

# Biopsychosocial Classification of Hearing Health Seeking in Adults Aged Over 50 Years in England

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**Objectives:** Approximately 10 to 35% of people with a hearing impairment own a hearing aid. The present study aims to identify barriers to obtaining a hearing aid and inform future interventions by examining the biopsychosocial characteristics of adults aged 50+ according to 7 categories: (i) Did not report hearing difficulties, (ii) Reported hearing difficulties, (iii) Told a healthcare professional about experiencing hearing difficulties, (iv) Referred for a hearing assessment, (v) Offered a hearing aid, (vi) Accepted a hearing aid, and (vii) Reported using a hearing aid regularly.

**Design:** The research was conducted using the English Longitudinal Study of Aging wave 7 with data obtained from 9666 adults living in England from June 2014 to May 2015. Cross-sectional data were obtained from a subset of 2845 participants aged 50 to 89 years of age with a probable hearing impairment measured by hearing screening (indicating a hearing threshold of >20 dB HL at 1 kHz or >35 dB HL at 3 kHz in the better ear). Classification according to hearing health-seeking category was via participants' self-report. Participants in each category were compared with people in all subsequent categories to examine the associations between each category and biopsychosocial correlates (sex, age, ethnicity, educational level, wealth, audiometric hearing level, self-reported health status, cognitive performance, attitudes to aging, living alone, and engagement in social activities) using multiple logistic regression.

**Results:** The proportions of individuals (N = 2845) in categories i to vii were 40.0% (n = 1139), 14.0% (n = 396), 4.5% (n = 129), 4.0% (n = 114), 1.2% (n = 34), 7.7% (n = 220), and 28.6% (n = 813), respectively. Severity of hearing impairment was the only factor predictive of all the categories of hearing health-seeking that could be modeled. Other correlates predictive of at least one category of hearing health-seeking included sex, age, self-reported health, participation in social activities, and cognitive function.

**Conclusions:** For the first time, it was shown that 40.0% of people with an audiometrically identified probable hearing impairment did not re-

port hearing difficulties. Each of the five categories of hearing health-seeking that could be modeled had different drivers and consequently, interventions likely should vary depending on the category of hearing health-seeking.

**Key words:** Hearing aid, Hearing impairment, Help-seeking, Referral, Uptake, Use, Utilization.

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## INTRODUCTION

Hearing impairment is a growing problem due to an aging population (Action on Hearing Loss 2011). Hearing impairment is associated with negative health outcomes, including communication difficulties (Heine & Browning 2002), poorer quality of life (Royal National Institute for Deaf and Hard of Hearing People (RNID) 2006; Chia et al. 2007; Ferguson et al. 2017), lower self-rated health (Mulrow et al. 1990), cognitive decline (Lin et al. 2013), dementia (Loughrey et al. 2018), hospitalization (Genther et al. 2013), declines in physical functioning (Dalton et al. 2003), falls (Viljanen et al. 2009), depression, anxiety, loneliness, social isolation, and fatigue (Gopinath et al. 2009, 2012) and adverse impact on relationships with significant others (Schulz et al. 2017).

Hearing aids are the primary treatment for hearing loss (Action on Hearing Loss 2011) and there are two pathways to obtaining a hearing aid in England. One pathway is through consultation with a private hearing aid dispenser and purchase of a hearing aid at an average cost of around £2500 per pair (Action on Hearing Loss 2017). The other pathway is to obtain socially subsidized hearing aids via the National Health Service (NHS), which provides over 80% of hearing aids in the United Kingdom (Davis 2007). In the NHS hearing care pathway, the individual must inform their general medical practitioner (GP) of their hearing difficulties and be referred for a hearing assessment at an NHS audiology clinic (Action on Hearing Loss 2017). After attending an NHS audiology clinic, being assessed and recommended a hearing aid, hearing aids are provided, fitted, and maintained at no direct cost to the recipient.

Despite free access to hearing aids and the clear benefit of hearing aids in improving communication (Ferguson et al. 2017), individuals delay on average 8.9 years from the point that they first notice hearing difficulties to first seeking professional help (Simpson et al. 2019), perhaps due to stigma around hearing loss (David & Werner 2016). The rate of hearing aid use among those with a hearing impairment is low, with only 10 to 35% of adults with a hearing impairment using a hearing aid (Smeeth et al. 2002; Chia et al. 2007; Davis et al. 2007; Hartley et al. 2010; Bainbridge & Ramachandran 2014; Nieman et al. 2016). The low rate of hearing aid use among those with a hearing impairment has been attributed to multiple factors. People

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may not recognize that they have a hearing impairment because hearing loss is slow and gradual, or people may not be aware of the hearing services available or how to access them (National Institute on Aging 2017). Even when people do seek help and mention difficulties with a general practitioner, only 40 to 51% were referred by GPs for a hearing assessment (Davis et al. 2007; Wallhagen & Pettengill 2008; Schneider et al. 2010a). GPs may perceive hearing loss as a normal part of aging or may prioritize other health issues (Yueh et al. 2003; Wallhagen & Pettengill 2008), and not refer people who report hearing difficulties to audiology services (Davis et al. 2007; Schneider et al. 2010a). If people do access audiological services and are offered hearing aids, they may refuse them (Abdellaoui & Tran Ba Huy 2013). Even after having obtained hearing aids, people may not use them (Solheim et al. 2018). The primary aim of the present study was to provide a cross-sectional profile of the proportion of people 50 to 89 years of age with a hearing impairment who reported being at differing categories of hearing health-seeking, to identify barriers to hearing aid ownership and use.

