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Impact of Tinnitus on Quality of Life and Cognitive Function in Adults: A Systematic Review

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ABSTRACT
Background: Tinnitus is often associated with cognitive difficulties, especially in attention and executive functioning. However, it remains unclear how much tinnitus itself contributes to cognitive decline, due to methodological differences among studies and confounding factors like hearing loss and psychological distress.
Objective: This systematic review assesses the impact of tinnitus on cognitive function in adults, examining the roles of concomitant hearing loss, mood (including anxiety, depression, and stress), and study design variability.
Methods: We conducted a systematic literature search (PUBMED, Google Scholar, Cochrane Library, ScienceDirect) on June 13, 2024, using keywords including “tinnitus,” “cognition,” “attention,” “memory,” and “adults.” Searches were limited to English-language studies. Following PRISMA guidelines, titles and abstracts were screened, and full texts were assessed; 16 studies were included from an initial pool of 24,395 records. Both observational and experimental studies of adults (18–75 years) were reviewed. Inclusion criteria required chronic subjective tinnitus and available data on cognitive outcomes. Exclusion criteria included objective tinnitus, neurodegenerative conditions, the use of ototoxic medications, or a lack of reported cognitive measures. Data were extracted on study design, sample characteristics (age, gender, hearing status), and cognitive outcomes (attention, memory, executive function, processing speed, language), as well as tinnitus assessments. The Mixed Methods Appraisal Tool (MMAT 2018) was used to assess study quality; ten studies were rated as having a low risk of bias, and six were rated as having a moderate risk, with none rated as having a high risk.
Results: Across the 16 included studies, tinnitus was most consistently associated with deficits in attentional control and executive processing. The majority of studies (14/16) reported that tinnitus patients performed more poorly than controls on demanding attention tasks (e.g., Stroop test, Trail Making Test). For example, Andersson et al. (2000) found tinnitus patients took significantly longer to name Stroop colors ($F(1,44)=17.8$, $p=0.0001$), and Stevens et al. (2007) reported slower reaction times in severe-tinnitus subjects during Stroop trials ($t=3.20$, $p=0.008$ for word naming; $t=3.10$, $p=0.011$ for color naming). Jackson et al. (2014) also observed reduced accuracy on attention tasks in tinnitus sufferers, with higher tinnitus distress (as measured by the STSS score) correlating with more errors ($r = -0.349$, $p = 0.004$). Brueggemann et al. (2021) similarly reported a significant negative correlation between Tinnitus Questionnaire (TQ) scores and Stroop/d2-test performance ($\beta = -0.22$, $p = 0.001$). In contrast, a few studies found little impact on attention: Ciências et al. (2010) noted that mild tinnitus did not impair selective auditory attention or temporal resolution, and Fetoni et al. (2021) found no significant correlation between tinnitus severity (THI) and global cognition (MMSE, $r=0.13$, $p>0.05$). Thus, while most evidence indicates attentional inefficiency in tinnitus, effect sizes and significance varied with tinnitus severity and study conditions.
Memory and processing speed were also examined. Generally, tinnitus was linked to subtle memory impairments. Pierce et al. (2012) reported that tinnitus patients showed initial deficits in word recall and learning during the first testing session, but their scores normalized on repeated trials (suggesting practice effects). Waechter et al. (2021) found mild working-memory deficits related to tinnitus handicap, even after controlling for hearing loss and mood. Qi et al. (2024) found that tinnitus patients had significantly lower MoCA scores than controls ($p < 0.001$ for both tinnitus-with-sleep-disorder and tinnitus-without-sleep-disorder groups compared to normal controls), indicating global cognitive differences. In language and executive function, Cardon et al. (2019) observed that tinnitus subjects performed worse on semantic fluency (19.5±6.2 vs. 23.1±5.9; $t(54) = 2.21$, $p = 0.015$), suggesting that executive control deficits impacted language (Table 3).
Psychological factors frequently mediated cognitive outcomes. Several studies reported that anxiety, depression, and tinnitus distress were associated with poorer cognitive performance, while some cognitive deficits persisted after adjusting for mood. Hearing loss also contributed variably: Fetoni et al. (2021) attributed cognitive impairment mainly to age and hearing loss rather than tinnitus, whereas Gudwani et al. (2017) found no significant correlation between hearing thresholds and cognitive scores. Overall, tinnitus patients often had coexisting high-frequency hearing loss, but its independent effect on cognition was inconsistent.

