jylha M, Guralnik JM, Ferrucci L, Jokela J, Heikkinen E. Is self-rated health comparable across cultures and genders? *J Gerontol B Psychol Sci Soc Sci* 1998;53:S144–52.
 11. Wang JJ, Foran S, Mitchell P. Age-specific prevalence and causes of bilateral and unilateral visual impairment in older Australians: the Blue Mountains Eye Study. *Clin Exp Ophthalmol* 2000;28:268–73.
 12. Liu PL, Cohen HJ, Fillenbaum GG, Burchett BM, Whitson HE. Association of Co-existing impairments in cognition and self-rated vision and hearing with health outcomes in older adults. *Geront & Geriatric Med* 2016;2.
 13. Molarius A, Janson S. Self-rated health, chronic diseases, and symptoms among middle-aged and elderly men and women. *J Clin Epidemiol* 2002;55:364–70.
 14. Idler EL, Kasl SV. Self-ratings of health: do they also predict change in functional ability? *J Gerontol B Psychol Sci Soc Sci* 1995;50:S344–53.
 15. Leinonen R, Heikkinen E, Jylha M. Changes in health, functional performance and activity predict changes in self-rated health: a 10-year follow-up study in older people. *Arch Gerontol Geriatr* 2002;35:79–92.
 16. Mulsant BH, Ganguli M, Seaberg EC. The relationship between self-rated health and depressive symptoms in an epidemiological sample of community-dwelling older adults. *J Am Geriatr Soc* 1997;45:954–8.
 17. Arlinger S. Negative consequences of uncorrected hearing loss—a review. *Int J Audiol* 2003;42(Suppl 2). 2s17–20.
 18. Boi R, Racca L, Cavallero A, Carpaneto V, Racca M, Dall'Acqua F, et al. Hearing loss and depressive symptoms in elderly patients. *Geriatr Gerontol Int* 2012;12:440–5.
 19. Evans JR, Fletcher AE, Wormald RP. Depression and anxiety in visually impaired older people. *Ophthalmology* 2007;114:283–8.
 20. Dalton DS, Cruickshanks KJ, Klein BE, Klein R, Wiley TL, Nondahl DM. The impact of hearing loss on quality of life in older adults. *Gerontol* 2003;43:661–8.
 21. Nussbaum M, Sen A. *The quality of life*. Oxford: Clarendon Press; 1993.
 22. Wikman A, Wardle J, Steptoe A. Quality of life and affective well-being in middle-aged and older people with chronic medical illnesses: a cross-sectional population based study. *PLoS One* 2011;6:e18952.
 23. McDougall FA, Matthews FE, Kvaal K, Dewey ME, Brayne C. Prevalence and symptomatology of depression in older people living in institutions in England and Wales. *Age Ageing* 2007;36:562–8.
 24. *Health Survey for England 2005, health of older people*, HSE (health Survey for England). 2007. Available at: <https://digital.nhs.uk/catalogue/PUB01184>. [Accessed 27 February 2018].
 25. Mirowsky J, Ross CE. Age and depression. *J Health Soc Behav* 1992;33:187–205. discussion 206–112.
 26. Fiske A, Wetherell JL, Gatz M. Depression in older adults. *Annu Rev Clin Psychol* 2009;5:363–89.
 27. Wang PS, Simon G, Kessler RC. The economic burden of depression and the cost-effectiveness of treatment. *Int J Methods Psychiatr Res* 2003;12:22–33.
 28. Davis A, Smith P, Ferguson M, Stephens D, Gianopoulos I. Acceptability, benefit and costs of early screening for hearing disability: a study of potential screening tests and models. *Health Technol Assess* 2007;11:1–294.
 29. Marmot M, Oldfield Z, Clemens S, Blake M, Phelps A, Nazroo J, et al. *English longitudinal study of ageing: waves 0-6, 1998-2013*, 23rd ed. London: UK Data Service; 2015. <https://doi.org/10.5255/UKDA-SN-5050-10>. [Accessed 20 February 2018].
