

Psychotic Symptoms and Sensory Impairment: Findings from the 2014 Adult Psychiatric Morbidity

Survey

Running Title: Sensory Impairment and Psychotic Symptoms

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Abstract Word Count:

Text body word count:

Abstract

Purpose

Psychosis is reportedly associated with hearing and visual impairment. The mechanisms for this are poorly understood. Using data from the 2014 English Adult Psychiatric Morbidity Survey, we hypothesised: that hearing and visual impairments would be associated with psychotic symptoms; that the probability of psychotic symptoms would be related to the severity of impairment; and that these associations would be partly explained by reduced social fulfilment.

Methods

We analysed cross-sectional data using logistic regression. Visual and auditory impairment comprised the exposures, while screening positive on the Psychosis Screening Questionnaire (PSQ) was the outcome. We used structural equation modelling to assess mediation by social fulfilment, measured by the Social Functioning Questionnaire.

Results

Screening positive on the PSQ was strongly associated with visual impairment overall (Adjusted Odds Ratio (AOR) 1.81, 95% Confidence Intervals (CI) 1.33 to 2.44), but especially with moderate visual impairment (AOR 2.75, 95% CI 1.78 to 4.24, $p < 0.001$). Psychotic symptoms were associated with a severe degree of hearing impairment (AOR 4.94, 95% CI 1.66 to 14.67, $p = 0.004$), but less so with hearing impairment overall (AOR 1.50, 95% CI 1.10 to 2.04, $p = 0.010$). Social functioning accounted for approximately 50% of associations with both types of sensory impairment, though confidence intervals were broad.

Conclusions

Our findings support a relationship between psychotic symptoms and visual impairment (particularly moderate impairment), and a linear association between psychosis and hearing impairment. Social functioning may mediate these relationships and so form an adjunctive target for intervention, alongside sensory correction. These associations should be investigated longitudinally.

Key words: Psychotic symptoms, visual impairment, hearing impairment, social fulfilment

Introduction

In the UK, one in eight people has impaired hearing¹. This increases with age, as age-related cochlea damage is the single greatest cause^{1,2}. Hearing impairment, defined as an inability to hear sounds softer than 40 decibels, can have a major impact on social participation¹. There are also nearly two million people living with sight loss in the UK, of whom around 360,000 are registered blind or partially sighted³. The World Health Organisation (WHO) defines visual impairment as a visual acuity of less than 0.3 or a visual field of below 30 degrees⁴.

Psychotic symptoms may be sufficient to meet diagnostic criteria for a psychotic disorder or fall below the required threshold. A 2016 systematic review found that people with hearing impairment were at greater risk of psychotic symptoms than those without hearing impairment⁵. One study found an age-specific association between hearing impairment and psychosis due to disruption during a critical developmental phase in early adolescence⁶. It has been postulated that more severe and chronic hearing impairment might carry the greatest risk of psychosis^{7,8}. The degree to which impairment is reversible with aids might also alter its impact on psychosis⁷. There are case reports of new onset auditory hallucinations emerging when hearing declines⁹, sometimes improving or resolving when hearing aids are introduced^{10,11}. Some studies found no association between hearing impairment and psychotic symptoms, albeit in small samples^{8,12}. The few studies reporting reduced odds of psychosis in hearing impaired people included very small numbers of participants with psychotic disorders¹³⁻¹⁵.

A 2013 WHO survey of over 20,000 people showed that people with visual problems had increased odds of psychotic symptoms¹⁶. Both near and distance visual impairment have been implicated¹⁷. In one study, one-eighth of middle-aged, severely mentally ill patients with schizophrenia, bipolar mood disorders and major depression had distance visual impairment¹⁸. This was towards the higher end of the estimated range for the local population.

Several competing hypotheses exist to explain the apparent association between sensory impairment and psychosis. Such impairment could be a biomarker of psychotic illness, as oxidative stress, NMDA receptor damage and deafferentation have all been noted to underlie both low-level sensory deficits and schizophrenia¹⁹. A few studies suggest an association between schizophrenia and reduced retinal fibre layer thickness^{20, 21} and visual processing abnormalities^{22, 23}. Visual problems are also a known side effect of antipsychotic medication and might therefore be an indirect result of psychosis.