Benova et al. (2014) proposed six categories of hearing health-seeking based on the English NHS hearing health care pathway to help understand socioeconomic inequalities in hearing health-seeking in England. Benova et al. analyzed data from wave 2 of the English Longitudinal Study of Aging ( $n = 8780$  adults aged 50 to 89 years old). Benova et al.'s six categories were "Self-reported hearing difficulties," "Told a healthcare professional," "Referred to ear specialist," "Hearing aid recommended," "Obtained a hearing aid," and "Using a hearing aid." Benova et al. found that disadvantaged socioeconomic position was associated with higher likelihood of self-reported hearing difficulties. Socioeconomic position was not associated with any category of hearing health-seeking except one: those from a more privileged socioeconomic position who reported experiencing hearing difficulties were less likely to have a hearing aid recommended. One potential limitation of Benova et al.'s study was the reliance on self-reported hearing loss to classify the study sample. In the absence of an audiometrically identified hearing impairment, Benova et al. were unable to consider a potentially vital category, namely, people with a hearing impairment who did not report any hearing difficulties. In the present study, behavioral assessment of hearing impairment allowed for consideration and inclusion of a seventh category of hearing health-seeking in addition to the six hearing health-seeking categories proposed by Benova et al. The novel category comprised individuals with a probable hearing impairment who reported no hearing difficulties (category i "Did not report hearing difficulties").

A second limitation of Benova et al.'s (2014) study was their focus on socioeconomic position, sex, and age as correlates of hearing health-seeking. The present study thus extends Benova et al.'s study by considering biopsychosocial correlates of hearing health-seeking in addition to social correlates. A review by Barnett et al. (2017) highlighted the importance of stigma as a barrier to hearing aid use, with people believing hearing aids are associated with old age and infirmity. We therefore included attitude to aging as one of the potential correlates of hearing health-seeking in this study. Other factors were selected based on previous research and included audiometric hearing level (Gatehouse 1994; Popelka et al. 1998; Hosford-Dunn & Halpern 2001; Hartley et al. 2010; Gopinath et al. 2011; Nash et al. 2013; Fisher et al. 2015; Moon et al. 2015), living situation

(Hickson et al. 1986, 1999), participation in social activities (Fisher et al. 2015; Fuentes-López et al. 2017), and cognitive function (Fisher et al. 2015) in addition to socioeconomic position, sex, and age (Benova et al. 2014).

The present study expands Benova et al.'s (2014) analysis of the categories of hearing health-seeking by (i) using behavioral assessment of hearing to identify those who have a hearing impairment irrespective of self-report and (ii) modeling a wider selection of potential correlates of hearing health-seeking including audiometric hearing level, living situation, participation in social activities and cognitive function. The primary aim was to identify the number of people at each of the categories, and the secondary aim was to identify correlates of each category to identify "high risk" groups and key predictors of each category of hearing health-seeking.

## MATERIALS AND METHODS

### Participants

This research was conducted using the English Longitudinal Study of Ageing (ELSA). The ELSA database contains information about wellbeing, health, social, lifestyle, and the economic situation of people aged 50 years and over living in England (Rogers et al. 2015). Invitation letters were sent randomly to households that had previously participated in the Health Survey for England in any or all the following years: 1998, 1999, and 2001 (Rogers et al. 2015). Figure 1 describes the selection of the sample. In wave 7, data were obtained from 9666 adults from England from June 2014 to May 2015. The response rate for wave 7 was 77% (Rogers et al. 2015). Ethical approval was granted for ELSA from the National Research and Ethics Committee (Nacsen Social Research 2012). The present study focused on a subset of 2845 respondents aged 50 to 89 years old who participated in wave 7 of ELSA who had a hearing impairment, as identified by the HearCheck Screener (Siemens, Munich, Germany).

### Measurements

Participants were interviewed at home, with information collected about participants' demographic characteristics, lifestyle, environmental factors, and medical information. Correlates of hearing health-seeking were selected for analysis in the present study based on previous research of the correlates of hearing health-seeking behavior (Knudsen et al. 2010; Meyer & Hickson 2012; Ng & Loke 2015). The potential correlates of hearing health-seeking included sex, age, ethnicity, educational level, wealth, audiometric hearing level (total tones heard for the better ear based on HearCheck performance—see later), self-reported health status, cognitive performance, attitudes to aging, living alone, and engagement in social activities.

### Categories of Hearing Health-Seeking

The categories of hearing health-seeking behavior were based on those identified by Benova et al. (2014). The present study added an extra initial category "Did not report hearing difficulties," which was based on participants identified as having a hearing impairment and who responded "no" to "Do you ever have any difficulties with your hearing?" The allocation of participants to one of the seven categories is described in Figure 2.

