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Review Article

Systematic Review of Factors Associated With Hearing Aid Use in People Living in the Community With Dementia and Age-Related Hearing Loss

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ABSTRACT

Objectives: To investigate factors that influence hearing aid use according to the Theoretical Domains Framework (TDF). The TDF is a behavioral science framework that aids understanding of factors that influence behavior.
Design: Systematic review.
Setting and Participants: People living in the community with dementia and age-related hearing loss who have air conduction hearing aids.
Methods: Systematic literature review following PRISMA guidelines. We searched for studies in 9 databases, including Ovid MEDLINE, Scopus, and OpenGrey. We undertook an interpretive data synthesis by mapping findings onto the TDF. We assessed confidence in the findings according to the GRADE-CERQual approach.
Results: Twelve studies (6 quantitative, 3 qualitative, and 3 mixed methods) were included in the review. The majority of these were rated low-moderate quality. We identified 27 component constructs (facilitators, barriers, or noncorrelates of hearing aid use) nested within the 14 domains of the TDF framework. Our GRADE-CERQual confidence rating was high for 5 findings. These suggest that hearing aid use for people living in the community with dementia and hearing loss is influenced by (1) degree of hearing aid handling proficiency, (2) positive experiential consequences, (3) degree of hearing aid comfort or fit, (4) person-environment interactions, and (5) social reinforcement.
Conclusions and Implications: Hearing aid interventions should adopt a multifaceted approach that optimizes the capabilities of people with dementia to handle and use hearing aids; addresses or capitalizes on their motivation; and ensures their primary support network is supportive and encouraging of hearing aid use. The findings also emphasize the need for further high-quality research that investigates optimal hearing aid use, influencing factors, and interventions that support hearing aid use.

Keywords:
Hearing loss
dementia
barriers
facilitators
hearing aids

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Hearing impairment affects up to 90% of older adults who are living with dementia,[1–3] and is more prevalent in people with dementia than among their peers with intact cognition.[4,5] The negative consequences of combined hearing and cognitive impairment include reduced quality of life, and increased social isolation and dependency on others.[6–8] Previous research suggests that treating hearing impairment with hearing aids represents an important opportunity to improve quality of life for people with dementia.[9,10]

Research within the general population has identified a range of factors associated with hearing aid use. Lack of perceived need for, or benefit from, hearing aids; difficulty adjusting to use; and problems with the fit or comfort of the devices are all barriers to use.[11–15] Conversely, increased age and severity of hearing loss are both positively associated with use of hearing aids.[16–18] In addition, motivation to use hearing aids may make people more likely to tolerate initial difficulties with hearing aids to become regular users of them.[19] People who report that they experience disabling effects of hearing loss are most likely to use hearing aids,[11,20–22] and the support of family or friends has also been identified as a facilitating factor for hearing aid use.[22,23]

One might expect that using hearing aids could be more challenging for people with dementia than in the general population because of the deterioration in cognitive and functional abilities associated with dementia. For example, awareness of hearing loss is an important correlate of hearing aid use,[11,20,21] yet loss of self-awareness commonly occurs in dementia.[24] Furthermore, people living with dementia may have increased difficulties in using hearing aids because of dementia-related factors such as reduced cognitive, visuospatial, and executive function abilities[25] and increased apathy.[26] These factors may negatively influence a person's ability to manipulate and maintain hearing aids, as well as their ability to persevere through difficulties such as initial discomfort.[27] People with dementia may also require support in order to use hearing aids successfully.[2,28] For those living in the community, family support may be of greatest relevance.[28]

Previous reviews of factors that influence hearing aid use have not considered the distinct needs of people living with dementia. Identifying barriers and facilitators to hearing aid behavior is therefore a crucial first step in developing interventions that support hearing aid use in this population.[29,30] The Theoretical Domains Framework (TDF)[31] is a proven behavioral science framework that provides a comprehensive framework for understanding determinants of behavior,[32,33] and identifying factors that need to be addressed to effect behavior change.[34] It was chosen as a framework for data synthesis in this review because there may be a range of factors that influence hearing aid use.[35] The objective of this literature review was therefore to identify, evaluate, and synthesize literature on factors that are associated with the use of hearing aids in people with dementia, according to the TDF.

Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) Statement[36] guided the methodology of this review. The protocol for this study was pre-registered on the PROSPERO international prospective register of systematic reviews (CRD42020173094).

Eligibility Criteria

Studies were eligible for inclusion, regardless of design, if the study

1. included people diagnosed with dementia and age-related hearing loss who had received air conduction hearing aids and were living in the community;
2. reported data related to hearing aid use and/or factors that influence use; and
3. was primary research

We did not impose any restrictions in relation to language or publication date.

Search Strategy

We searched the following electronic databases in May 2021: Ovid MEDLINE, Scopus, PsycINFO, and Cumulative Index to Nursing and Allied Health Literature (CINAHL). Additionally, we undertook searches of the Cochrane Databases of Systematic Reviews, reference lists of relevant papers, trial registers ClinicalTrials.gov and the World Health Organization international clinical trials registry platform (ICTRP), and unpublished "gray" literature via OpenGrey and Evidence Search.

We identified search terms based on free text words, Medical Subject Headings (MeSH), and reviews of relevant literature. Search terms were adapted, where necessary, to meet the requirements of the databases.

Study Selection

Two reviewers independently screened a sample of the titles and abstracts. Following consensus discussion, clarification of the inclusion criteria, and further independent screening, we achieved perfect interrater agreement (Cohen $\kappa = 1.00$). The first author then screened the remaining titles and abstracts. Once screening was complete, 2 reviewers independently appraised the full text of all potentially relevant studies against the full inclusion and exclusion criteria.

Data Extraction

We performed the data extraction using a bespoke form. We contacted the authors of the 2 included conference abstracts to request missing data, 1 of whom responded to our request.

Quality Assessment

We critically appraised the quality of the selected studies using the Mixed Methods Appraisal Tool (MMAT).[37,38] Within the MMAT, reviewers appraise each included study against core validity criteria for differing study designs (qualitative, quantitative RCT, quantitative nonrandomized, quantitative descriptive, or mixed methods). The Johns Hopkins Nursing Evidence-Based Practice (JHNEBP) framework[39] was used to appraise and categorize the studies according to the level of research evidence (Level I, experimental; II, quasi-experimental; III, nonexperimental or qualitative; IV, practice guidelines or position statements; or V, case reports).

Data Synthesis

Because this is a mixed methods review, quantitative and qualitative data were treated with equal status and analyzed concurrently, according to the A−QUAL + QUAN framework.[40] An interpretive data synthesis was undertaken by mapping extracted findings to the 14 domains of the Theoretical Domains Framework.[31,41] Any determinants of hearing aid use that did not fit into the domains of the TDF were categorized as "other" to ensure completeness of the synthesis.

Confidence in the findings was assessed according to the Grading of Recommendations Assessment, Development and Evaluation Confidence in the Evidence from Reviews of Qualitative Research (GRADE-CERQual) approach.[42] For this, we assessed each finding in relation to methodologic limitations, coherence, adequacy, and relevance. The outcomes of these appraisals informed an overall assessment of confidence in the findings, according to the GRADE-CERQual criteria of high, moderate, low, or very low. Further details of the methods are outlined in Supplementary Material 1.

Results

The combined database and hand searches resulted in 2987 returned records. Following deduplication, 1915 unique records remained. After screening the titles and abstracts, we retained 125 records for full-text review against the eligibility criteria. Of these, 112 were excluded, resulting in final inclusion of 13 records (Supplementary Figure 1). Two journal articles presented relevant results from the same study. The final 13 records therefore represented 12 studies with data of relevance to the present review.