Alternatively sensory impairment might cause psychosis. Short-term sensory deprivation can induce psychotic symptoms in healthy individuals^{24 9}. There is some early evidence implicating visual difficulties in the aetiology of psychotic symptoms. Thus a recent longitudinal study of over 1,000,000 Swedish military conscripts showed that men with severe visual impairment had an increased risk of subsequently being diagnosed with a psychotic disorder²⁵.

An absence of known cases of schizophrenia in congenitally cortically blind individuals has led to a proposed 'Protection against Schizophrenia' (PaSZ) model²⁶. This suggests that the incorrect interpretation of visual information caused by partial visual impairment may increase the risk of schizophrenia; in contrast, perfect and absent vision protect against it²⁶. This model is supported by evidence from one²⁵, but not a second observational study²⁷ and to our knowledge there is no other evidence to support it. In contrast there are many reported cases of psychosis occurring in profound congenital hearing impairment, so the theory that severe sensory impairment may be protective is not supported in relation to hearing²⁸.

Another possible explanation for an association between sensory impairments and psychosis is that sensory impairment reduces opportunities for social participation, thereby increasing social isolation and loneliness, and increasing the risk of developing psychosis⁵. Both visual and hearing impairments may contribute to loneliness, depression and reduced social participation in older

adults ²⁹⁻³³, while younger adults may experience discrimination and reduced educational, social and occupational opportunities ³⁴.

These considerations led us to examine the relationship between sensory impairment and psychosis.

Specifically we hypothesised that:

1. People with hearing or visual impairment would be more likely to report psychotic symptoms than people without such impairments, and this would correspond to the degree of impairment.
2. The association between sensory impairment and psychotic symptoms would be mediated by reduced social fulfilment.

This is, to our knowledge, the first study to test whether reduced social fulfilment is a mechanism linking sensory impairment to psychotic symptoms; and to assess whether the level of symptoms is associated with visual impairment in a dose-dependent manner in a nationally representative sample.

Methods

Sample

The UK Adult Psychiatric Morbidity Survey (APMS) is a cross-sectional household survey, conducted every 7 years since 1993³⁵. Questions on sensory impairment were included for the first time in the most recent (2014) survey. This involved interviews with 7,546 members of the general English population aged over 16³⁵. It was a stratified, multi-stage probability sample. Participants were selected randomly from households, which themselves had been randomly selected from postal areas stratified according to socioeconomic variables. The response rate was 57%. Data are weighted to account for non-response and selection probability. Permission to use the data for the current study was granted by *NHS Digital*.

Outcome Measures

The Psychosis Screening Questionnaire (PSQ) is a screening tool for detecting the presence of psychotic symptoms³⁶. It had high sensitivity and specificity for identifying psychosis cases in a general practice sample³⁶. The original PSQ included clusters of questions each relating to 6 symptoms: hypomania, thought interference, persecution, perceptual abnormalities, 'strange experiences' and hallucinosis; 20 questions in total. In APMS the hypomania cluster was excluded, leaving 5 clusters and 17 questions. Endorsing one or more clusters on the PSQ is indicative of the presence of clinically significant psychotic symptoms³⁷. We considered individuals as experiencing psychotic symptoms if any one cluster was endorsed; this required a specific answer to more than one question.

Exposure variables

Participants were asked whether they had difficulty hearing or wore a hearing aid as a single question with a yes/no response, thus providing a binary exposure variable. We also analysed the severity of hearing impairment as a second exposure variable. Participants who responded yes to

the first question were asked: (*With your hearing aid*) how would you describe your difficulty hearing? - *No difficulty, mild difficulty, moderate difficulty, severe difficulty, or cannot do*. We combined the *severe difficulty* and *cannot do* categories in order to increase statistical power and precision of estimates.

People were also asked how much difficulty they had reading a newspaper (near vision impairment), and seeing a face across the room (distance vision impairment), even with visual aids. They gave their answers as a degree of difficulty on a Likert scale (again *no difficulty, mild difficulty, moderate difficulty, severe difficulty, or cannot do*). We combined the near and distance categories of visual impairment, recording the more severe degree of visual impairment from either category. Again we combined the *severe* and *cannot do* categories, analysing the presence of any degree of visual impairment as a binary exposure variable, and the degree of visual impairment as a second exposure.