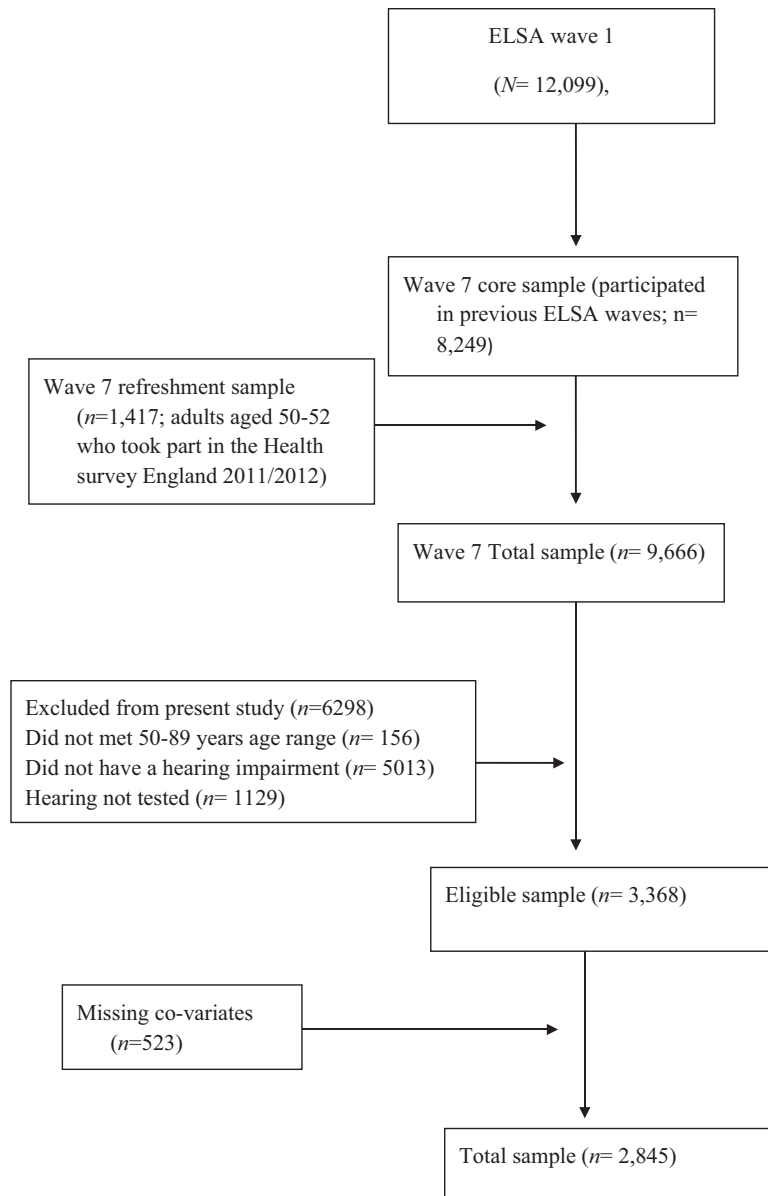


Fig. 1. Study sample selection. ELSA indicates English Longitudinal Study of Aging.

Number of adults aged 50 to 89 with an audiometrically identified hearing impairment who report being at various categories of hearing health-seeking.

### Audiometric Hearing Level

The HearCheck Screener (Siemens, MUnich, Germany) was used to index audiometric hearing level. Hearing testing with the HearCheck screener was carried out by trained interviewers at the participant's home. Otoscopy was not conducted. The HearCheck Screener involves presenting tones at two frequencies, with three intensities at each frequency (1 kHz; 20, 35, and 55 dB HL and 3 kHz; 35, 55, and 75 dB HL). Participants were asked to indicate when they hear a tone by raising their finger. The sensitivity and specificity of the HearCheck Screener was 90.9% and 95.4%, respectively, with reference to a hearing impairment at 40 dB HL (Fellizar-Lopez et al. 2011).

Hearing impairment is defined as hearing fewer than 6 tones, in the better hearing ear, indicating a hearing threshold of >20

dB HL at 1 kHz or >35 dB HL at 3 kHz in the better ear. Each ear was tested separately for approximately 30 seconds per ear. Hearing aid users completed the test without their hearing aids. The HearCheck Screener is described in greater detail by Davies et al. (2017).

### Socioeconomic Status, Age, and Sex

Socioeconomic status (SES) was measured using two variables, wealth, and education. Educational levels were categorized according to the individual's highest level of study. Participants who reported "degree or equivalent" were categorized "University or higher." Participants who reported an educational level lower than a "degree or equivalent" were categorized as "high school or lower." Participants who reported "no qualification" were categorized as "no qualification." Wealth was coded into quartiles using participants' total net financial wealth. Age and sex were coded for each participant. Ethnicity was recoded into white or non-white categories.