Study Characteristics

Supplementary Table 1 presents characteristics of the included studies. Six quantitative or mixed methods intervention studies, 3 quantitative descriptive observational studies, 2 qualitative case reports, and 1 qualitative phenomenologic study were included. Sample sizes ranged from 1 to 647 participants. Ages of the participants ranged from 49 to 96 years. Care partners, such as spouses or adult children, were included in all of the intervention studies, 1 of the quantitative descriptive studies, and 2 of the qualitative studies.

Participants had varying degrees of cognitive impairment, from mild to advanced dementia. Hearing status was reported according to a variety of parameters in 9 of the 12 studies. Degree of hearing impairment varied from mild to severe hearing loss. Whether or not hearing aids were being used was reported in a variety of ways, including caregiver report (6 studies), researcher descriptions (3 studies), identification in clinical records (2 studies), and participant report (1 study). Frequency and/or duration of hearing aid use was measured in 4 studies using caregiver logs. No studies used data logging, despite this being a feature of most hearing aids.[43]

Quality Appraisal

Evidence levels and quality varied across the included studies. The majority (8) of the included studies were of Level III evidence. Of these, Gregory et al's[44] qualitative study, and Leroi et al's[45] and Sheikh et al's[46] mixed methods studies were rated as high quality. However, the participant sample that received the extended intervention, which yielded data of most relevance to the present review in Leroi et al's[45] study, was small (n = 4 dyads). Palmer et al's[47] qualitative case study, and Nirmalasari et al's[48] and Kim et al's[49] quantitative descriptive studies were rated as moderate quality. The remaining Level III studies were rated as low quality, with limitations in the reporting (Nieman et al[50]) or trial design and conduct that resulted in high researcher subjectivity and risk of bias (Hutchison et al[51,52]).

There were 2 Level II studies (Dupuis et al[28] and Palmer et al[53]). These quantitative nonrandomized studies were both rated as low quality, with small sample sizes and incomplete outcome data. There was 1 Level 1 study, a randomized controlled trial (Nguyen et al[54]), which was rated as moderate quality because of a lack of complete outcome data and adherence to the intervention. Additionally, lack of a power calculation or justification of sample size rendered the adequacy of the included sample unclear. The final case report (Hawkins[55]) was Level V evidence and rated as low quality. The full MMAT quality[37] and JHNEBP[39] quality and evidence levels appraisals are presented in Supplementary Table 2.

Influences on Hearing Aid Use According to the TDF

Extracted data were mapped to all domains of the TDF. Three additional findings did not fit within the TDF domains and were categorized as "other." Summary findings, along with GRADE-CERQual[42] ratings of confidence in the findings are presented in Table 1.

In total, 27 component constructs (facilitators, barriers, or noncorrelates of hearing aid use) nested within the 14 domains of the TDF framework. Of these, our confidence rating was high for 5 constructs, moderate for 7, and low for 15. Further detail of the GRADE-CERQual[42] assessment outcomes are presented in Supplementary Table 3.

The key findings of this review are those for which there is the strongest current evidence and in which we have the highest confidence. These are as follows:

1. A person's degree of hearing aid handling proficiency influences hearing aid use; difficulty in handling inhibits use whereas being able to handle aids proficiently enables use. Hearing aid skills difficulties that we identified related to insertion, removal, adjustment, and maintenance. This finding maps into the TDF domain *skills.*

There was high confidence in this finding because although there were methodologic limitations in some of the studies, a body of evidence across 7 studies formed the finding.[28,44–46,52,53,55]

Some studies in our review sought to aid the development of hearing aid handling skills.[45,46] Because of a lack of controlled studies, we were unable to determine whether providing additional support to develop hearing aid handling skills increased hearing aid use compared with standard care pathways. None of the included studies adopted cognitive rehabilitation strategies within their skills development approaches.

2. Experiencing positive consequences of hearing aids is associated with their use. A range of positive consequences of hearing aid use was reported in the included studies. However, no study reported whether these consequences directly influenced hearing aid use. This finding maps into the TDF domain *reinforcement.*

The greatest amount of evidence mapped to this finding, across 8 of the included studies.[28,44–47,51,53,54] Although there were moderate concerns about the methodologic quality and relevance of the studies that contributed to this finding, there were only minor concerns about coherence and no concerns about adequacy, rendering overall confidence as high.

3. The degree of fit and comfort of hearing aids influences their use; problems with fit are a barrier whereas finding them comfortable is an enabler. This finding also maps into the TDF domain *reinforcement.*

Although only represented in 2 of the included studies,[44,45] leading to moderate concerns about adequacy, the data were rich enough to

Table 1
Findings Summary Table

Finding	GRADE-CERQual Confidence Rating	Studies Contributing to the Review Finding	TDF Domain (Definition Provided for First Occurrence)[31]
Degree of hearing aid–handling proficiency influences hearing aid use: difficulty in handling inhibits use, whereas being able to handle aids proficiently enables	High confidence	28,44–46,52,53,55	Skills (An ability or proficiency acquired through practice)
Experiencing positive consequences of hearing aids is associated with their use	High confidence	28,44–47,51,53,54	Reinforcement (Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus)
Degree of fit and comfort influences hearing aid use: problems with fit are a barrier whereas finding them comfortable is an enabler	High confidence	44,45	Reinforcement
Factors related to person-environment interactions influence hearing aid use: excessive noise or perceived lack of need in differing listening situations lead to reduced use	High confidence	44	Environmental context and resources (Any circumstances of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence, and adaptive behavior)
Receiving social reinforcement enables hearing aid use	High confidence	44,45,53	Social influences (Those interpersonal processes that can cause individuals to change their thoughts, feelings, or behaviors)
Standard manufacturer guidance does not enable hearing aid use	Moderate confidence	45,55	Knowledge (An awareness of the existence of something)
Misplacing hearing aids is a barrier to their use; having a set place for storage is an enabler	Moderate confidence	44,53	Memory, attention, and decision processes (The ability to retain information, focus selectively on aspects of the environment, and choose between 2 or more alternatives)
Mindset toward the visibility of hearing aids influences their use: concern about their visibility is a barrier, whereas welcoming their visibility is an enabler	Moderate confidence	44,46	Social/professional role and identity (A coherent set of behaviors and displayed personal qualities of an individual in a social or work setting)
Absence of—or negative—expectancy about the outcomes of hearing aids are barriers to their use	Moderate confidence	44,46	Beliefs about consequences (Acceptance of the truth, reality, or validity about outcomes of a behavior in a given situation)
Degree of intent influences hearing aid use: lack of intent is a barrier whereas positive intent is an enabler	Moderate confidence	44,53	Intentions (A conscious decision to perform a behavior or a resolve to act in a certain way)
Negative emotional responses to hearing aids are a barrier to their use, whereas positive impact on affective state resulting from hearing aid use is an enabler	Moderate confidence	44–46,49,51,55	Emotion (A complex reaction pattern, involving experiential, behavioral, and physiological elements, by which the individual attempts to deal with a personally significant matter or event)
Lack of care partner hearing aid knowledge is a barrier; presence of care partner knowledge, skills, and optimism are enablers	Moderate confidence	45–47	Social influences
Degree of procedural knowledge influences hearing aid use: lack of knowledge impedes use whereas improvement in knowledge enables use	Low confidence	28,44,45,55	Knowledge
Awareness of the presence of disabling hearing loss is associated with hearing aid use	Low confidence	45–47,51,52	Knowledge
Degree of self-confidence in ability to handle hearing aids influences their use: low confidence is a barrier whereas increasing confidence is an enabler	Low confidence	45,55	Beliefs about capabilities (Acceptance of the truth, reality or validity about an ability, talent, or facility that a person can put to constructive use)