Conclusion: This review suggests that chronic tinnitus is associated with domain-specific cognitive deficits, particularly in attention and executive function, rather than a global decline. Cognitive impairments tend to worsen with greater tinnitus severity and emotional distress. The relationship between tinnitus, hearing loss, and cognition is complex and often confounded, as hearing loss itself (especially untreated) can mimic or exacerbate cognitive effects. Inconsistencies in study design, cognitive tests, and participant matching (including age, hearing, and mood) limit the firmness of conclusions. Future research should employ standardized cognitive batteries, rigorously control for confounding factors (e.g., via well-matched controls or longitudinal designs), and investigate causality. Clinically, a multifaceted approach is recommended: assessment should include cognitive screening, and management should address hearing rehabilitation, psychological support (e.g., CBT for anxiety/depression), and targeted cognitive strategies to improve attention and working memory in tinnitus patients.

Keywords: tinnitus, cognition, quality of life, cognitive function, adults

INTRODUCTION

Tinnitus is often described as a phantom auditory perception—the conscious experience of sound without an external stimulus (Henry, 2005). It typically manifests as a high-pitched ringing, buzzing or whistling noise (Holmes & Padgham, 2011) and is considered a symptom rather than a disease itself (Jastreboff, 1990). Tinnitus is common worldwide, affecting roughly 4–37% of adults (Jarach et al., 2022), with most estimates around 10–15% (Baguley et al., 2013). Prevalence increases with age (Yetiser et al., 2002), with younger adults (~10%) and older adults (~24%) commonly reporting tinnitus (Yetiser et al., 2002). Chronic tinnitus can severely affect quality of life, disrupting sleep, mood, and daily functioning (Yetiser et al., 2002). It is frequently comorbid with anxiety, depression, and stress (Zöger et al., 2006; Brueggemann et al., 2021) and can lead to social withdrawal or irritability (Brueggemann et al., 2021). Although many tinnitus patients also have high-frequency hearing loss (Vielsmeier et al., 2015), tinnitus can occur in people with normal audiometric thresholds, indicating multiple underlying pathologies (Jastreboff & Hazell, 2004). Peripheral auditory damage may generate aberrant neural signals that are interpreted by limbic and auditory centers as distressing (Jastreboff & Hazell, 2004).

Beyond sensory symptoms, tinnitus has been increasingly linked to cognitive dysfunction. "Cognition" encompasses mental processes like attention, memory, executive function, language, and visuospatial skills (Andersson & McKenna, 2006). Early reports noted that tinnitus sufferers often complained of poor concentration, impaired attention, and forgetfulness (Hallam et al., 1984; R. S. Hallam et al., 2004; Stevens et al., 2007). Subsequent studies have examined whether tinnitus objectively affects cognitive test performance. For example, tinnitus patients have shown slower reaction times or lower accuracy on selective attention and executive tasks such as the Stroop test or Trail Making Test (Andersson et al., 2000; Jackson et al., 2014; Stevens et al., 2007). They have also sometimes performed worse on working-memory tasks and memory recall tests (Cardon et al., 2019; Pierce et al., 2012). Neuroimaging provides a possible mechanism: altered activity and connectivity have been found in tinnitus patients in frontal and insular brain regions involved in top-down attention (Burton et al., 2012; Vanneste et al., 2011). These findings support the hypothesis that the constant perception of tinnitus may "load" the brain's attentional resources, making cognitive tasks more demanding (Burton et al., 2012; Vanneste et al., 2011).

Despite these findings, the literature is mixed. Some studies report no cognitive differences after adjusting for hearing loss or mood (Fetoni et al., 2021; Gudwani et al., 2017), and tinnitus severity does not always predict the magnitude of cognitive impairment. The heterogeneity in study designs, cognitive measures, and participant samples complicates interpretation. For example, some experiments included mostly young adults, others focused on older populations; some controlled for hearing ability, while others did not. Differences in questionnaires and neuropsychological tests also limit comparability.

Aim: This systematic review aims to clarify the impact of tinnitus on cognitive function in adults, taking into account the roles of hearing loss and psychological distress. We hypothesize that chronic tinnitus is associated with deficits in attention, processing speed, and memory, which, in turn, may contribute to a reduced quality of life. We also examine the co-occurrence of high-frequency hearing loss and its influence on cognitive outcomes among tinnitus patients. By synthesizing the evidence, we seek to identify consistent patterns and gaps in the literature and to inform future research and clinical practice.