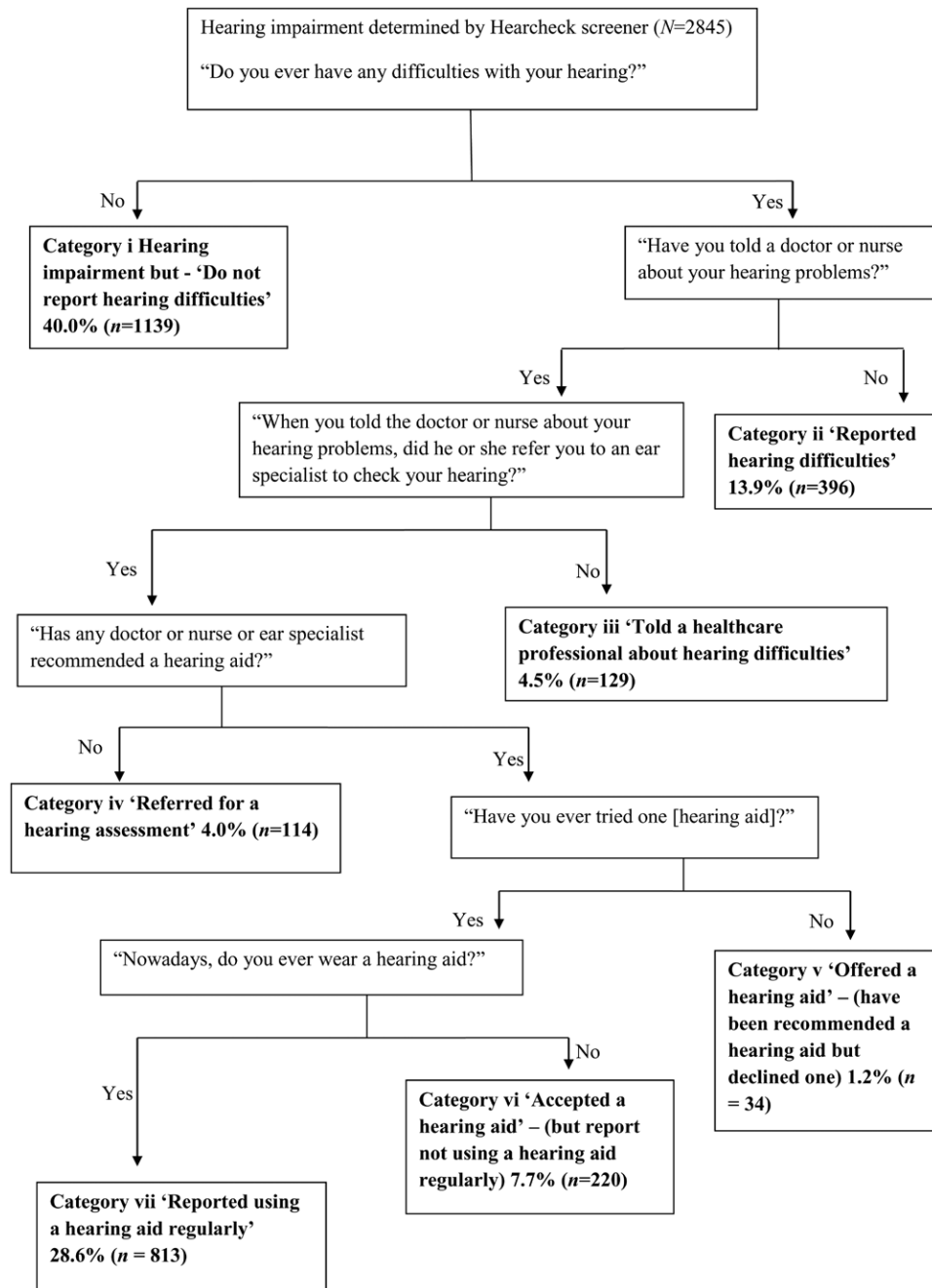


Fig. 2. Number of adults aged 50 to 89 with an audiometrically identified hearing impairment who report being at various categories of hearing health-seeking.

### Self-Reported Health

Self-reported health was measured by the response to a single item “Would you say your health is...?”. Participants were categorized based on their response “Excellent,” “Very good,” “Good,” “Fair,” or “Poor.”

### Cognitive Function and Attitudes Toward Ageing

An index of cognitive function was produced from a factor analysis of all the memory tests used in ELSA wave seven, consistent with previous studies which have constructed an index of cognitive function (Dawes et al. 2015; Sawyer et al. 2019a). The memory tests included were word list recall, animal naming,

backward counting from 20, serial sevens, naming objects and people, and word list recall repeat (detailed information may be found at [https://www.elsa-project.ac.uk/uploads/elsa/docs\\_w7/1\\_W7MS\\_Project%20Instructions\\_v1.pdf](https://www.elsa-project.ac.uk/uploads/elsa/docs_w7/1_W7MS_Project%20Instructions_v1.pdf)).

Attitudes toward aging were indexed in two ways. First, a summed score was obtained from the attitude to aging questionnaire (Demakakos et al. 2006), which consists of 12 items that ask about attitudes to aging scored on a Five-point Likert scale (e.g., “Old age is a time of ill-health”; strongly agree to strongly disagree). Negatively phrased items were recoded to a positive score by reversing the score. The full list of items is at <http://www.elsa-project.ac.uk/uploads/elsa/report06/ch11.pdf>. Participants were also asked “How old do you feel you are?”

and a response was given in years. The age participants felt was subtracted from the chronological age of participants to produce a score for perceived age relative to actual age.

### Living Alone and Participation in Social Activities

Living alone was categorized from the response to a question about the number of people living in the household. Participants who reported two or more people in the household were categorized as “living with others” and those who reported only one were categorized as “living alone.” Participation in social activities was indexed based on the number of responses to “Are you a member of any of these organizations, clubs, or societies?” (political party, trade union or environmental groups/tenants’ groups, resident groups, neighborhood watch/church or other religious groups/charitable associations/education, arts or music groups or evening classes(s)/sports clubs, gyms, exercise classes/any other organizations, clubs, or societies).

### Data Analysis

Analyses were performed using IBM SPSS version 22. The number of participants in each health-seeking category was calculated. Descriptive statistics (mean, SD, and frequency) on baseline participants’ biopsychosocial characteristics for each category were calculated. Spearman correlation coefficients were conducted to examine correlations between biopsychosocial factors and categories of hearing health-seeking.

Multivariate logistic regressions were used to model biopsychosocial correlates of each category of hearing health-seeking simultaneously. Participants in the target category were compared with those at all subsequent categories (e.g., participants in category ii were compared with participants in categories iii to vii) to identify correlates of those in the target category versus those who had progressed from the target category. Multivariate modeling of the final category “Reported using a hearing aid regularly” was not undertaken as this was the final category of hearing health-seeking with no later categories for comparison. The biopsychosocial correlates included sex, age, wealth, education, audiometric hearing level, self-reported health status, living alone, participation in social activities, attitude toward aging, age participant felt, and cognitive function. Nagelkerke  $r^2$  statistics were used to estimate the total variance explained by the correlates in the multivariate model for each of the categories of hearing health-seeking; values range from 0 to 1.0 and models that perfectly predict the outcome have an  $r^2$  of 1.0 (Nagelkerke 1991).

## RESULTS

### Proportion of Adults in Each Category of Hearing Health-Seeking

From the total participants in wave 7, 2845 were identified as having a probable hearing impairment (measured by the Hear-Check Screener). The largest proportion of participants were in the initial category (“Did not report hearing difficulties”), with 40.0% of those identified with a probable hearing impairment reporting they do not experience difficulties (Fig. 2). Only a small number of participants (ranging from 1 to 14%) were in categories ii to vi. The remaining 28.6% of participants reported regularly using their hearing aid. Of those who obtained a hearing aid, 22.4% reported no longer using their hearing aids.

Table 1 shows the characteristics of all participants and participants at each stage. In total, 49.6% of participants were male and 96.5% were from a White British background. Participant’s age ranged from 50 to 89 years old and the mean age was 72.12 years old (SD 9.13).