Potential mediator

Reduced social fulfilment was analysed as a potential mediator of the relationship between sensory impairment and psychotic symptoms (Figure 1). The Social Functioning Questionnaire (SFQ) is a validated eight-item scale measuring perceived social functioning on a score ranging from 0 to 24³⁸. Lower scores represent better functioning. Feelings of loneliness, stress, relationships, and enjoyment of leisure time are among the items covered. The total SFQ score was used as a proxy continuous measure of social fulfilment.

Confounders

As potential confounding variables in the models testing associations between sensory impairment and psychosis we included age (in 10 year brackets), gender, and ethnicity, together with housing tenure and highest educational qualification (as markers of socioeconomic status). Ethnicity was coded as White British, White Other; Black / African / Caribbean / Black British; Asian / Asian British,

or mixed/multiple ethnic groups/other ethnic groups. The highest educational qualification was coded as Degree/ Teaching / Higher National Diploma / Nursing, A Level, GCSE or equivalent, Foreign/other, or No Qualifications. Tenure was coded as *owned outright, buying with a mortgage or loan, paying part rent and part mortgage (shared ownership), rental, living rent free, or squatting*. We also included the Alcohol Use Disorders Identification Test (AUDIT) score³⁹. These variables were included as potential confounders if they were differentially distributed among those exposed and unexposed and those with and without the outcome, or if they had been previously recognised to be associated with the exposure and outcome and not on the causal pathway.

Sensitivity Analyses

We did not adjust for estimated verbal IQ in our main analyses, because this would have restricted the analytic sample to native English speakers only⁴⁰. We ran separate analyses adjusting for this. We did not adjust for current use of antipsychotic medication in the main analyses, as this is a result of the outcome, but we performed a separate sensitivity analysis when visual impairment was the exposure variable. We also performed a sensitivity analysis in which participants who reported screening positive on the PSQ purely due to the presence of auditory or visual hallucinations were removed from the analytic sample, in order to exclude the possibility that hallucinations resulting directly from sensory deprivation were the sole driver of the association. We also separately tested for an interaction between age (in 10 year brackets) and sensory deprivation in relation to PSQ results, in case older and younger people were affected differently by sensory impairment. Finally, we performed a sensitivity analysis in which reports of having received a diagnosis of psychosis or schizophrenia was the outcome.

Statistical Analysis

We undertook *complete case* analyses in Stata version 15⁴¹. The weighting used in the original APMS survey was preserved in our study using the Stata *svy* command. Where missing data meant that a stratum contained only one primary sampling unit, the observations within that unit were moved to

an adjacent stratum to allow the variation within each stratum to be calculated⁴². This was essential to preserve the weighting without loss of data. We report weighted percentages, but unweighted absolute numbers. We explored differences between those with and without missing data.

We used logistic regression to assess whether people with hearing or visual impairment (as binary exposures) had increased odds of screening positive on the PSQ relative to those without. The exposure variable was presence either of hearing impairment or of visual impairment. The outcome was whether the participant screened positive on the PSQ.

We also carried out logistic regressions with the degree of hearing or visual impairment as separate exposures and screening positive on the PSQ as the outcome. Univariable models were run initially, followed by multivariable models including relevant confounding variables.

Finally, we built structural equation models using the Stata *gsem* command, appropriate for binary outcomes, to test to what extent reduced social fulfilment might account for the associations between sensory impairment and screening positive on the PSQ. An estimated percentage mediation was obtained by dividing the indirect effect of the exposure on the outcome, via the mediator, by the total effect of the exposure on the outcome (including any direct effect). We used additive log coefficients in these calculations, but present their exponentials in the results section.

Results

Sample Demographics

Of 7546 people who participated in the AMPS, 7107 provided all relevant data and constitute the analytic sample. Table 1 shows the demographic characteristics of this sample according to sensory impairment. 435 (6.4%) screened positive on the PSQ. Hearing impairment was reported by 1207 (14.3%), while 934 (11.9%) reported visual impairment, and 241 (2.6%) reported both.

People with sensory impairment were more likely to be aged over 65 and widowed, and less likely to have a degree.

Of people in the sample, 45 (<0.1%) reported having been diagnosed with schizophrenia or psychosis at some time. 53.4% of this group screened positive on the PSQ, compared to 6.2% reporting no diagnosis of psychosis.