METHODS

Search Strategy

A systematic search of the literature was conducted (June 13, 2024) in PUBMED, Google Scholar, the Cochrane Library, and ScienceDirect using combinations of terms including "tinnitus," "cognition," "attention," "memory," "executive function," "processing speed," and "adults." Search results were filtered to English-language publications. The search process followed the PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) framework to ensure comprehensive identification and transparent reporting of studies. References of key articles were also hand-searched for additional relevant studies.

Study Selection

Inclusion criteria were: (1) studies of adult participants (≥18 years old) with chronic tinnitus; (2) use of standardized cognitive assessments or questionnaires to evaluate domains such as attention, memory, executive function, language, or general cognition (e.g., MMSE, MoCA, Stroop test, Trail Making Test, COWAT, RBANS-H); and (3) reported quantitative data on tinnitus severity and cognitive performance. Both cross-sectional and experimental studies were eligible. Exclusion criteria were: (1) participants under 18; (2) objective tinnitus (i.e. with identifiable somatic or vascular cause); (3) concurrent neurodegenerative disease; (4) use of known ototoxic drugs; (5) life-threatening illnesses (e.g., active cancer) that could affect cognition; (6) studies lacking validated tinnitus or cognitive measures; and (7) studies not reporting cognitive outcomes in relation to tinnitus. Four reviewers independently screened titles and abstracts, and then reviewed the full texts for eligibility. Discrepancies were resolved by consensus.

Data Extraction

From each included study, we extracted: author and year, study design, sample size, participant age range and gender distribution, audiological assessments (e.g., pure-tone audiometry, speech recognition), hearing status of tinnitus and control groups, and details of tinnitus (duration, laterality, type, severity scores such as THI, TQ, or THQ). We also recorded cognitive outcome measures and main findings (e.g., reaction times, test scores, correlation coefficients, p-values). Key statistics (means, SDs, effect sizes, p-values, correlations) were noted when available. Three authors independently extracted data to ensure accuracy.

Risk of Bias Assessment

Study quality and risk of bias were assessed using the Mixed Methods Appraisal Tool (MMAT, 2018). Each study was rated on methodological criteria relevant to its design (cross-sectional, observational, experimental). Of the 16 studies, ten were judged to have a low risk of bias, and six a moderate risk; none were rated as high risk. Common limitations included small sample sizes and a lack of blinding in cognitive testing.

RESULTS

Study Characteristics

The PRISMA flow diagram **(Figure 1)** depicts the study selection process. From 24,395 initial records, 16 studies (total N≈1057) met the inclusion criteria. Sample sizes ranged from 14 (Pierce et al., 2012) to 146 (Neff et al., 2021). Study designs included cross-sectional (n=7), case-control (n=1), prospective or longitudinal (n=3), and experimental paradigms (n=5). Participant ages spanned 18–75 years. Hearing status varied: many tinnitus groups had normal-to-mild hearing loss in one ear, and most controls had normal hearing. Tinnitus characteristics are summarized in **Table 2**. Roughly 20–70% of tinnitus cases were unilateral, with the remainder bilateral or undefined. Tinnitus duration was typically ≥3–6 months; one study (Neff et al., 2021) required a minimum of 3 months. Tinnitus quality was mostly pure-tone or high-frequency; severity scores (THI, TQ) varied widely (e.g., Stevens et al. 2007 reported THI means ~47.6 for tinnitus vs. 1.55 for controls).

- **Cognitive measures:** A variety of tests were employed **(Table 1).** Global cognition was assessed using the MMSE or MoCA. Attention and executive function were assessed via Stroop tasks, Trail Making Tests (TMT-A/B), Attention Network Test (ANT), digit-dichotic tests, or video display tests. Verbal fluency was assessed using the COWAT/FAS test. Working memory was assessed with tasks such as the reading span. Visuospatial/constructional skills were utilized in RBANS-H subtests. The impact of tinnitus was measured using inventories (THI, TQ, THQ, TEQ, PSQ). Anxiety/depression were measured by HADS, PHQ, STAI, etc.

TABLE 1. SUMMARY OF CHARACTERISTICS OF ALL STUDIES INCLUDED IN THE SYSTEMATIC REVIEW.