### Correlates of the Categories of Hearing Health-Seeking

The Nagelkerke  $r^2$  for the models ranged from 0.14 to 0.23, meaning the models explained 14 to 23% of the variance in membership of each stage versus later stages of health-seeking. Due to the small numbers of those in category v “Offered a hearing aid” and the requirement of a minimum of 10 cases per predictor to support multiple regression analysis (Concato et al. 1995), it was not possible to undertake multivariate modeling of “Offered a hearing aid.”

Sex was only associated with category i, individuals in category i “Did not report hearing difficulties” tended to be women (odds ratio [OR] = 0.68 [confidence interval {CI} = 0.55 to 0.84]) compared with individuals in later categories of health-seeking (Table 1). Individuals in category i “Did not report hearing difficulties” (OR = 0.98 [CI = 0.97 to 0.99]), category ii “Report hearing difficulties” (OR = 0.97 [CI = 0.95 to 0.99]), category iv “Referred for a hearing assessment” (OR = 0.91 [CI = 0.87 to 0.95]), tended to be younger compared with individuals in later categories of health-seeking. Hearing level was associated with all categories; individuals in category i “Did not report hearing difficulties” (OR = 0.46 [CI = 0.40 to 0.52]), category ii “Report hearing difficulties” (OR = 0.50 [CI = 0.42, 0.59]), category iii “Told a healthcare professional about hearing difficulties” (OR = 0.55 [CI = 0.43 to 0.70]), category iv “Referred for a hearing assessment” (OR = 0.44 [CI = 0.32 to 0.60]), category vi “Accepted a hearing aid” (OR = 0.63 [CI = 0.52 to 0.76]), tended to have better hearing compared with individuals in later categories of hearing health-seeking (Table 2).

Self-reported health was associated with category i “Did not report hearing difficulties” and category ii “Report hearing difficulties,” individuals in category i (very good OR = 1.69 [CI = 1.08 to 2.64]) and category ii (excellent OR = 4.08 [CI = 1.78 to 9.37]) and very good OR 2.80 [CI = 1.37 to 5.72]) reported better health compared with individuals in later categories of health-seeking. Individuals in category ii “Report hearing difficulties” (OR = 0.86 [CI = 0.76 to 0.98]) and category iii “Told a healthcare professional about hearing difficulties” (OR = 0.78 [CI = 0.63 to 0.97]), tended to participate in fewer social activities compared with individuals in later categories of health-seeking. Individuals in category i “Did not report hearing difficulties” tended to have lower cognitive function (OR = 0.98 [CI = 0.97 to 0.99]) compared with individuals in later categories of hearing health-seeking.

## DISCUSSION

For the first time, the present study shows that a substantial minority (40.0%) of people with likely hearing impairment do not report hearing difficulties and that relatively few people were at later categories of hearing health-seeking. Our interpretation is that the main barrier to hearing health-seeking is recognizing hearing difficulties. This interpretation makes intuitive sense; people will not seek help if they do not perceive a hearing problem. The second key finding was that the severity of hearing impairment was the only factor that correlated with all five

TABLE 1. Characteristics of the seven hearing health-seeking categories

	Category							
	Total (N = 2845)	i "Do Not Report Hearing Difficulties" (n = 1139)	ii "Reported Hearing Difficulties" (n = 396)	iii "Told a Healthcare Professional About Hearing Difficulties" (n = 129)	iv "Referred for a Hearing Assessment" (n = 114)	v "Offered a Hearing Aid" (n = 34)	vi "Accepted a Hearing Aid" (n = 220)	vii "Reported Using a Hearing Aid Regularly" (n = 813)
Sex (male %)	49.6	44.2	50.8	46.5	61.4	50.0	54.1	54.2
Age (mean years)	72.1 (9.1)	71.0 (9.3)	70.2 (9.0)	70.6 (9.3)	67.0 (8.4)	69.7 (9.6)	73.3 (8.3)	75.4 (8.3)
Ethnicity (White British %)	96.5	94.6	97.2	96.1	94.7	97.1	97.7	98.9
Wealth (%)								
First quartile (lowest income)	26.3	28.0	25.5	33.6	34.5	38.2	29.0	21.6
Second quartile	27.2	26.3	27.9	19.5	22.7	44.1	27.6	29.4
Third quartile	24.7	24.8	24.3	25.8	24.5	11.8	21.2	25.4
Fourth quartile (highest income)	21.8	20.9	22.2	21.1	18.2	5.9	22.1	23.7
Education (%)								
University or higher	14.8	13.7	16.6	14.0	12.9	12.5	14.4	16.3
Qualification post primary	49.6	50.0	53.3	43.8	48.5	37.5	46.4	49.6
No qualification post primary school	35.6	36.3	30.1	42.1	38.6	50.0	39.2	34.1
Audiometric hearing level (number of tones heard in better ear)	2.9 (1.1)	2.5 (0.8)	2.6 (0.8)	2.7 (1.0)	2.6 (0.8)	2.9 (0.9)	3.1 (1.1)	3.7 (1.3)
Self-reported health status (poor %)	35.0	31.6	31.1	46.5	44.7	52.9	38.8	36.5
Number of leisure activities	1.4 (1.4)	1.4 (0.8)	1.4 (1.4)	1.14 (1.3)	1.4 (1.3)	1.2 (1.7)	1.5 (1.4)	1.5 (1.4)
Live alone (yes %)	29.3	30.0	24.5	33.3	24.6	32.4	30.9	30.1
Attitude to aging score (higher score more negative attitude to aging)	34.9 (6.5)	34.5 (6.5)	35.8 (6.3)	36.6 (6.5)	35.0 (6.9)	35.8 (6.0)	35.5 (6.4)	34.6 (6.4)
Age participants feels (age minus age participant feels)	10.05 (15.2)	9.94 (18.9)	9.23 (13.1)	9.56 (13.3)	10.8 (11.1)	7.3 (7.8)	10.2 (11.7)	10.6 (13.0)
Z score cognitive function (better cognitive function)	0.00 (1.00)	-0.04 (1.02)	0.17 (0.95)	0.05 (1.01)	0.14 (1.02)	-0.12 (0.68)	-0.04 (1.02)	-0.04 (0.98)