 30. Maharani A, Dawes P, Nazroo J, Tampubolon G, Pendleton N. Visual and hearing impairments are associated with cognitive decline in older people. *Age Ageing* 2018;47:575–81.
 31. Hyde M, Wiggins RD, Higgs P, Blane DB. A measure of quality of life in early old age: the theory, development and properties of a needs satisfaction model (CASP-19). *Aging Ment Health* 2003;7:186–94.
 32. Wallace RB, Herzog AR, Ofstedal MB, Steffick DE, Fonda S, Langa KM. *Documentation of affective functioning measures in the health and retirement study*. 2000. Available at: <http://hrsonline.isr.umich.edu/sitedocs/userg/dr-005.pdf>. [Accessed 20 February 2018].
 33. Karim J, Weisz R, Bibi Z, Rehman uS. Validation of the eight-item center for epidemiologic studies depression scale (CES-D) among older adults. *Curr Psychol* 2015;34:681–92.
 34. Radloff LS. The CES-D scale: a self-report depression scale for research in the general population. *Appl Psychol Meas* 1977;1:385–401.
 35. Schane RE, Walter LC, Dinno A, Covinsky KE, Woodruff PG. Prevalence and risk factors for depressive symptoms in persons with chronic obstructive pulmonary disease. *J Gen Intern Med* 2008;23:1757–62.
 36. Blazer D, Burchett B, Service C, George LK. The association of age and depression among the elderly: an epidemiologic exploration. *J Gerontol* 1991;46:M210–5.
 37. Andresen EM, Malmgren JA, Carter WB, Patrick DL. Screening for depression in well older adults: evaluation of a short form of the CES-D (Center for Epidemiologic Studies Depression Scale). *Am J Prev Med* 1994;10:77–84.

38. Courtin E, Knapp M, Grundy E, Avendano-Pabon M. Are different measures of depressive symptoms in old age comparable? An analysis of the CES-D and Euro-D scales in 13 countries. *Int J Methods Psychiatr Res* 2015;24:287–304.
39. Strawbridge WJ, Deleger S, Roberts RE, Kaplan GA. Physical activity reduces the risk of subsequent depression for older adults. *Am J Epidemiol* 2002;156:328–34.
40. Weil E, Wachterman M, McCarthy EP, Davis RB, O'Day B, Iezzoni LI, et al. Obesity among adults with disabling conditions. *J Am Med Assoc* 2002;288:1265–8.
41. Kopelman P. Health risks associated with overweight and obesity. *Obes Rev Off J Int Assoc Study Obes* 2007;8(Suppl 1):13–7.
42. Luppino FS, de Wit LM, Bouvy PF, Stijnen T, Cuijpers P, Penninx BW, et al. Overweight, obesity, and depression: a systematic review and meta-analysis of longitudinal studies. *Arch Gen Psychiatr* 2010;67:220–9.
43. Chen DS, Genter DJ, Betz J, Lin FR. Association between hearing impairment and self-reported difficulty in physical functioning. *J Am Geriatr Soc* 2014;62:850–6.
44. Lin FR, Yaffe K, Xia J, Xue QL, Harris TB, Purchase-Helzner E, et al. Hearing loss and cognitive decline in older adults. *JAMA internal medicine* 2013;173:293–9.
45. Reuben DB, Mui S, Damesyn M, Moore AA, Greendale GA. The prognostic value of sensory impairment in older persons. *J Am Geriatr Soc* 1999;47:930–5.
46. Reyes-Ortiz CA, Kuo YF, DiNuzzo AR, Ray LA, Raji MA, Markides KS. Near vision impairment predicts cognitive decline: data from the hispanic established populations for epidemiologic studies of the elderly. *J Am Geriatr Soc* 2005;53:681–6.
47. Wallhagen MI, Strawbridge WJ, Shema SJ, Kurata J, Kaplan GA. Comparative impact of hearing and vision impairment on subsequent functioning. *J Am Geriatr Soc* 2001;49:1086–92.
48. Hultsch DF, Hammer M, Small BJ. Age differences in cognitive performance in later life: relationships to self-reported health and activity life style. *J Gerontol* 1993;48:P1–11.