Author	Study Type	Sample Size	Gender	Age (years)	Outcome measures	Audiologic Assessments	Hearing status
Andersson et al., 2000	Mixed-design	46	NM	20-68	Emotional Stroop task, WAIS-R, S-TQ	PTA, Tinnitus Loudness Match	C: Normal B/L E: Normal in better ear Mild HL in worse ear
Brueggemann et al., 2021	Cross-sectional observational	107	M = 49 F = 58	22-73	TQ, Stroop Test, d2-Test, PSQ, coping: SWOP	PTA, Tinnitus Matching	Normal B/L
Cardon et al., 2019	Cross-sectional prospective	56	M = 28 F = 28	60-62	RBANS, Visuospatial Scale, TFI, VAS, HADS, HQ	PTA, SRT in quite	Normal-Moderate B/L
Ciencias et al., ,2010	Cross-sectional observational	45	M = 6 F = 39	19-30	THI, GIN, SNT, DDT	PTA	Normal B/L
Fetoni et al., 2021	Observational	102	Male = 42 F = 60	>55	THI, HADS-A, HADS-D, MMSE	Otoscopy, Tympanometry, Acoustic Reflex, PTA	Mild HL B/L
Gudwani et al. 2017	Prospective NRCT	25	M = 14 F = 11	20-45	VAIS, WAIS, HHI, THQ	PTA, HFA, EHA, SRT, SDS, MCL, UCL, Tinnitus pitch and Loudness Matching, Residual Inhibition	Mild-Moderate HL B/L
Hallam et al., 2004	Case control	92	M = 58 F =34	20-60	STAI, CFQ, NART	Not mentioned PTA for TIG and HIG only	HIG: Mild HL B/L TIG: Normal B/L
Heeren et al., 2014	Comparative experimental	40	M = 20 F = 20	20 - 72	QIPA, ANT	Not mentioned	Not measured

Jackson et al., 2014	Cross-sectional	66	M = 33 F = 33	Mean = 48.18	STSS, VDT, HADS, STROOP Paradigm	Not mentioned	Not mentioned
Lee et al., 2020	Prospective	58	M= 23 F = 35	>65	K-PHQ-9, MOCA-K, K-IADL, THI, VAS	PTA, Tinnitus Pitch and Loudness Matching	MCI: Mild HL B/L Non-MCI: Normal B/L
Neff et al., 2021	Longitudinal intervention	146	M = 72 F = 74	18-75	TMT-A, TMT-B, MWT-B, HADS, PSQ, ICD-10	PTA, SIN	Mild HL B/L
Pierce et al., 2012	Observational	14	M = 10 F = 4	18-60	THI, COWAT/FAS, CVLT	PTA, SRT	Mild HL B/L Severe HL in a few participants
Qi et al., 2024	Cross-sectional observational	124	M = 75 F = 49	20-50	TEQ, PSQI, MoCA	Tinnitus Loudness Match, PTA	Normal B/L
Rossiter et al; 2006	Experimental	38	M = 29 F = 9	30-63	NART, Reading Span Test, STAI, CFQ, TRQ	Not mentioned	Not mentioned
Stevens et al., 2007	Experimental	22	M = 12 F = 10	18-65	TQ, NART, STAI, BDI-II	PTA	C: Mild-Profound HL B/L E: Moderate-Severe HL B/L
Waechter et al., 2021	Cross-sectional	76	M = 32 F = 44	23.3-66.3	THI, HADS, n-back test	Otoscopy, PTA, BEHFPTA	C: Normal-Severe HL B/L E: Normal-Moderate HL B/L