(*continued on next page*)

Table 1 (*continued*)

Finding	GRADE-CERQual Confidence Rating	Studies Contributing to the Review Finding	TDF Domain (Definition Provided for First Occurrence)[31]
Proactive care partner support with handling and maintaining hearing aids enables their use	Low confidence	44,47,52	Social influences
Severity of cognitive impairment does not appear to be associated with hearing aid use	Low confidence	50,53,54	Memory, attention, and decision processes
Forgetting to use hearing aids is a barrier to their use; implementing compensatory strategies is an enabler	Low confidence	44	Memory, attention, and decision processes
Developing habitual routines enables hearing aid use	Low confidence	44	Behavioral regulation (Anything aimed at managing or changing objectively observed or measured actions)
Degree of adaptation to hearing aids influences their use; perseverance is an enabler	Low confidence	44,53	Behavioral regulation
Resistance to change is a barrier to hearing aid use	Low confidence	55	Behavioral regulation
Optimism about efficacy of hearing aids enables their use	Low confidence	44	Optimism (The confidence that things will happen for the best or that desired goals will be attained)
Identification of goals relating to hearing aids enables their use	Low confidence	28,45,47	Goals (Mental representations of outcomes or end states that an individual wants to achieve)
Lack of financial resources are a barrier to hearing aid use	Low confidence	50,52	Environmental context and resources
Age may not influence hearing aid use	Low confidence	50,53,54	Other
Degree of hearing loss may not influence hearing aid use	Low confidence	48,52−54	Other
Ethnicity influences hearing aid use; non-White ethnic groups are less likely to use hearing aids	Low confidence	50	Other

support the interpretation, and came from high-quality, relevant studies.

4. Factors related to person-environment interactions influence hearing aid use; excessive noise or perceived lack of need in differing listening situations lead to reduced use. This finding maps into the TDF domain *environmental context and resources.*

Although evidence for this finding came from just 1 study,[44] it was a high-quality, relevant study and there were no concerns about coherence.

5. Receiving social reinforcement in the form of prompts and encouragement enables hearing aid use. This finding maps into the TDF domain *social influences.*

Evidence that contributed to this finding were drawn from 3 relevant studies of good-high quality,[44,45,53] with only minor concerns about threats to coherence and adequacy.

Discussion

This systematic review has identified factors that are associated with hearing aid use in people living in the community with dementia and age-related hearing loss. Mapping of data from 12 relevant studies to the TDF revealed 27 different constructs for hearing aid use. The strongest evidence mapped to the *skills*, *reinforcement*, *environmental context and resources*, and *social influences* domains of the TDF.

Our findings suggest that people with dementia experience similar determinants of hearing aid use as the general population. In particular, similar barriers relating to hearing aid handling skills difficulties,[12,20] fit and comfort of the devices,[12] and difficulty in tolerating amplified background noise[19,56,57] were evident. Equally, similar facilitators relating to self-perceived benefit[11] and social support[22] were evident. Our findings therefore indicate that these factors are at least as important for people with dementia as the general population, suggesting that intervention approaches should account for this. However, there was insufficient evidence in the current literature to evaluate the impact of cognitive, functional, and spatial challenges on hearing aid use. These may represent critical differences between people with dementia and the general population, and so warrant further investigation.

In relation to intervention approaches, there was some evidence in our findings that people with dementia may benefit from learning strategies to optimize their hearing aid handling skills, such as those offered by cognitive rehabilitation.[58] In these respects, our findings suggest that hearing aid care pathways require flexibility and a skilled workforce. However, standard pathways lack the flexibility to support the specific needs of people with dementia,[59] and audiologists report that they lack formal training in dementia.[60]

Additionally, our findings suggest that social support plays a critical role in supporting hearing aid use in dementia. This is congruent with advice in clinical papers, which recommend that family members of people with dementia participate in audiology appointments so that they can support the effective use of hearing aids.[2,61,62] However, a recent study revealed that 18% of people with dementia that live in the community received little or no support for their daily living needs.[63] There may therefore be around a fifth of people with dementia living in the community who do not have adequate social support for their hearing aid use. In these cases, our findings suggest that it may be useful for hearing professionals to explore other options to provide social support around hearing aid use, such as within home care plans. Given that recognizing and managing changes to a person with dementia's social support over time (such as following the death of a spouse) has been highlighted as an important way to support continued hearing aid use,[60] our findings suggest that regular reviews of the presence and effectiveness of support systems is also crucial.

Strengths and Limitations

Strengths

In this systematic review, we used the TDF framework to collate barriers and enablers to hearing aid use in dementia. An advantage of using the TDF is that it provides theoretically informed direction about ways in which interventions can be targeted.[30,34,64] Additionally, use of an existing framework to organize the findings engenders confidence in the validity of the framework and enables integration into the wider literature base.

We also conducted a broad search of the literature in order to be as inclusive as possible. We did not exclude studies because of quality, and did not impose any restrictions on language or publication date. Use of the MMAT,[37] JHNEBP,[39] and GRADE-CERQual[42] frameworks provided structure to our assessments of quality and confidence in the findings.

Limitations

There was limited published literature that directly addressed our research question. The level of evidence was predominantly low, and the quality of evidence was largely of a low-moderate grade. The studies that met the inclusion criteria generally had small sample sizes and represented a perspective in predominantly high-income, English-speaking countries (with the exception of Sheikh et al's[46] feasibility study in South Asia). There was a lack of controlled studies or overt exploration of influences on hearing aid use, which limited our ability to understand causal factors affecting hearing aid use. These factors limit the generalizability of our findings.

Future research

Michie et al[30] propose 3 incremental stages in the design of behavior change interventions: first, understanding the behavior; second, identifying intervention options; and third, identifying intervention content and implementation options. Although this review represents a starting point in understanding factors that influence the behavior of hearing aid use in people with dementia, there was insufficient evidence to evaluate the impact of cognitive, functional, and spatial challenges on hearing aid use. There was also insufficient evidence to evaluate whether the onset of dementia affected hearing aid use in established hearing aid users. Furthermore, the target behavior for optimal hearing aid use remains unknown in this population, and also lacks consensus in the general population.[65] Therefore, there is a critical need for a program of high-quality research that investigates (1) optimal hearing aid use and (2) influencing factors of hearing aid use in dementia. Once a robust understanding of the target behavior and influencing factors exists, identification of intervention options, development of intervention content, and identification of implementation options can follow.

Conclusions and Implications

Our findings suggest that the determinants of hearing aid use in dementia are multifaceted. Intrinsic determinants include a person's skills in handling hearing aids and motivating factors related to the consequences and comfort of hearing aids. Extrinsic determinants include the listening context and presence of external prompts and encouragement. Within these constructs, both facilitators and barriers to hearing aid use are evident.

Our findings suggest that enhanced support pathways that tailor to the abilities and motivators of the individual with dementia while also accounting for their social support systems over time represent the best opportunity to optimize hearing aid use. Further robust research to establish parameters of the target behavior of optimal hearing aid use, and to generate further understanding of influencing factors, is indicated.

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Supplementary Material 1. Methods

Inclusion and Exclusion Criteria

	Inclusion Criteria	Exclusion Criteria
Population	Diagnosed dementia Age-related hearing loss Living in the community Has air conduction hearing aids	Mild cognitive impairment/no dementia Congenital deafness Living in long-term care Does not have air conduction hearing aids
Phenomenon of interest	The use of air conduction hearing aids	Other audiological devices including cochlear implants, bone conduction hearing aids, or assistive listening devices
Outcome	Hearing aid use Factors that influence use	Other outcomes not related to the present review
Study type	Quantitative studies Qualitative studies Mixed methods studies	

Search Strategy

Electronic databases: Ovid MEDLINE, Scopus, PsycINFO, and Cumulative Index to Nursing and Allied Health Literature (CINAHL).