49. Blane D, Netuveli G, Montgomery SM. Quality of life, health and physiological status and change at older ages. *Soc Sci Med* (1982) 2008;66:1579–87.
50. Potter GG, Steffens DC. Contribution of depression to cognitive impairment and dementia in older adults. *Neurol* 2007;13:105–17.
51. Langa KM, Llewellyn DJ, Lang IA, Weir DR, Wallace RB, Kabeto MU, et al. Cognitive health among older adults in the United States and in England. *BMC Geriatr* 2009;9:23.
52. Karpa MJ, Gopinath B, Beath K, Rochtchina E, Cumming RG, Wang JJ, et al. Associations between hearing impairment and mortality risk in older persons: the Blue Mountains Hearing Study. *Ann Epidemiol* 2010;20:452–9.
53. Gopinath B, Hickson L, Schneider J, McMahon CM, Burlutsky G, Leeder SR, et al. Hearing-impaired adults are at increased risk of experiencing emotional distress and social engagement restrictions five years later. *Age Ageing* 2012;41:618–23.
54. Kim SY, Kim HJ, Park EK, Joe J, Sim S, Choi HG. Severe hearing impairment and risk of depression. *A national cohort study* 2017;12:e0179973.
55. Newman CW, Jacobson GP, Hug GA, Sandridge SA. Perceived hearing handicap of patients with unilateral or mild hearing loss. *Ann Otol Rhinol Laryngol* 1997;106:210–4.
56. Scherer MJ, Frisina DR. Characteristics associated with marginal hearing loss and subjective well-being among a sample of older adults. *J Rehabil Res Dev* 1998;35:420–6.
57. Chia EM, Mitchell P, Rochtchina E, Foran S, Golding M, Wang JJ. Association between vision and hearing impairments and their combined effects on quality of life. *Arch Ophthalmol* 2006;124:1465–70.
58. Boorsma M, Joling K, Dussel M, Ribbe M, Frijters D, van Marwijk HW, et al. The incidence of depression and its risk factors in Dutch nursing homes and residential care homes. *Am J Geriatr Psychiatry Off J Am Assoc Geriatr Psychiatr* 2012;20:932–42.
59. Netuveli G, Wiggins RD, Hildon Z, Montgomery SM, Blane D. Quality of life at older ages: evidence from the English longitudinal study of aging (wave 1). *J Epidemiol Community Health* 2006;60:357–63.
60. Gale CR, Cooper C, Deary IJ, Aihie Sayer A. Psychological well-being and incident frailty in men and women: the English Longitudinal Study of Ageing. *Psychol Med* 2014;44:697–706.
61. Li CM, Zhang X, Hoffman HJ, Cotch MF, Themann CL, Wilson MR. Hearing impairment associated with depression in US adults, national health and nutrition examination survey 2005–2010. *JAMA otolaryngology– head & neck surgery* 2014;140:293–302.
62. Mener DJ, Betz J, Genter DJ, Chen D, Lin FR. Hearing loss and depression in older adults. *J Am Geriatr Soc* 2013;61:1627–9.
63. Tambs K. Moderate effects of hearing loss on mental health and subjective well-being: results from the Nord-Trøndelag Hearing Loss Study. *Psychosom Med* 2004;66:776–82.
64. Nachtegaal J, Smit JH, Smits C, Bezemer PD, van Beek JH, Festen JM, et al. The association between hearing status and psychosocial health before the age of 70 years: results from an internet-based national survey on hearing. *Ear Hear* 2009;30:302–12.
65. Lee AT, Tong MC, Yuen KC, Tang PS, Vanhasselt CA. Hearing impairment and depressive symptoms in an older Chinese population. *J Otolaryngol* 2010;39:498–503.
66. Gopinath B, Wang JJ, Schneider J, Burlutsky G, Snowdon J, McMahon CM, et al. Depressive symptoms in older adults with hearing impairments: the Blue Mountains Study. *J Am Geriatr Soc* 2009;57:1306–8.