**TABLE 2.** The odds ratios from the multivariate logistic models for five of the categories of the hearing health-seeking behavior

	Category i “Do Not Report Hearing Difficulties” OR (CI)	Category ii “Reported Hearing Difficulties” OR (CI)	Category iii “Told a Healthcare Professional About Hearing Difficulties” OR (CI)	Category iv “Referred for a Hearing Assessment” OR (CI)	Category vi “Accepted a Hearing Aid” OR (CI)
Sex (male)	0.68 (0.55–0.84)	0.81 (0.59–1.11)	0.79 (0.49–1.29)	1.29 (0.74–2.28)	1.03 (0.67–1.59)
Age (older age)	0.98 (.97–0.99)	0.97 (0.95–0.99)	0.97 (0.94–1.01)	0.91 (0.87–0.95)	0.98 (0.95–1.01)
Wealth					
First quartile (lowest income)	—	—	—	—	—
Second quartile	0.86 (0.64–1.17)	1.31 (0.82–2.10)	0.61 (0.29–1.26)	0.61 (0.26–1.42)	0.77 (0.42–1.42)
Third quartile	0.85 (0.64–1.17)	1.14 (0.71–1.85)	1.23 (0.63–2.39)	1.30 (0.60–2.84)	0.87 (0.47–1.62)
Fourth quartile (highest income)	0.75 (0.54–1.05)	1.01 (0.61–1.68)	0.81 (0.38–1.70)	1.05 (0.46–2.40)	0.84 (0.44–1.60)
Education					
University or higher	—	—	—	—	—
Qualification post primary	1.12 (0.83–1.50)	1.10 (0.72–1.68)	0.96 (0.48–1.92)	1.20 (0.56–2.56)	1.02 (0.58–1.79)
No qualification post primary school	1.11 (0.78–1.60)	0.79 (0.47–1.35)	1.46 (0.67–3.17)	1.54 (0.62–3.83)	1.28 (0.65–2.51)
Audiometric hearing level (number of tones heard in better ear)	0.46 (0.40–0.52)	0.50 (0.42–0.59)	0.55 (0.43–0.70)	0.44 (0.32–0.60)	0.63 (0.52–0.76)
Self-reported health status (poor)	—	—	—	—	—
Excellent	1.10 (0.63–1.92)	4.08 (1.78–9.37)	0.79 (0.24–2.59)	0.47 (0.12–1.88)	1.27 (0.42–3.84)
Very good	1.69 (1.08–2.64)	2.80 (1.37–5.72)	1.02 (0.43–2.45)	0.89 (0.31–2.55)	1.48 (0.64–3.41)
Good	1.31 (0.86–1.99)	1.75 (0.89–3.42)	0.70 (0.32–1.55)	0.56 (0.22–1.56)	1.15 (0.54–2.46)
Fair	1.05 (0.68–1.62)	1.64 (0.82–3.29)	0.71 (0.31–1.64)	1.40 (0.52–3.77)	1.30 (0.59–2.87)
Number of leisure activities	0.94 (0.87–1.02)	0.86 (0.76–0.98)	0.78 (0.63–0.97)	1.02 (0.82–1.27)	1.01 (0.87–1.18)
Live alone (yes)	1.13 (0.88–1.44)	1.35 (0.93–1.97)	1.09 (0.61–1.94)	1.53 (0.78–3.00)	1.01 (0.61–1.66)
Attitude to aging score (higher score; more negative attitude to aging)	0.99 (0.97–1.00)	1.02 (0.98–1.04)	1.03 (0.99–1.07)	0.99 (0.94–1.03)	1.03 (0.99–1.06)
Age participant feels (age minus age participant feels; higher score indicates participants feel younger than their age)	0.99 (0.99–1.00)	0.99 (0.98–1.01)	1.01 (0.99–1.03)	1.02 (0.99–1.04)	0.99 (0.98–1.02)
Z score cognitive function (better cognitive function)	0.98 (0.97–0.99)	0.99 (0.97–1.01)	1.02 (0.99–1.05)	0.99 (0.96–1.02)	0.99 (0.97–1.02)

CI, confidence interval; OR, odds ratio.

modeled categories of hearing health-seeking, with individuals with poorer hearing more likely to be in the later categories of hearing health-seeking. Other correlates associated with at least one category of hearing health-seeking included sex, age, self-reported health, participation in social activities, and cognitive function. The following discussion focuses on the implications of the findings.

### Proportion of Adults at Various Categories of Hearing Health-Seeking

To obtain hearing aids, individuals must progress through several categories of hearing health-seeking, including seeking help, being referred for a hearing assessment and obtaining a hearing aid. The largest category (40.0%) was those who likely had a hearing impairment but did not report hearing difficulties (category i). Previous studies have shown a disconnect between audiometric indices of hearing impairment and self-reported hearing, demonstrating that people with the same hearing level may perceive their hearing impairment as less problematic than others with the same hearing level (Saunders et al. 2005). One explanation may be that because of lifestyle differences in listening demands, the same level of audiometric hearing impairment may be less problematic for some people than for others. Alternatively, because of the insidious onset of hearing loss, some individuals may not be aware that they have a hearing loss

and instead attribute hearing difficulties to external factors (Rabinowitz 2000; Arlinger 2003). Although they may not recognize hearing loss as the reason, those with hearing impairment may still experience communication difficulties and reduced quality of life. Earlier recognition of hearing loss and management of hearing loss may increase the number of years lived without disability and/or improve their quality of life (Arlinger 2003; UK Department of Health 2015). Those fitted earlier may also benefit from hearing aids more; individuals who are fitted earlier had better adaption to using and maintaining their hearing compared with those fitted after a 10-year delay (Davis et al. 2007).