Missing Data

Participants with missing data were less likely to be aged over 65 (37% vs 20.8%). They were slightly less likely to be Asian or Asian British (3.8% vs 7.1%), and more likely to be from a mixed or 'other' ethnic group (4.8% vs 2.5%). They were more likely to have no qualifications (34.1% vs 19.7%), and to own their home outright (41.6% vs 31%). A similar proportion of people excluded from the analytic sample, relative to those included, scored positive on the PSQ (5.5% with missing data vs 6.4% without). People with missing data were more likely to report hearing impairment (23.1% vs 14.3%) and visual impairment (18.7% vs 11.9%).

A further 242 people were excluded from the mediation analysis because they had not completed the SFQ.

Visual Impairment and Psychosis

We found evidence of an association between visual impairment and a positive PSQ result, even after controlling for potential confounders ((Adjusted Odds Ratio (AOR) 1.81, 95% confidence intervals (CI) 1.33 - 2.44, $p < 0.001$). (Table 2). When levels of impairment were analysed, we found strongest evidence that moderate visual impairment was associated with screening positive on the PSQ, including following adjustment (AOR 2.75, 95% CI 1.78 to 4.24, $p < 0.001$). There was weak evidence for an association with mild (AOR 1.49, 95% CI 0.99 to 2.24, $p = 0.054$), but not severe visual impairment (AOR 1.43, 95% CI 0.60 to 3.42, $p = 0.423$) (Table 3). The mediation analysis attributed 50% (95% CI 18% to 81%, $P = 0.002$) of the association between visual impairment and psychotic experiences to reduced social fulfilment (Table 4).

Hearing Impairment and Psychosis

There was weak evidence for an association between any hearing impairment and screening positive on the PSQ following adjustment for potential confounders (AOR 1.50, 95% CI 1.10 to 2.04, $p=0.010$) (Table 2). Severe hearing impairment was significantly associated with screening positive on the PSQ, although the confidence intervals were wide (AOR 4.94, 95% CI 1.66 to 14.67, $p=0.004$). We found weak evidence that mild hearing impairment was associated with a positive PSQ result (AOR 1.59, 95% CI 1.07 to 2.35, $p=0.022$), but evidence for an association with moderate hearing impairment fell short of conventional levels of significance despite the odds ratio being very similar (AOR 1.56, 95% CI 0.92 to 2.64, $p=0.097$). Odds of psychosis were highest in severe hearing impairment (Table 3).

Mediation analysis suggested that reduced social functioning accounted for 42% of the association between any hearing impairment and PSQ result, although the 95% confidence intervals were wide (95% CI 5% to 79%, $p=0.026$). (Table 4)

Sensitivity Analyses

Adjustment for estimated verbal IQ slightly weakened the evidence of association between mild visual impairment and PSQ (OR 1.39, 95% CI 0.90 to 2.15, $p=0.137$). It weakened the evidence of an association between PSQ and mild hearing impairment (OR 1.28, 95% CI 0.85 to 1.93, $p=0.235$), and hearing impairment overall (OR 1.36, 95% CI 1.00 to 1.87, $p=0.053$). It strengthened the evidence of association between moderate hearing impairment and PSQ (OR 1.71, 95% CI 1.02 to 2.88, $p=0.043$). Of note, there were no participants with an intellectual disability (estimated verbal IQ lower than 70) in the sample.

Adjusting for whether participants reported currently using antipsychotic medications did not alter the adjusted results in which vision was the exposure variable.

Excluding participants who screened positive on the PSQ solely due to reporting hallucinations did not markedly affect the associations with presence of overall visual impairment. It did however

slightly weaken the association of severe hearing impairment with screening positive on the PSQ (AOR 4.01, 95% CI 1.23 to 13.06, $p=0.021$), and reduced the strength of association with hearing impairment overall (AOR 1.47, 95% CI 1.06 to 2.05, $p=0.022$). It markedly weakened the association between mild visual impairment and screening positive on the PSQ (AOR 1.38, 95% CI 0.90 to 2.11, $p=0.145$).

There was no evidence of association between either hearing or visual impairment and reporting a diagnosis of schizophrenia or psychosis.

There was also no evidence of an interaction between age and sensory impairment in influencing PSQ result.

Discussion

Main Findings

We found evidence that visual impairment was associated with screening positive on the PSQ, and moderate visual impairment was more strongly associated than a mild or severe degree. This association was driven purely by hallucinosis. Over half of the association between visual impairment and psychotic symptoms could be accounted for by poorer social fulfilment. While hearing impairment overall was weakly associated with screening positive on the PSQ, the association was stronger with greater impairment of hearing.