67. Penninx BW, Guralnik JM, Ferrucci L, Simonsick EM, Deeg DJ, Wallace RB. Depressive symptoms and physical decline in community-dwelling older persons. *J Am Med Assoc* 1998;279:1720–6.
68. Ribeiro MV, Hasten-Reiter Junior HN, Ribeiro EA, Juca MJ, Barbosa FT, Sousa-Rodrigues CF. Association between visual impairment and depression in the elderly: a systematic review. *Arq Bras Oftalmol* 2015;78:197–201.
69. Choi HG, Lee MJ, Lee SM. *Visual impairment and risk of depression: a longitudinal follow-up study using a national sample cohort*, vol. 8; 2018. p. 2083.
70. Carabellese C, Appollonio I, Rozzini R, Bianchetti A, Frisoni GB, Frattola L, et al. Sensory impairment and quality of life in a community elderly population. *J Am Geriatr Soc* 1993;41:401–7.
71. Brown RL, Barrett AE. Visual impairment and quality of life among older adults: an examination of explanations for the relationship. *J Gerontol B Psychol Sci Soc Sci* 2011;66:364–73.
72. Mangione CM, Gutierrez PR, Lowe G, Orav EJ, Seddon JM. Influence of age-related maculopathy on visual functioning and health-related quality of life. *Am J Ophthalmol* 1999;128:45–53.
73. Rein DB, Wirth KE, Johnson CA, Lee PP. Estimating quality-adjusted life year losses associated with visual field deficits using methodological approaches. *Ophthalmic Epidemiol* 2007;14:258–64.
74. Coyne JC. Self-reported distress: analog or Ersatz depression? *Psychol Bull* 1994;116:29–45.
75. Clak DA, Beck AT. *Scientific foundations of cognitive theory and therapy of depression*. Hoboken: John Wiley & Sons Inc; 1999.

76. Townsend N, Bhatnagar P, Wilkins E, Wickramasinghe K, Rayner M. *Cardiovascular disease statistics*. London: British Heart Foundation; 2015.
77. Hirai A, Takata M, Mikawa M, Yasumoto K, Iida H, Sasayama S, et al. Prolonged exposure to industrial noise causes hearing loss but not high blood pressure: a study of 2124 factory laborers in Japan. *J Hypertens* 1991;9:1069–73.
78. Chang TY, Liu CS, Huang KH, Chen RY, Lai JS, Bao BY. High-frequency hearing loss, occupational noise exposure and hypertension: a cross-sectional study in male workers. *Environ Health* 2011;10:35.
79. Wang WL, Chen N, Sheu MM, Wang JH, Hsu WL, Hu YJ. The prevalence and risk factors of visual impairment among the elderly in Eastern Taiwan. *Kaohsiung J Med Sci* 2016;32:475–81.
80. Weeks DG, Michela JL, Peplau LA, Bragg ME. Relation between loneliness and depression: a structural equation analysis. *J Pers Soc Psychol* 1980;39:1238–44.
81. Hawton A, Green C, Dickens AP, Richards SH, Taylor RS, Edwards R, et al. The impact of social isolation on the health status and health-related quality of life of older people. *Qual Life Res Int J Qual Life Aspects Treat Care Rehabil* 2011;20:57–67.
82. Gibson WK, Cronin H, Kenny RA, Setti A. Validation of the self-reported hearing questions in the Irish longitudinal study on ageing against the whispered voice test. *BMC Res Notes* 2014;7:361.
83. Zimdars A, Nazroo J, Gjonca E. The circumstances of older people in England with self-reported visual impairment: a secondary analysis of the English Longitudinal Study of Ageing (ELSA). *Br J Vis Impair* 2012;30:22–30.
84. Popelka MM, Cruickshanks KJ, Wiley TL, Tweed TS, Klein BE, Klein R. Low prevalence of hearing aid use among older adults with hearing loss: the Epidemiology of Hearing Loss Study. *J Am Geriatr Soc* 1998;46:1075–8.
85. Evans BJ, Rowlands G. Correctable visual impairment in older people: a major unmet need. *Ophthalmic Physiol Optic J Bri Coll Ophthalmic Opticians (Optometrists)* 2004;24:161–80.