The US National Academies of Sciences, Engineering, and Medicine (2016) concluded that public awareness about the prevalence and impact of hearing impairment, and increasing accessibility of effective treatment options should be a priority. Campaigns that raise the public's awareness of hearing loss and reduce the stigma around hearing aids may be an important first step in earlier identification and treatment of hearing problems and the uptake of hearing aids, particularly if campaigns are informed by theories of behavior change to promote recognition of hearing problems and uptake of hearing support opportunities. For example, one relevant behavior change framework, namely Michie et al.'s (2011) behavior change wheel could be used for designing evidence-based hearing health interventions.

The behavior change wheel posits that the key drivers of behavior are capability, opportunity, and motivation. Promotion of hearing help-seeking may need to focus on increasing capability (e.g., knowledge of the signs of hearing loss, physical ability to report hearing problems), opportunity (e.g., somewhere to report hearing problems, support from family), and/or motivation (e.g., knowledge of the consequences of untreated hearing loss).

Relatively few people (17.4%) reported being in categories iii to vi of hearing health-seeking (being referred for a hearing assessment, recommended, offered, and obtained a hearing aid). Previous studies have reported that GPs are a potential barrier to hearing aid use, with GPs referring just 50% of those who mentioned hearing difficulties (Yueh et al. 2003; Davis et al. 2007; Wallhagen & Pettengill 2008; Schneider et al. 2010b). These studies suggested that GPs may not refer people for hearing assessment as GPs may prioritize other health concerns or perceive hearing loss as normal part of aging (Davis et al. 2007; Schneider et al. 2010b). However, the present study did not find GPs were a barrier; only 4.5% of those reporting hearing difficulties reported not being referred for a hearing assessment. It may be that UK GP referral practices have changed, or that earlier findings in relation to a small number of UK GP practices (Davis et al. 2007) are not generalizable to the United Kingdom, or that practice in other countries differs to that in the United Kingdom (Schneider et al. 2010b).

Few participants (1.2%) reported being offered a hearing aid but not having obtained one (category vi “Accepted a hearing aid”). The very high uptake of hearing aids may be because individuals sufficiently motivated to attend a hearing assessment may be likely to follow the advice of a hearing health care professional to obtain a hearing aid following a hearing assessment (Armitage et al. 2017). A high level of motivation to use hearing aids in individuals attending audiological clinics has been demonstrated in previous studies (Meister et al. 2008, 2014; Ferguson et al. 2016; Armitage et al. 2017; Sawyer et al. 2019b).

Only 28.6% of individuals with a probable hearing impairment reported using their hearing aid regularly. However, we did not collect pure-tone audiometry data, so it is unknown how many individuals who did not regularly use a hearing aid also meet the audiometric criteria for a hearing aid. In the present study, among those who had obtained a hearing aid, 22.4% of participants reported not using their hearing aids. This rate of nonuse is consistent with other reported rates of nonuse which range from 3 to 24% (Ferguson et al. 2017). A scoping review identified limited benefit from the hearing aid, difficulties with hearing aid care and maintenance, and perceptions of insufficient need for a hearing aid as the main reasons why people do not use their hearing aids (McCormack & Fortnum 2013).

### Correlates of Hearing Health-Seeking

Hearing level was the only correlate predictive of all categories of health-seeking: those with poorer hearing were more likely to be in the later categories. Each category had different correlates, suggesting that each category may have different drivers. Therefore, the content and focus of interventions to promote hearing health-seeking would need to vary according to the category of health-seeking that was targeted. Individuals with poorer hearing may perceive greater need and be more likely to seek help. Several review articles have also reported

that audiometric hearing level is associated with hearing help-seeking (Knudsen et al. 2010), hearing aid uptake (Knudsen et al. 2010; Jenstad & Moon 2011; Meyer & Hickson 2012; Ng & Loke 2015), and use (Ng & Loke 2015).

“Did not report hearing difficulties” was the only category that was independently associated with sex, with men less likely to be in this category compared with later categories. Perhaps the association between sex and “Did not report hearing difficulties” is due to women having better-coping strategies for dealing with hearing loss and are thus less likely to report experiencing hearing difficulties than men. Previous research by Hallberg et al. (2008) found women were more likely to use nonverbal communication strategies, for example, lipreading and sitting close to the speaker, compared with men. An alternative explanation for the negative association between “Did not report hearing difficulties” and male sex may be due to residual confounding with audiometric hearing level; men tend to have poorer hearing than women (Davis et al. 2007), so tend to be in later categories of hearing health-seeking compared with women. Cognitive function was also associated with reporting hearing difficulties, with those with better cognitive function being more likely to be in later categories (i.e., had reported hearing difficulties and acted on them). Individuals with better cognitive function may have better insight into hearing difficulties, be more likely to initiate help-seeking, and be able to negotiate their way through hearing health care pathways.

Individuals with better self-reported health were more likely to be in the two initial categories (“Did not report hearing difficulties” and “Reported hearing difficulties”) compared with later categories. Individuals who have poorer self-reported health may also be more likely to report other health concerns, including hearing difficulties, and therefore are more likely to be in the later categories of the hearing health-seeking pathway. Alternatively, poorer self-reported health may be associated with reported hearing difficulties due to residual confounding with audiometric hearing level, as individuals with poorer health may have more severe hearing impairment (Tafforeau & Demarest 2001; Hogan et al. 2009).