Additional searches: Cochrane Databases of Systematic Reviews, reference lists of relevant papers, trial registers ClinicalTrials.gov and the World Health Organization international clinical trials registry platform (ICTRP), and unpublished “gray” literature via OpenGrey and Evidence Search.

The full search syntax used for the Ovid MEDLINE search was: (exp DEMENTIA/OR dement* OR Alzheimer* OR Vascular* OR ‘Lewy Bod*’ OR (Parkinson* AND (dementia* or disease)), OR Frontotemporal dement* OR ((cogniti* OR memory) AND (impair* OR deficit* OR disord*))) AND (exp HEARING/OR ‘hearing loss’ OR ‘hearing disord*’ OR ‘hearing deficit*’ OR ‘hearing impair*’ OR ‘auditory impair*’ OR presbycusis OR presby*) AND (exp ‘HEARING AIDS’/OR ‘hearing aid*’ OR ‘correction of hearing impairment’).

Study Selection

A sample of 12% of the titles and abstracts were independently screened by the first author and a second reviewer (H.C.), resulting in moderate interrater agreement (Cohen $\kappa = 0.44$). These were reassessed following consensus discussion and clarification of the inclusion criteria, and substantial agreement was reached (Cohen $\kappa = 0.63$). During this process, we retained any papers that remained unclear for further appraisal. Screening of a further 6% of the returned search resulted in perfect agreement (Cohen $\kappa = 1.00$). The first author then screened the remaining titles and abstracts.

Once the title and abstract screening was complete, the first author and second reviewer independently appraised the full text of all potentially relevant studies against the full inclusion and exclusion criteria. Disagreements between the 2 reviewers were resolved through discussion, and with the input of another member of the review team (P.D.).

Data Extraction

The primary researcher performed the data extraction using a bespoke form. The second reviewer checked this for accuracy. The primary researcher contacted authors of the 2 included conference abstracts to request missing data, which were provided by one of these.

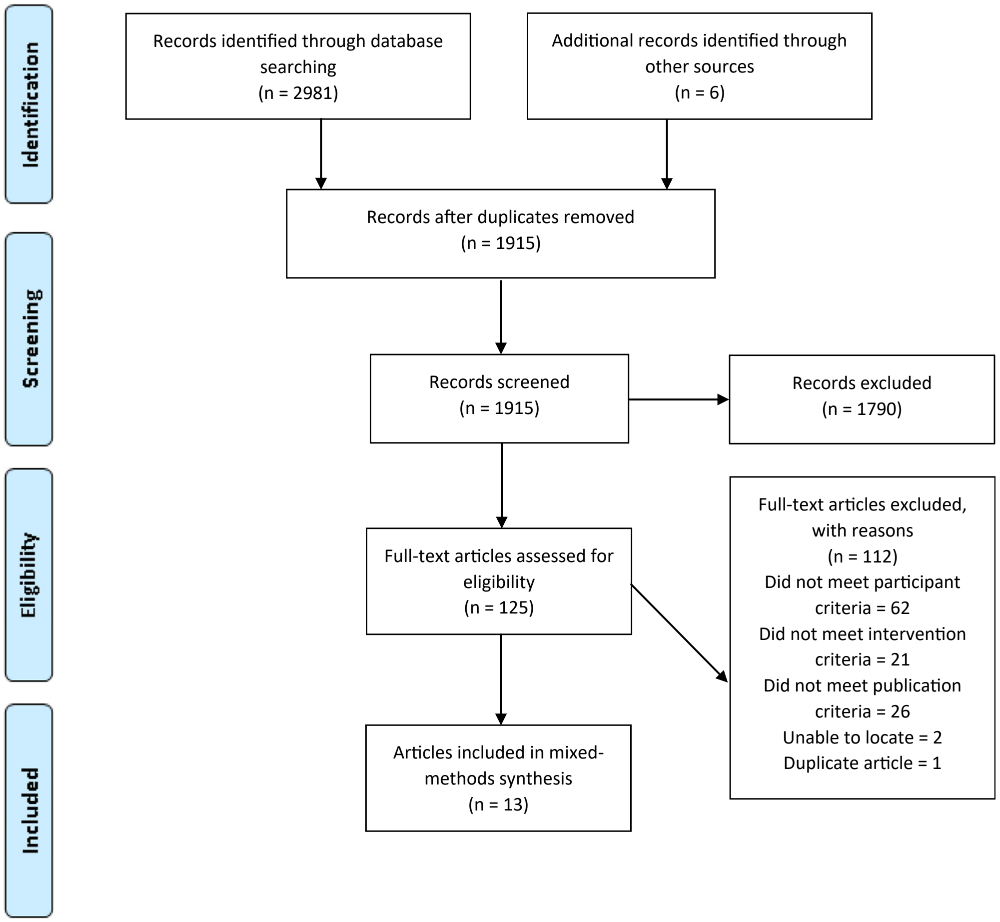
Quality Assessment

The first author and second reviewer independently critically appraised the quality of the selected studies using the Mixed Methods Appraisal Tool (MMAT).[37,38] The same reviewers then used the Johns Hopkins Nursing Evidence-Based Practice (JHNEBP) framework[39] to appraise and categorize the studies according to the level of research evidence. Throughout this process, any discrepancies were resolved through discussion, and with the input of another member of the research team (L.B.).

Data Synthesis

Because this is a mixed methods review, quantitative and qualitative data were treated with equal status and analyzed concurrently, according to the A–QUAL + QUAN framework.[40] An interpretive data synthesis was undertaken by mapping extracted findings to the 14 domains of the Theoretical Domains Framework.[31,41] Any determinants of hearing aid use that did not fit into the domains of the TDF were categorized as “other” to ensure completeness of the synthesis.

Confidence in the findings was assessed according to the Grading of Recommendations Assessment, Development and Evaluation Confidence in the Evidence from Reviews of Qualitative Research (GRADE-CERQual) approach.[42] For this, the first author and second reviewer independently assessed each finding in relation to methodologic limitations, coherence, adequacy, and relevance. The outcomes of these appraisals informed an overall assessment of confidence in the findings, according to the GRADE-CERQual criteria of high, moderate, low, or very low.



Supplementary Fig. 1. *PRISMA* Flow Diagram.