Comparison with Existing Literature

Our finding that hearing impairment is associated with psychosis is consistent with previous literature⁵. Our finding that severe hearing impairment is the most strongly associated is consistent with a straightforward, linear relationship between psychosis and hearing impairment.

The finding that visual impairment overall is associated with psychosis accords with results from three previous longitudinal studies^{25, 43, 44}, but is at odds with a study of over 600,000 Israeli military conscripts. The latter found refractive errors to be associated with a *reduced* risk of later schizophrenia²⁷. This may be because the prevalence of refractive error in that sample was lower than would usually be expected²⁵. This was also a young sample, who may have been affected differently to the older population with sensory impairment in the APMS sample. The finding that moderate visual impairment is the most strongly associated is at odds with the concept of a dose-response relationship, and may be explained in several ways. If visual impairment is a biomarker of psychosis, then perhaps the pathological process involved does not cause eyesight to deteriorate to a severe level. If it is a consequence of the treatment or reduced ability for self-care, then again this may be the case. Alternatively, this finding is consistent with the 'Protection against Schizophrenia' model whereby reduced or absent vision are protective against schizophrenia. Lastly, the

participants with the most severe visual impairment reported greater median social fulfilment than those with moderate impairment; so mediation by social functioning remains plausible.

Strengths and Limitations

Strengths of this study include the large, nationally representative sample and adjustment for a broad range of potential confounders. The inclusion of people who were not in contact with clinical services widens the remit of the investigation. The use of a screening tool for psychosis also meant that we examined a broad population. Our study included females, unlike the two large studies of military conscripts described above ^{25, 27}.

There are a number of limitations. Our analyses were cross-sectional, so we cannot determine temporal association between the outcome, exposure and mediator. We cannot therefore cannot draw any firm conclusions as to whether sensory impairments are a cause of psychosis, a biomarker, or even a consequence of people with psychosis having poorer general health. It is also possible that the nature of the association is bidirectional.

In addition, sensory impairment was self-reported rather than objectively assessed by ophthalmological or audiology services. This might have affected the validity of the measurement. People with psychotic symptoms may be less able to assess their own sensory capabilities accurately, for example if they perceive their vision to be worse than it is due to visual processing difficulties, or if they have less contact with other people and therefore do not realise they are less able to hear speech. The same may apply to social fulfilment.

We do not know how many participants had congenital versus acquired sensory impairment, and these have been shown to be differently associated with psychosis ²⁸. Neither did we know how many people in our study were British Sign Language (BSL) users. Using sign language early on in the family environment facilitates the development of language as well as psychosocial and emotional development in deaf children, which might protect against mental health problems ⁴⁵.

Being a household survey, the APMS excludes people who have been hospitalised due to severe psychotic illness or who live in hostels, or were unable or unwilling to participate as a result of psychosis. This might have introduced a selection bias leading to an underestimation of associations between psychosis and sensory impairment. It has been estimated that people living in communal establishments make up fewer than 2% of the overall UK population, so the effect of this should have been minimal³⁵. People with significant sensory impairment might also have been less likely to participate in the survey. As the group of APMS participants excluded from our study due to missing data had a slightly higher rate of psychosis, this might have reduced the association. However, the number of people unable to participate is likely to have been small. An unavoidable limitation of our study is the relatively small number of participants with severe sensory impairments. Consequently, some of our estimates of association lacked precision. For example, while we found an increasing odds of psychosis risk in groups with mild, moderate and severe hearing impairment, confidence intervals for these estimates overlapped.

Although we have made efforts to include all relevant confounders, residual confounding is always possible in observational studies. For example, cognitive impairment was not measured in participants aged under 60 and therefore could not be included⁴⁶.

Lastly, the confidence intervals around the estimates for the percentage of the association between hearing and visual impairments and screening positive on the PSQ that was mediated by social fulfilment were very wide.