PTA: Pure Tone Audiometry, SRT: Speech Recognition Thresholds, C: Control group, E: Experimental group, THI, Tinnitus handicap inventory; GIN, Gap-in-noise, SIN/SNT, Speech-in-Noise; DDT, Dichotic Digits test; WAIS, Wechsler Adult Intelligence Scale; S-TQ, Short Tinnitus Questionnaire; TQ, Tinnitus Questionnaire; PHQ, Patient Health Questionnaire; SWOP, Self-efficacy, optimism and pessimism; RBANS, Repeatable Battery for the Assessment of Neuropsychological Status; TFI, Tinnitus Functional Index; VAS, Visual Analog Scale; HADS, Hospital Anxiety & Depression Scale; MMSE, Mini Mental State Examination; VAIS, Verbal Adult Intelligence Scale; ; HHI, Hearing Handicap Inventory; THQ, Tinnitus Handicap; STAI, State-Trait Anxiety Inventory; CFQ, Cognitive Failure Questionnaire; NART, National Adult Reading Test; QIPA, Questionnaire on Psychological Impact of Tinnitus; ANT, Attention Network Test; STSS, Secondary Traumatic Stress Scale; VDT, Vedio Display Terminal; MoCA, Montreal Cognitive Assessment; IADL, Instrumental Activities of Daily Living; TMT, trail-making tests; MWT-B, Multiple Choice Vocabulary test; ICD, International Classification of Diseases; COWAT, Controlled Oral Word Association Test; CVLT, California Verbal Learning Test; TEQ, Tinnitus Evaluation Questionnaire; PSQI, Pittsburgh Sleep Quality Index; TRQ, Tinnitus Reaction Questionnaire; BDI, Beck Depression Inventory

Table 2. CHARACTERISTICS OF TINNITUS IN THE INCLUDED STUDIES.

Author	**Laterality**	**Duration (months/years)**	**Type**	**Tinnitus Score (mean ± SD or %)**
Andersson et al., 2000	Left 13%; Right 17%; Equal 70%	Mean = 6.3 y (SD 4.1)	Subjective	STQ: 70.3 (22.8)
Brueggemann et al., 2021	Not specified	<3 months	Chronic subjective	TQ: 37.73
Cardon et al., 2019	U/L: 50%; B/L: 18%; Central 32%	≥6 months (mean 5.7 y)	Chronic subjective	TFI 37–38 (no VAS/HADS/HQ scores)
Ciências et al., 2010	B/L: 100%	≤5 y in 53.3%; >5 y in 46.7%	Continuous (pure tone)	THI avg 12.3
Fetoni et al., 2021	U/L: 30%; B/L: 70%	≥6 months (mean 47.4 mo; 4–240 mo)	Subjective	THI 32.8 ± 22.5
Gudwani et al., 2017	U/L: 68%; B/L: 32%	Onset ≥2.5 months	Non-pulsatile chronic	THI 28.00 ± 9.55
Hallam et al., 2004	Not specified	Not specified	Chronic subjective	–
Heeren et al., 2014	U/L & B/L	10.90 years	Constant subjective	QIPA: pres. 6.40/7 (t>3.66, p<.001)
Jackson et al., 2014	Not specified	Not specified	Low/moderate tinnitus	STSS: Ctrl=0; Tinnitus=7.06 (2.38)
Lee et al., 2020	U/L: 48%; B/L: 51%	≥6 months (mean 2 y)	Chronic subjective	THI≥30: MCI 33.6; Non-MCI 21.9

Neff et al., 2021	Not specified	≥3 months (mean 180 d)	Chronic subjective	TQ mean 33.1 (8–80, range 72)
Pierce et al., 2012	U/L: 35%; B/L: 64%	≥6 months (median 7.0 y; 0.5–17.9 y)	Non-pulsatile subjective	THI≥38: median 51 (38–76)
Qi et al., 2024	Not specified	>6 months	Persistent high-freq	– (not reported)
Rossiter et al., 2006	U/L: 27%; B/L: 73%	>3 months	Chronic moderate	TQ 36.39 (0–74)
Stevens et al., 2007	U/L: 19%; B/L: 81%	>2 years	Constant severe	TQ exp 47.64 (2–81); ctrl 1.55 (0–4)
Waechter et al., 2021	U/L: 21%; B/L: 60%; Undefinable 18%	6 months	Chronic subjective	THI 35.3 ± 21.4 (6–84)

Table 3. SUMMARY OF COGNITIVE DOMAINS AND IMPACT OF TINNITUS.