Supplementary Table 1
Characteristics of Included Studies

Author (Year), Country of Origin	Type of Publication	Study Design*	Evidence Level†/Quality Rating*	Inclusion Criteria	Participant Characteristics	Study Description	HA Use	Correlates of HA Use
Dupuis et al (2016)[28] Canada	Conference abstract and poster	Quantitative nonrandomized intervention	Level II/Low	Not reported	Sample size: n = 4 dyads Age: mean 90 y (range 80-92) Gender: 50% male Cognitive status: mean MoCA score 16.75 (SD 4.03) – indicative of moderate cognitive impairment/mild dementia. Dementia type: 25% diagnosed with AD; 25% other dementia variant; 50% MCI variants Hearing status: mean BEA = 40.4 dB (SD 5.58) Living circumstances: 50% cohabiting with spouse; 25% cohabiting with adult child; 25% alone Socioeconomic status: Not reported Ethnicity: Not reported	Aim: To examine the impact of including significant others in audiologic rehabilitation of people with cognitive impairment Intervention: HAs (mixture of ITE and BTE, monaural and binaural) and audiologic rehabilitation Control: No control condition Duration: 3 mo	Data source: Researcher report Data type: Qualitative (descriptive) Outcome: “Successful use” for all participants	Enablers: Identification of goals relating to listening and communication; Positive consequences of use (reduced listening and communication difficulties, increased safety in the home, increased engagement in participatory activities). Barriers: Lack of procedural knowledge (difficulty differentiating, naming, and comprehending parts); Difficulty with handling skills (incorrect battery insertion). Noncorrelates: None reported

Gregory et al (2020)[44] UK	Peer-reviewed journal	Qualitative phenomenologic	Level III/ High	Aged 50+ y Diagnosed mild AD or MCI (sMMSE score ≥21) Confirmed hearing loss Provided with HAs Exclusion: Not fluent in English Lack capacity to consent	Sample size: n = 10 Age: Range 75-86 y Gender: 60% male Cognitive status: sMMSE score range 21-28, indicative of mild cognitive impairment/mild dementia Dementia type: 80% AD; 20% MCI Hearing status: not reported Living circumstances: not reported Socioeconomic status: not reported Ethnicity: 50% White British, 50% White Irish, Black, Asian, Punjabi	Aim: To explore the experiences of HA use in people with dementia or mild cognitive impairment via semistructured interview	Data source: Participant report Data type: Qualitative (descriptive) Outcome: Selective use related to situations, motivation, and consequences	Enablers: Incorporation into everyday routine; Keeping aids in a set location when not in use; Perseverance; Welcoming visibility of HAs in aiding communication awareness of others; Optimism about efficacy; Positive consequences of use (increased confidence, feeling protected, finding them helpful) Comfortable fit; Support of care partner to insert aids; Social reinforcement (reminders and encouragements from family) Barriers: Lack of knowledge and handling skills (HA insertion); Misplacing and losing aids; Forgetting to use them; Stigma related to visibility; Belief that HA use could lead to overreliance on them; Ambivalence about need; Influence of environmental factors (excessive noise, demands of the listening situation) Noncorrelates: None reported

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Supplementary Table 1 (*continued*)

Author (Year), Country of Origin	Type of Publication	Study Design*	Evidence Level†/Quality Rating*	Inclusion Criteria	Participant Characteristics	Study Description	HA Use	Correlates of HA Use
Hawkins (2011)[55] USA	Practitioner Magazine	Qualitative case report	Level V/ Low	Not reported	Sample size: n = 1 Age: 89 y Gender: male Cognitive status: moderate to advanced dementia; cognitive assessment score not reported Dementia type: mixed dementia Hearing status: mild to moderate hearing loss Living circumstances: cohabiting with spouse Socioeconomic status: not reported Ethnicity: not reported	Aim: To report difficulties encountered in the provision of replacement HAs for a person with dementia	Data source: Researcher report Data type: Qualitative (descriptive) Outcome: Rejection of replacement HAs	Enablers: None reported Barriers: Deterioration of knowledge and skills (affecting comprehension of HA controls and device maintenance); Manufacturer's manual triggering anxiety about complexity of aids; Immovable mindset precipitating resistance to changing aids; Lack of confidence in capabilities, agitation arising from this Noncorrelates: None reported

Hutchison et al (2012)[51] and (2012)[52] USA	Peer-reviewed journal	Mixed methods intervention	Level III/ Low	Aged 65+ y Diagnosed mild to moderate dementia (MMSE score 14-24) Mild to moderate hearing loss (determined by HHIE-S score) No cerumen blockage No history of middle ear surgery Little to no HA experience Living independently or with family within commuting distance of the research facility	Sample size: n = 10 Age: median 86.5 (range 82-94) y Gender: 20% male Cognitive status: MMSE score not reported. Researcher-determined 70% with "moderate dementia"; 30% "no dementia" Dementia type: not reported Hearing status: 50% moderate to severe hearing loss; 50% mild to moderate Living circumstances: 60% alone; 30% cohabiting with spouse; 10% cohabiting with other family Socioeconomic status: Not reported Ethnicity: not reported	Aim: To ascertain the viability of treatment, impact of hearing loss treatment on behavioral symptoms and psychosocial factors for people with dementia, and willingness of caregivers to provide support Intervention: Binaural BTE HAs Control: No control condition Duration: 4 wk	Data source: Caregiver log Data type: Quantitative (continuous) Outcome: Data for n = 7; median 211.5 hours over 4 wk (range 114-419.5) n = 1 rejected HAs	Enablers: Positive consequences of HA use (improved ability to engage in social, leisure, and religious activities, increased connection with the internal or external auditory environment; improved participation in communication); Improved affective state (increased morale: Hedges *g* 1.47 on Lawton Morale Scale, large effect; signs of decreased depression and joy); Care partner assistance (successfully supported HA use in 9/10 participants) Barriers: Lack of awareness of hearing loss; Resistance to using HAs; Difficulty with HA insertion; Concerns about affordability (2 of 10 participants believed they were affordable) Noncorrelates: Hearing threshold was not associated with use (Hedges *g* 0.07)

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Supplementary Table 1 (*continued*)

Author (Year), Country of Origin	Type of Publication	Study Design[*]	Evidence Level[†]/Quality Rating[*]	Inclusion Criteria	Participant Characteristics	Study Description	HA Use	Correlates of HA Use
Kim et al (2021)[49] USA	Peer-reviewed journal	Quantitative descriptive observational	Level III/ Moderate	Attendees at a community memory assessment clinic Completed audiometric and neurocognitive testing	Sample size: 101 Age: mean 76.3 (range 49-93) y Gender: 44% male Cognitive status: mean MMSE score 23.1 (SD 4.4), indicative of mild dementia Dementia type: 52% AD or related dementias; 27% MCI; 21% other cognitive disorders Hearing status: mean BEA 31.4 dB HL (SD 13.3) 34% unimpaired hearing; 44% mild loss; 20% moderate loss; 3% severe loss Living circumstances: not reported Socioeconomic status: not reported Ethnicity: 82% White, 18% Black	Aim: Chart review to examine the association between objective hearing loss and neuropsychiatric symptoms (NPSs) among people with varying degrees of cognitive impairment	Data source: Clinical records Data type: Quantitative (categorical binary) Outcome: 20% of sample used HAs: 5.9% of those with no hearing loss ($n = 2$); 16% of those with mild hearing loss ($n = 7$); 48% of those with moderate to severe hearing loss ($n = 11$)	Enablers: HA use was inversely associated with both the number and severity of NPS Barriers: None reported Noncorrelates: None reported

Leroi et al (2020)[45] Cyprus, France, and UK	Peer-reviewed journal	Mixed methods intervention	Level III/ High	Aged 60+ y Diagnosed with mild to moderate dementia (AD, VaD, mixed) (MoCA score ≥12) Hearing loss >35 dB HL over 1-3 kHz in better ear Community dwelling Study partner available Capacity to consent Exclusion: Congenital hearing loss Unstable medical or psychiatric condition	Sample size: n = 19 dyads Age: median 76 (range 63-88) y Gender: 63% male Cognitive status: mean MoCA score 17.3 (range 12-23), indicative of moderate cognitive impairment or mild dementia Dementia type: 47% diagnosed with AD; 47% VaD; 5% mixed Hearing status: mean Better Ear Hearcheck score = 3.8 Living circumstances: 79% cohabiting with study partner Socioeconomic status: not reported Ethnicity: not reported	Aim: To field-trial a prototype hearing and vision intervention in dementia Intervention: Binaural digital BTE HAs, troubleshooting support. Glasses for comorbid vision loss n = 4 dyads received an additional extended “sensory intervention” from a Sensory Support Therapist (SST) Control: No control condition Duration: 4 wk (basic intervention) or 12 wk (extended intervention)	Data source: Caregiver report Data type: Quantitative (continuous) Outcome: Data for n = 4: 4-12 h/d; 4-7 d/wk	Enablers: Improvement in knowledge, and skills in HA use; Becoming confident in HA wear and care; Setting goals related to device use, device care, communication, function, and social inclusion; Positive consequences of HA use (increased confidence, increased engagement in social and leisure activities, improved communication); Fostering of positive affect; Building care partner device knowledge and skills (8% improvement in knowledge and 24% improvement in skills on HASK assessment); Care partner encouragement Barriers: Lack of awareness of the presence of hearing loss (HHIE-S mean baseline score 7.87, indicative of no perceived hearing loss); Extraneous information within manufacturer manual; Experiencing problems with device fit Noncorrelates: None reported