Implications

Our results suggest that visual impairment, particularly moderate impairment, is associated with psychotic symptoms. These results are more consistent the 'Protection against Schizophrenia' (PaSZ) model, whereby moderate visual impairment might carry the highest risk of psychosis, than with a linear dose response relationship²⁶. This remains inconclusive however, as we do not report data on congenitally blind individuals. More longitudinal research is needed to establish whether correcting

refractory errors and increasing uptake of hearing aids, and otherwise reducing the incidence of sensory impairment are credible interventions for reducing the impact of psychosis. Regardless, these associations highlight the importance of assisting people with psychosis to attend opticians' and audiology appointments and address conditions that may cause sensory impairment.

Reduced social fulfilment might be one mechanism underlying a relationship between sensory impairments and psychosis: this finding requires to be tested in longitudinal studies. Social isolation and loneliness affect many people with mental illness, and may be preventable or amenable to modification through increasing social connection and support.

Acknowledgements

Supported by the University College London Hospital National Institute of Health Research Biomedical Research Centre.

Permission to use data from the 2014 Adult Psychiatric Morbidity Survey was granted by NHS Digital.

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Table 1: Sociodemographics of analytic sample

Characteristic N=7107	No hearing Impairment	Hearing Impairment	No Visual Impairment	Visual Impairment
	n (Weighted %)	n (Weighted %)	n (Weighted %)	n (Weighted %)
Total (and % of total sample)	5900 (85.7%)	1207 (14.3%)	6173 (88.1%)	934 (11.9%)
Number scoring Positive on Psychosis Screening Questionnaire (PSQ)	368 (6.4%)	67 (6.3%)	348 (5.9%)	87 (9.6%)
Male	2280 (47.8%)	594 (55.2%)	2509 (49.1%)	365 (47.4%)
Aged over 65	1330 (15.9%)	713(50.2%)	1662 (19.3%)	378 (32.0%)
Ethnicity				
White British	4928 (79.2%)	1112 (89.6%)	5216 (80.2%)	824 (84.1%)
Any Other Ethnic Background	972 (20.8%)	95 (10.4%)	957 (19.8%)	110 (15.8%)
Marital Status				
Married or cohabiting	3303 (61.7%)	645 (65.1%)	3521 (63.0%)	427 (56.4%)
Single	1355 (26.3%)	138 (12.2%)	1314 (24.7%)	179(21.3%)
Divorced or separated	761 (7.6%)	162 (9.0%)	765 (7.4%)	158 (10.8%)
Widowed	481 (4.4%)	262 (13.8%)	573 (5.0%)	170 (11.6%)
Highest Educational Qualification				
Degree	1533 (26.7%)	210 (19.5%)	1576 (26.6%)	167 (19.1%)
Teaching / Higher National Diploma / nursing	485 (7.8%)	95 (7.9%)	509 (7.9%)	71 (7.3%)
A levels	1000 (19.4%)	153 (14.5%)	1041 (19.4%)	112 (14.0%)
GCSE or equivalent	1457 (25.8%)	227 (20.2%)	1466 (24.9%)	218 (25.8%)
Foreign / other	180 (2.6%)	71 (5.6%)	211 (3.0%)	40 (3.5%)
No qualifications	1245 (17.6%)	451 (32.5%)	1370 (18.3%)	326 (30.3%)
Tenure				
Own Outright	1908 (27.8%)	651 (49.8%)	2201 (30.7%)	358 (32.8%)
Buying with help of mortgage or loan / shared ownership scheme	1925 (35.2%)	207 (22.3%)	1922 (34.3%)	210 (26.6%)
Renting	1897 (32.9%)	318 (25.3%)	1876 (31.2%)	339 (36.2%)
Living rent-free (including squatting)	170 (4.1%)	31 (2.7%)	174 (3.8%)	27 (4.4%)
Currently Taking Antipsychotic Medications	66 (1.0%)	18 (1.3%)	58 (0.8%)	26 (2.3%)
Alcohol Use Disorders (AUDIT) score*	4.2 (4.6)	3.7 (4.2)	4.1 (4.4)	4.0 (5.3)
Verbal Intelligence Quotient (IQ)*	103.4 (15.3)	102.9 (16.2)	103.7 (15.1)	100.5 (17.1)
Social Functioning Questionnaire (SFQ) Score*	4.2 (3.5)	3.9 (3.4)	4.0 (3.4)	5.1 (4.1)
Reported having ever been diagnosed with psychosis or schizophrenia	31 (<0.1%)	6 (<0.1%)	29 (<0.1%)	8 (<0.1%)

This is the analytic sample for the primary analyses.

n = Number in group (unweighted)

Weighted % = percentage of group weighted

*For these variables, the mean (standard deviation) is shown.