Age was associated with three of the five categories modeled, with older people more likely to be in later stages. The associations between age and the later categories of hearing health-seeking may be due to residual confounding with audiometric hearing level as older people generally have poorer hearing. Alternatively, younger individuals may perceive hearing loss as a sign of getting old (Dawes et al. 2014) and therefore may be reluctant to report experiencing hearing difficulties or accept/use a hearing aid. Previous studies reported stigma influences acceptance of hearing loss and hearing aid use (Knudsen et al. 2010; Wallhagen 2010). Public health campaigns and the media may need to work to reduce stigma and avoid negative representations of hearing impairment and hearing aids.

Participation in leisure activities was associated with the second and third categories of the hearing health-seeking behavior. Socially active people were more likely to be in later categories. Socially active people may be more likely to perceive a need for help with their hearing and therefore motivated to address hearing difficulties and maintain good communication. Alternatively, hearing loss has been linked to social isolation and loneliness (Pronk et al. 2011; Gopinath et al. 2012), therefore it is possible that with untreated hearing loss are more likely to withdraw from social situations and therefore



less likely to be in the later stages of hearing health-seeking (Mick et al. 2014).

The present study did not find SES was associated with any of the categories. Benova et al. (2014) reported that lower SES was associated with higher likelihood of self-reported hearing difficulties, and higher SES was associated with lower likelihood of a hearing aid being recommended. The difference in patterns of association with SES and health-seeking category between Benova et al.'s study and the present one may be due to differences in sample selection. Benova et al. relied on self-reported hearing difficulties to identify the study sample, so likely did not include a large proportion of those with hearing impairment. Benova et al. reported that SES was no longer associated with "Offered a hearing aid" after adjusting for referral to an ear specialist (to try to control for hearing level), consistent with the present study. Therefore, hearing level may be more important predictor of "Offered a hearing aid" than SES.

### Limitations

The present study provides a cross-sectional profile of the proportion of English adults over age 50 years with a probable hearing impairment who reported being at various categories of hearing health-seeking. Due to the cross-sectional study design, the study cannot determine cause and effect. Progression through the categories of hearing health-seeking would need to be tested longitudinally. No data relating to progression through each category were obtained, and it was not possible to examine the timing of progression through categories of hearing health-seeking. However, the study provides an insight into relative proportions of adults who are at various categories of hearing health-seeking and characteristics of those at each category that may warrant further research attention.

Due to the small numbers of people who did not obtain a hearing aid, no multivariate regression could be performed for "Offered a hearing aid." There were differences in age, audiometric hearing level, and wealth between those who chose to obtain hearing aids versus those who declined to use hearing aids, but it was not possible to determine the independent association of any characteristic with this category of hearing health-seeking. However, because nearly 100% of people who reported being recommended a hearing aid also reported having obtained one, the correlates of this category seemed relatively unimportant.

Hearing health-seeking may be lower in ethnic minority versus majority groups in the United Kingdom (Sawyer et al. 2019a). Unfortunately, the ELSA data set did not have enough people with ethnic minority backgrounds to support analysis of hearing health-seeking by ethnic background. Future studies may need to examine how ethnicity influences hearing health-seeking.

There were also no data on adults' intentions or attitudes towards hearing aids. Previous studies have shown attitudes toward hearing aids and beliefs such as self-efficacy, have been implicated with hearing aid use (Brooks 1989; Van den Brink et al. 1996; Brooks & Hallam 1998; Kricos 2000; Wilson & Stephens 2003). Future studies may need to include attitudes and beliefs specific to hearing health-seeking behavior when modeling potential correlates of hearing health-seeking.

No adjustments were made for multiple statistical comparisons in the present study. We chose not to adjust for the multiple comparisons because all the potential correlates of hearing health

seeking were identified a priori based on previous research and because Bonferroni corrections have been criticized for being too conservative (Forstmeier & Schielzeth 2011) and increasing the likelihood of false negatives (Perneger 1998). Some of the associations reported here may be false positives, although most of the correlates of hearing health-seeking reported in the present study are consistent with those reported in previous research, which gives confidence in the reliability of results.

Some of the variables used in the ELSA dataset may not have fully captured the variability of the construct. For example, participation in social activities was measured by asking the number of social activities in which an individual participated. However, these activities may vary in terms of the amount and quality of social interaction they involve.

The HearCheck Screener only tests hearing at 1000 and 3000 Hz and classifies a hearing impairment as better ear threshold >20 dB HL at 1 kHz or >35 dB HL at 3 kHz. The HearCheck does not test lower frequencies tested in pure-tone audiometry. The present study could only determine if individuals had a probable hearing loss. It is unknown if, based on pure-tone audiometry, individuals were eligible for a hearing aid. It is therefore possible that individuals are not in the latter category as they did not fit audiometric criteria for a hearing aid based on pure-tone audiometry and therefore the proportion of adults in stage vii may be under-reported. However, Davis et al. (2007) reported that the best marker for classifying individuals who were likely to use and benefit from hearing aids were audiometric thresholds >35 dB HL, which was the rationale for using this threshold of impairment by those who developed the HearCheck device (Parving et al. 2008; Fellizar-Lopez et al. 2011).

Individuals in the category "Did not report hearing difficulties" arguably do not need a hearing aid as they do not perceive their hearing loss as an issue. However, age-related hearing loss is gradual and individuals might be unaware of their difficulties (Rabinowitz 2000) or perceive their difficulties as caused by external factors (e.g., those around them not speaking clearly). Davis et al. (2007) reported that individuals with a hearing loss who were identified and fitted earlier had greater benefit through the additional years of hearing aid use and were better able to adapt to using a hearing aid compared with those fitted with a hearing aid later.

### CONCLUSIONS

The largest category of hearing health-seeking among UK adults with a probable hearing impairment was those who reported not experiencing hearing problems. Earlier recognition of hearing problems might be facilitated by hearing screening linked to interventions, informed by theories of behavior change, which increase awareness of the prevalence and impacts of hearing loss as well as the availability of effective treatments. Interventions to promote hearing health-seeking need to be specific to each category of hearing health-seeking, due to the different correlates of each category.

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