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Supplementary Table 1 *(continued)*

Author (Year), Country of Origin	Type of Publication	Study Design[*]	Evidence Level[†]/Quality Rating[*]	Inclusion Criteria	Participant Characteristics	Study Description	HA Use	Correlates of HA Use
Nguyen et al (2017)[54] France	Peer-reviewed journal	Quantitative RCT intervention with semicrossover design	Level I/ Moderate	Aged 65+ y Diagnosed mild to moderate AD (MMSE score 10-28) Bilateral sensorineural hearing loss (21-80 dB HL) No HAs in last 2 y Able to tolerate HAs for at least 1 h/d Living with caregiver. Exclusion: Not AD Recent introduction or dose change of AD treatment Break/lose HA twice or more during the study	Sample size: n = 51 (randomized) Age: mean 82.6 (SD 6.69) y Gender: 40% male Cognitive status: mean MMSE score 19.52 (SD 4.51), indicative of moderate dementia Dementia type: AD Hearing status: mean hearing threshold 48.75 dB (SD 10.48) Living circumstances: all cohabiting Socioeconomic status: not reported Ethnicity: not reported	Aim: To assess the efficacy of HA provision on the cognitive status of people with Alzheimer's disease and hearing loss Intervention: Binaural digital HAs and audiologic rehabilitation Control: Dummy HAs that were activated at 6 mo in a semicrossover design Duration: 12 mo. (primary outcomes at 6 mo)	Data source: Caregiver log Data type: Quantitative (continuous and categorical) Outcome: Of the total sample, 31.6% were categorized as bad or moderate users and 68.4% as good or very good users at 6 mo Of the bad or moderate users, 66.7% were in the control group; of the good or very good users, 46.2% were in the control group. Daily use for 73.7% of active group and 59.1% of control group at 6 mo.	Enablers: Younger age was associated with good compliance (mean age was 80.3 y for good or very good users and 86 y for bad or very bad; Hedges *g* 0.88, large effect) Barriers: Insufficient audiological gain (66.7% of the bad or moderate HA users were in the control group) Noncorrelates: Stage of cognitive decline was not associated with compliance (Hedges *g* 0.1); Hearing threshold was not associated with HA compliance (Hedges *g* 0.19)
Nieman et al (2018)[50] USA	Conference abstract	Quantitative descriptive observational	Level III/ Low	Meet diagnostic criteria for dementia Community-dwelling Reliable study partner	Sample size: n = 647 Age: ≥65 y Cognitive status: Mild cognitive impairment/mild dementia (MMSE score 21-30) 38%; moderate dementia (MMSE score 11-21) 40%; severe dementia (MMSE score 0-10) 18%. Dementia type: Not specified. Hearing status: Not reported Living circumstances: not reported Socioeconomic status: 15% low income (<$11,000); 28% middle income ($11,000-$24,999); 57% high income (>$25,000) Ethnicity: 44% White, 50% African American, 6% other	Aim: To establish the prevalence of proxy-rated hearing loss and HA use of community-dwelling people with dementia	Data source: Proxy report Data type: Quantitative (categorical binary) Outcome: Use according to age: 0% of 65-75 y; 17% of 75-85 y; 31.3% of 85+ y. Use according to cognition: 25.6% of mild dementia; 16% of moderate dementia; 21.7% of severe dementia. Use according to income: 0% of <$11,000; 23.5% of $11,000-$24,999; 23.7% of >$25,000. Use according to ethnicity: 27.5% of White; 5.6% of African American; 0% of other	Enablers: None reported Barriers: Use was lower among participants with lower socioeconomic status (effect size calculation not possible); Use was lower among younger participants (effect size calculation not possible); Use was lower among non-White participants (effect size calculation not possible) Noncorrelates: Stage of cognitive decline was not associated with compliance (effect size calculation not possible)

Nirmalasari et al (2017)[48] USA	Peer-reviewed journal	Quantitative descriptive observational	Level III/ Moderate	Aged 50+ y Diagnosed cognitive impairment Hearing screened English speaking	Sample size: n = 100 Age: mean 76 (SD 9.3) y Gender: 42% male Cognitive status: mean MMSE score 21.8 (SD 5.4), indicative of mild dementia Dementia type: 68% unspecified dementia; 32% MCI or other Hearing status: mild loss 32%; moderate 25%; severe 3% Living circumstances: not reported Socioeconomic status: not reported Ethnicity: 68% White; 32% non-White	Aim: Chart review to establish the prevalence of hearing loss in a memory clinic, and to investigate rates of HA use and demographic associations within this	Data source: Clinical records Data type: Quantitative (categorical binary) Outcome: 21% of sample used HAs: 8% of those with no loss (n = 3); 9% of those with mild loss (n = 3); 54% of those with moderate to severe loss (n = 15)	Enablers: People with greater severity of hearing loss were more likely to use HAs (effect size calculation not possible) Barriers: None reported Noncorrelates: None reported
Palmer et al (1998)[47] USA	Peer-reviewed journal	Qualitative case study	Level III/ Moderate	Not reported	Sample size: n = 1 Age: 78 y Gender: male Cognitive status: MMSE score 18, indicative of moderate dementia Dementia type: mixed dementia Hearing status: BEA 58-dB HL over 0.5, 1, 2 kHz Living circumstances: Cohabiting with spouse Socioeconomic status: not reported Ethnicity: White	Aim: To report the impact of a hearing intervention on a person with dementia Intervention: Monaural ITE HA, audiological training support and troubleshooting Control: No control condition Duration: 6 wk preintervention; 8 wk postintervention	Data source: Caregiver log Data type: Quantitative (continuous) Outcome: 15 h/d	Enablers: Awareness of hearing loss (baseline HHIE score 35); Identification of listening situation goals; Positive consequences of use (reduced hearing-related disability, significant reduction in HHIE score to 11 at follow-up, increased enjoyment in listening situations, increased communication); Care partner support with maintenance and use Barriers: Lack of troubleshooting knowledge for care partner Noncorrelates: None reported

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Supplementary Table 1 (*continued*)