Table 2: Odds ratios with 95% Confidence Intervals for Screening Positive on the Psychosis Screening Questionnaire (PSQ) according to Presence of Hearing and Visual Impairment

Type of Sensory Impairment n=7107	Unadjusted Odds Ratio relative to no difficulty (95% CI)	P-value	Adjusted Odds Ratio relative to no difficulty (95% CI)	P-Value
Hearing Impairment	0.98 (0.74 to 1.31)	0.911	1.50 (1.10 to 2.04)	0.010
Visual Impairment	1.68 (1.26 to 2.24)	<0.001	1.81 (1.33 to 2.44)	<0.001

*Adjusted for age (in 10 year brackets), gender, ethnicity, highest educational qualification, tenure and Alcohol Use Disorders Identification Test (AUDIT) score.

n=Total number of participants in analysis.

Table 3: Odds of Screening Positive on Psychosis Screening Questionnaire (PSQ) by Degree of Sensory Impairment

Degree of Sensory Impairment	Unadjusted Odds Ratio relative to no difficulty (95% CI)	P-value	*Adjusted Odds Ratio relative to no difficulty (95% CI)	P-Value
Hearing Impairment				
No Difficulty (Reference Category) N=6116	1		1	
Mild Difficulty n=630	1.10 (0.75 to 1.60)	0.630	1.59 (1.07 to 2.35)	0.022
Moderate Difficulty N=310	0.94 (0.58 to 1.53)	0.800	1.56 (0.92 to 2.64)	0.097
Severe Difficulty or Cannot do N=51	2.36 (0.87 to 6.39)	0.091	4.94 (1.66 to 14.67)	0.004
Visual Impairment				
No Difficulty (Reference Category) N=6173	1		1	
Mild Difficulty N=519	1.45 (0.97 to 2.16)	0.070	1.49 (0.99 to 2.24)	0.054
Moderate Difficulty N=274	2.45 (1.62 to 3.71)	<0.001	2.75 (1.78 to 4.24)	<0.001
Severe Difficulty or Cannot do N=141	1.20 (0.56 to 2.59)	0.637	1.43 (0.60 to 3.42)	0.423

*Adjusted for age, gender, ethnicity, employment type, highest educational qualification, housing tenure and Alcohol Use Disorders Identification Test (AUDIT) score.

n=Total number of participants in analysis.

Table 4: Mediation Analysis: Assessment of Mediation of Association of Visual Impairment with Odds of Screening Positive on Psychosis Screening Questionnaire (PSQ) as Binary Outcome by Social Functioning Questionnaire (SFQ) Score

Analytic Sample n=6865	Unadjusted Odds Ratio in Visual Impairment (95% Confidence Interval)	P-value	Adjusted* Odds Ratio in Visual Impairment (95% Confidence Interval)	P-value
Total effect of Visual Impairment on Odds of Positive PSQ Screen	1.59 (1.14 to 2.22)	0.006	1.78 (1.28 to 2.48)	0.001
Indirect effect via SFQ score	1.31 (1.21 to 1.42)	<0.001	1.33 (1.24 to 1.43)	<0.001
Direct effect of Visual Impairment on Odds of Positive PSQ Screen	1.22 (0.86 to 1.72)	0.261	1.34 (0.95 to 1.89)	0.095
	Unadjusted Odds Ratio in Hearing Impairment (95% Confidence Interval)	P-value	Adjusted* Odds Ratio in Hearing Impairment (95% Confidence Interval)	P-value
Total effect of Hearing Impairment on Odds of Positive PSQ Screen	0.99 (0.72 to 1.35)	0.937	1.45 (1.05 to 2.00)	0.024
Indirect effect via SFQ score	0.98 (0.92 to 1.04)	0.524	1.17 (1.10 to 1.24)	<0.001
Direct effect of Hearing Impairment on Odds of Positive PSQ Screen	1.01 (0.74 to 1.37)	0.963	1.24 (0.90 to 1.70)	0.186

*Direct effect of sensory impairment on Psychosis Screening Questionnaire (PSQ) result adjusted for age, gender, ethnicity, highest educational qualification, housing tenure, and Alcohol Use Disorders Identification Test (AUDIT) score.