Author (Year), Country of Origin	Type of Publication	Study Design*	Evidence Level†/Quality Rating*	Inclusion Criteria	Participant Characteristics	Study Description	HA Use	Correlates of HA Use
Palmer et al (1999)[53] USA	Peer-reviewed journal	Quantitative nonrandomized intervention	Level II/ Low	Diagnosed mild to moderate AD (MMSE score 12-24) HHIE-P score >18% Bilateral sensorineural hearing loss appropriate for amplification Living at home with spouse or adult child Exclusion: Significant h/o alcohol abuse, schizophrenia, Parkinson's, head trauma, or cardiovascular accident English not first language	Sample size: n = 8 dyads Age: mean 79 (range 71-89) y Gender: 62% male Cognitive status: mean MMSE score 14 (range 5-18), indicative of moderate dementia Dementia type: AD Hearing status: mean 40.4-dB HL over 0.5, 1, 2 kHz (range 21.7-56.6) Living circumstances: all cohabiting: 50% with spouse; 50% with adult child Socioeconomic status: not reported Ethnicity: not reported	Aim: To ascertain the impact of HA provision on caregiver-identified problem behaviors of people with dementia Intervention: Monaural ITE HA, audiological training support and troubleshooting Control: No control condition Duration: 6-10 wk preintervention; 8 wk postintervention	Data source: Caregiver log Data type: Quantitative (continuous) Outcome: median 9 h/d (range 4-13)	Enablers: Severity of cognitive impairment (participants with greater impairment wore aids for longer per day: Hedges *g* 0.28, small effect); Positive intention for use; Positive consequences of use (reduced hearing-related disability—significant positive change scores on HHIE for 3 of 4 participants, improved ability to engage in social and leisure activities, improved communication in 6 of 8 participants); Severity of hearing loss (participants with greater severity of hearing loss wore HAs for longer - Hedges *g* 0.58, medium effect) Barriers: Difficulty with handling skills (evident in two-thirds of sample); Misplacing HAs; Incomplete adaptation; Noncorrelates: Age was not associated with HA use (Hedges *g* 0.10)

Sheikh et al (2021)[46] Pakistan	Peer-reviewed journal	Mixed methods intervention	Level III/High	Aged 60+ y Diagnosed with AD, VaD, or mixed AD + VaD, or evidence of undiagnosed dementia Mild to moderate cognitive impairment (MoCA score ≥10) Adult-acquired bilateral hearing loss worse than 35-dB HL at ≥1 kHz in the better ear Capacity to consent Living at home Has a steady partner or informal caregiver ≥18y old Exclusion: Congenital hearing impairment Profound hearing loss Unstable medical or psychiatric condition Participating in trial of cognitive enhancing intervention	Sample size: 15 Age: median 64 y, range 60-80 y Gender: 47% male Cognitive status: mean MoCA score 15 (SD 2.9) range 10-20 (n = 14), indicative of moderate cognitive impairment or mild dementia 1 participant with score ≥26 (normal cognition) Dementia type: AD (n = 1), VaD (n = 1), undiagnosed (n = 13) Hearing status: not reported Living circumstances: all cohabiting—50% with spouse, 40% with other family Socioeconomic status: not reported Ethnicity: not reported	Aim: To culturally adapt and evaluate the feasibility, acceptability, and impact of a multifaceted hearing support intervention to enhance quality of life for persons with dementia in Pakistan Intervention: HAs (type not reported), training and support in HA use, goal setting, communication training, dementia awareness training (study partner) Control: No control condition Duration: ≤13 wk	Data source: Researcher report Data type: Qualitative (descriptive) Outcome: All participants were willing to use their prescribed aids; no report of frequency or duration.	Enablers: Awareness of hearing loss (mean baseline HHIE score 66.7 [SD 17.9], significant perceived hearing disability); Increased confidence in using and handling HAs; Positive consequences (reduced hearing-related disability: HHIE change score Hedges *g* 3.50, very large effect, improved ability to engage in social and leisure activities, improved communication); Fostering of positive affect (PHQ-9 Hedges *g* 1.62, large effect; GAD-7 Hedges *g* 1.89, large effect); Improvement in care partner's device knowledge and skills; Care partner optimism about HAs Barriers: Negative perception of hearing loss as a disability; Lack of awareness that HAs may help Noncorrelates: None reported

AD, Alzheimer's disease; BEA, better ear average; BTE, behind the ear; GAD-7, Generalized Anxiety Scale—7[66]; HA, hearing aid; HASK, Hearing Aid Skills and Knowledge Test[67]; HHIE-P, Hearing Handicap Inventory for the Elderly—Proxy[68]; HHIE-S, Hearing Handicap Inventory for the Elderly—Screening[69]; ITE, in the ear; MCI, Mild Cognitive Impairment; MoCA, Montreal Cognitive Assessment[70]; PHQ-9, Patient Health Questionnaire—9[71]; sMMSE, Standardized Mini Mental State Examination[72]; VaD, vascular dementia.

*Categorized according to the Mixed Methods Appraisal Tool (MMAT).[37]

†Based on the Johns Hopkins Nursing Evidence-Based Practice framework (JHNEBP).[39]

Supplementary Table 2
MMAT Quality[37] and JHNEBP[39] Quality and Evidence Level Appraisals

	Dupuis et al (2016)[28]	Gregory et al (2020)[44]	Hawkins (2011)[55]	Hutchison et al (2012[51] and 2012[52])	Kim et al (2021)[49]	Leroi et al (2020)[45]	Nguyen et al (2017)[54]	Nieman et al (2018)[50]	Nirmalasari et al (2017)[48]	Palmer et al (1998)[47]	Palmer et al (1999)[53]	Sheikh et al (2021)[46]
MMAT Checklist												
Screening												
Clear research question?	Yes	Yes	No	Yes	Yes	Yes	Yes	Can’t tell	Yes	Can’t tell	Yes	Yes
Collected data addresses research question?	Can’t tell	Yes	Can’t tell	Yes	Yes	Yes	Yes	Can’t tell	Yes	Can’t tell	Yes	Yes
Qualitative												
Appropriate approach?		Yes	Can’t tell							Yes		
Adequate data collection methods?		Yes	Can’t tell							Yes		
Findings adequately derived?		Yes	Can’t tell							Can’t tell		
Results sufficiently substantiated?		Yes	Can’t tell							Yes		
Coherence?		Yes	No							Can’t tell		
Quantitative RCT												
Randomisation performed appropriately?							Yes					
Groups comparable at baseline?							Yes					
Complete outcome data?							No					
Assessor blinding?							Yes					
Adherence to intervention?							No					
Quantitative nonrandomized												
Participants representative of target?	Yes										No	
Measurements appropriate?	Can’t tell										Yes	
Complete outcome data?	No										No	
Confounders accounted for?	Can’t tell										Can’t tell	
Intervention administered as intended?	Can’t tell										Can’t tell	
Quantitative descriptive												
Relevant sampling?					Can’t tell			Can’t tell	Yes			
Representative sample?					Can’t tell			Can’t tell	Yes			
Appropriate measurements?					Yes			No	No			
Low risk of nonresponse bias?					Yes			Can’t tell	Yes			
Appropriate statistical analysis?					Yes			Can’t tell	Yes			
Mixed methods												
Adequate rationale for mixed methods?				No		Yes						Yes
Effective integration of components?				Yes		Yes						Yes
Adequate interpretation of components?				No		Yes						Yes
Divergencies and inconsistencies adequately addressed?				Yes		Yes						Yes
Adherence to quality criteria?				No		Yes						Yes
JHNEBP results												
Evidence level	Level II	Level III	Level V	Level III	Level III	Level III	Level I	Level III	Level III	Level III	Level II	Level III
Quality rating	C	A/B	C	C	B	A	B	C	B	C	C	A
Quality Category	Low	High	Low	Low	Moderate	High	Moderate	Low	Moderate	Moderate	Low	High