Effect of sensory impairment on SFQ result adjusted for age, gender, ethnicity, highest educational qualification, housing tenure, and Alcohol Use Disorders Identification Test (AUDIT) score.

Effect of SFQ score on PSQ result adjusted for age, gender, ethnicity, housing tenure and Alcohol Use Disorders Identification Test (AUDIT) score.

n= Number in analysis

Total effect = Combined estimated direct effect of sensory impairment on odds of screening positive on PSQ + indirect effect mediated by SFQ score

Indirect effect = Estimated effect of sensory impairment on odds of screening positive on PSQ via effect on SFQ score

Direct effect = Estimated direct effect of sensory impairment on odds of screening positive on PSQ (not via SFQ score)

Estimated degree of mediation was obtained by dividing the indirect effect by the total effect.

Figure 1: Mediation Model

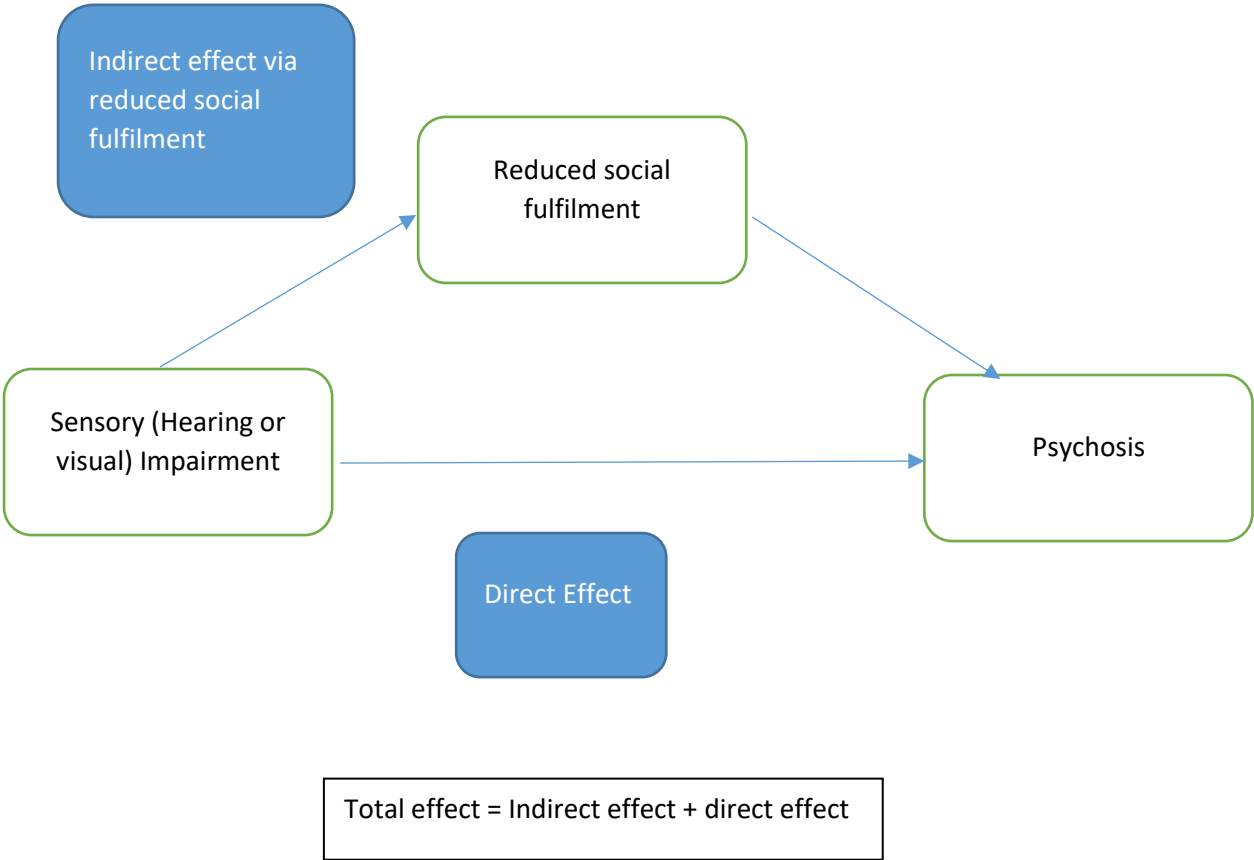


Figure 2: Missing Data
(Could be supplementary)