Supplementary Table 3
GRADE-CERQual[42] Outcomes

TDF Domain	Component Construct	Studies Contributing to the Construct	Assessment of Methodologic Limitations	Assessment of Coherence	Assessment of Adequacy	Assessment of Relevance	Overall Assessment of Confidence	Explanation of Judgment
Knowledge	Awareness of the presence of disabling hearing loss is associated with hearing aid use	45–47,51,52	Moderate concerns	Moderate concerns	Moderate concerns	Mild concerns	Low confidence	Low confidence due to moderate concerns in relation to coherence, adequacy, and methodology
	Degree of procedural knowledge influences hearing aid use: lack of knowledge impedes use whereas improvement in knowledge enables use	28,44,45,55	Moderate concerns	Moderate concerns	Moderate concerns	Moderate concerns	Low confidence	Low confidence due to moderate concerns in relation to coherence, adequacy, relevance, and methodology
	Standard manufacturer guidance does not enable hearing aid use	45,55	Moderate concerns	Minor concerns	Moderate concerns	Minor concerns	Moderate confidence	Moderate confidence due to moderate concerns in relation to adequacy and methodology
Skills	Degree of hearing aid–handling proficiency influences hearing aid use: difficulty in handling inhibits use whereas being able to handle aids proficiently enables	28,44–46, 52,53,55	Moderate concerns	Minor concerns	No or very minor concerns	Minor concerns	High confidence	High confidence because despite some methodologic limitations, there was a body of relevant data to support the finding
Memory, attention, and decision processes	Severity of cognitive impairment does not appear to be associated with hearing aid use	50,53,54	Substantial concerns	Minor concerns	Moderate concerns	Minor concerns	Low confidence	Low confidence due to substantial methodologic limitations of the studies and moderate concerns about adequacy
	Misplacing hearing aids is a barrier to their use; having a set place for storage is an enabler	44,53	Moderate concerns	Moderate concerns	Moderate concerns	Minor concerns	Moderate confidence	Moderate confidence due to moderate concerns about adequacy and methodologic quality
	Forgetting to use hearing aids is a barrier to their use; implementing compensatory strategies is an enabler	44	No or very minor concerns	Moderate concerns	Serious concerns	Minor concerns	Low confidence	Low confidence due to substantial concerns about adequacy and moderate concerns about coherence
Behavioral regulation	Developing habitual routines enables hearing aid use	44	No or very minor concerns	Moderate concerns	Serious concerns	Minor concerns	Low confidence	Low confidence due to substantial concerns about adequacy and moderate concerns about coherence
	Degree of adaptation to hearing aids influences their use; perseverance is an enabler	44,53	Moderate concerns	Minor concerns	Serious concerns	Minor concerns	Low confidence	Low confidence due to substantial concerns about adequacy and moderate concerns about methodology
	Resistance to change is a barrier to hearing aid use	55	Substantial concerns	Minor concerns	Moderate concerns	Minor concerns	Low confidence	Low confidence due to substantial concerns about methodology and moderate concerns about adequacy

(*continued on next page*)

Supplementary Table 3 (*continued*)

TDF Domain	Component Construct	Studies Contributing to the Construct	Assessment of Methodologic Limitations	Assessment of Coherence	Assessment of Adequacy	Assessment of Relevance	Overall Assessment of Confidence	Explanation of Judgment
Role and identity	Mindset toward the visibility of hearing aids influences their use: concern about their visibility is a barrier whereas welcoming their visibility is an enabler	44,46	No or very minor concerns	Moderate concerns	Moderate concerns	Minor concerns	Moderate confidence	Moderate confidence due to moderate concerns about coherence and adequacy
Beliefs about capabilities	Degree of self-confidence in ability to handle hearing aids influences their use: low confidence is a barrier whereas increasing confidence is an enabler	45,55	Moderate concerns	Moderate concerns	Moderate concerns	Minor concerns	Low confidence	Low confidence due to moderate concerns in relation to coherence, adequacy, and methodology
Optimism	Optimism about efficacy about hearing aids enables their use	44	No or very minor concerns	Moderate concerns	Serious concerns	Minor concerns	Low confidence	Low confidence due to substantial concerns about adequacy and moderate concerns about coherence
Beliefs about consequences	Absence of—or negative—expectancy about the outcomes of hearing aids are barriers to their use	44,46	No or very minor concerns	Moderate concerns	Moderate concerns	Minor concerns	Moderate confidence	Moderate confidence due to moderate concerns about coherence and adequacy
Intentions	Degree of intent influences hearing aid use: lack of intent is a barrier whereas positive intent is an enabler	44,53	Moderate concerns	No or very minor concerns	Moderate concerns	Minor concerns	Moderate confidence	Moderate confidence due to moderate concerns about adequacy and methodology
Goals	Identification of goals relating to hearing aids enables their use	28,45,47	Moderate concerns	Substantial concerns	Moderate concerns	Moderate concerns	Low confidence	Low confidence due to substantial concerns about coherence and moderate concerns about adequacy, relevance, and methodology
Reinforcement	Experiencing positive consequences of hearing aids is associated with their use	28,44–47,51,53,54	Moderate concerns	Minor concerns	No concerns	Moderate concerns	High confidence	High confidence because although there were moderate concerns about relevance and methodology, there were only very minor concerns about coherence and adequacy
	Degree of fit and comfort influences hearing aid use: problems with fit are a barrier whereas finding them comfortable is an enabler	44,45	No or very minor concerns	Minor concerns	Moderate concerns	Minor concerns	High confidence	High confidence because although there were moderate concerns about adequacy due to low quantity, the data were rich enough to support this interpretation

Emotion	Negative emotional responses to hearing aids are a barrier to their use, whereas positive impact on affective state resulting from hearing aid use is an enabler	44–46,49, 51,55	Moderate concerns	Minor concerns	No or very minor concerns	Moderate concerns	Moderate confidence	Moderate confidence due to moderate concerns about relevance and methodology
Environmental context and resources	Factors related to person-environment interactions influence hearing aid use: excessive noise or perceived lack of need in differing listening situations lead to reduced use	44	No or very minor concerns	No or very minor concerns	Minor concerns	Minor concerns	High confidence	High confidence because although it was only represented in 1 study, this was a high-quality, relevant study and there were no concerns about coherence
	Lack of financial resources negatively influence hearing aid use	50,52	Substantial concerns	Minor concerns	Minor concerns	Substantial concerns	Low confidence	Low confidence due to substantial concerns in relation to relevance and methodologic quality of the studies
Social influences	Proactive care partner support with handling and maintaining hearing aids enables their use	44,47,52	Moderate concerns	Minor concerns	Moderate concerns	Moderate concerns	Low confidence	Low confidence due to moderate concerns in relation to adequacy, relevance, and methodologic quality
	Lack of care partner hearing aid knowledge is a barrier; presence of care partner knowledge, skills and optimism are enablers	45–47	Minor concerns	Moderate concerns	Minor concerns	Moderate concerns	Moderate confidence	Moderate confidence due to moderate concerns about coherence and relevance
	Receiving social reinforcement enables hearing aid use	44,45,53	Minor concerns	Minor concerns	Minor concerns	Minor concerns	High confidence	High confidence because there were only minor concerns in each domain
Other	Degree of hearing loss may not influence hearing aid use	48,52–54	Moderate concerns	Moderate concerns	Minor concerns	Moderate concerns	Low confidence	Low confidence due to moderate threats to coherence, relevance, and methodologic limitations
	Age may not influence hearing aid use	50,53,54	Substantial concerns	Moderate concerns	Minor concerns	Minor concerns	Low confidence	Low confidence due to moderate threats to coherence and substantial methodologic limitations
	Ethnicity influences hearing aid use: non-White ethnic groups are less likely to use hearing aids	50	Substantial concerns	No or very minor concerns	Moderate concerns	Moderate concerns	Low confidence	Low confidence due to moderate concerns about adequacy and relevance, and substantial methodologic concerns