Author	Cognitive Domains	Impact on Cognition	Impact on Quality of Life
Andersson et al., 2000	Attention; Executive function; Processing speed	Overall impaired performance; worse Stroop scores (slower naming)	Cognitive inefficiency may disrupt daily functioning
Brueggemann et al., 2021	Attention; Working memory; Executive function	Greater tinnitus distress → larger deficits in attention and inhibition	Impaired attention/concentration likely affects routines
Cardon et al., 2019	Memory; Language; Attention	Tinnitus loudness linked to poorer semantic fluency (executive task)	Semantic fluency deficits may impair communication
Ciências et al., 2010	Sensation & perception; Attention; Working memory	Mild tinnitus did not impair selective attention or temporal resolution	No significant impact observed
Fetoni et al., 2021	Attention; Calculation; Memory; Language; Visuospatial	No overall relation with tinnitus severity, though verbal fluency was lower	Mild discomfort reported (age/hearing factors involved)
Gudwani et al., 2017	Memory; Perceptual & visual-motor	Tinnitus group showed poorer attention, memory, and visuomotor scores	Patients exhibited moderate/severe brain-function dysfunction
Hallam et al., 2004	Attention & concentration; Memory; Language	Tinnitus patients had higher cognitive-failure scores; worse Stroop	Increased concentration difficulties reported
Heeren et al., 2014	Attention; Executive function	No general attention deficit; impaired top-down executive control	Likely indirect reduction in quality of life
Jackson et al., 2014	Attention; Executive function; Processing speed	Severe tinnitus led to slower Stroop and VDT responses; more errors	Slower processing may indirectly affect daily tasks
Lee et al., 2020	Attention; Memory; Concentration	High tinnitus severity associated with mild cognitive impairment (lower MoCA)	Mild reduction in quality of life (MCI risk relevant)
Neff et al., 2021	Processing speed; Executive function; Attention	Higher tinnitus distress was linked to poorer executive performance; processing speed unaffected	Tinnitus distress and hearing loss may jointly lower cognitive capacity
Pierce et al., 2012	Attention; Memory; Processing speed	Initial deficits in learning/recall on first session; improved on retest	70% reported sleep problems; practice mitigated deficits
Qi et al., 2024	Processing speed	Tinnitus patients had slower visual processing speed (risk factor)	Slower processing speed can affect daily cognitive tasks
Rossiter et al., 2006	Memory; Attention	Only moderate-tinnitus patients showed memory impairments	Chronic tinnitus affected working memory beyond verbal ability
Stevens et al., 2007	Attention	Severe tinnitus associated with slower Stroop performance (depleted resources)	Selective attention deficits may impair performance under demand
Waechter et al., 2021	Working memory	Mixed results: tinnitus may impair some working memory tasks	Tinnitus distress correlated with reduced concentration

Impact on Quality of Life

Although most studies have focused on cognitive tests rather than direct quality-of-life measures, several authors have noted that cognitive strain from tinnitus can significantly impact daily life. For example, Andersson et al. (2000) hypothesized that slower information processing could indirectly disrupt routine functioning. Others pointed out that deficits in attention and executive control (e.g., Heeren et al., 2014) would likely lead to a reduction in overall well-being. In general, impaired concentration and memory in tinnitus sufferers were said to contribute to poorer sleep, reduced work productivity, and increased frustration (Brueggemann et al., 2021; Yetiser et al., 2002), exacerbating emotional distress.

DISCUSSION

This systematic review found consistent evidence that chronic tinnitus in adults is associated with domain-specific cognitive impairments, particularly in attention and executive functions, rather than a broad global decline. Fourteen of the 16 included studies reported that tinnitus patients performed worse than controls on demanding cognitive tasks (Tables 2–3). However, the studies varied widely in design, participant characteristics, and control of confounding factors. Many did not adequately match tinnitus and control groups for age, hearing ability, or education, all of which independently affect cognition (Dupuis et al., 2015; Lin et al., 2011). For example, unbalanced hearing loss could confound an apparent "tinnitus effect" if worse hearing leads to degraded auditory input during testing (Cuny et al., 2004). Psychological factors were also unevenly controlled; patients with severe tinnitus often had higher anxiety or depression (Andersson et al., 2005; Zöger et al., 2006), which can bias attention and memory. Therefore, some observed deficits may reflect these confounds (Hallam et al., 1984; Stevens et al., 2007) rather than tinnitus per se.

Domain-specific impairments

Consistent with recent literature (Clarke et al., 2020), our review suggests tinnitus is linked to specific deficits in attention, working memory, and executive control. Many studies (Andersson et al., 2000; Jackson et al., 2014; Stevens et al., 2007) found that tinnitus patients had slower reaction times or lower accuracy on tasks requiring inhibitory control and divided attention (Stroop, TMT, dual-task paradigms). In contrast, performance on automatic or well-practiced tasks (such as word reading or simple recall) was typically similar to controls (Rossiter et al., 2006; Waechter et al., 2021). This aligns with the idea that tinnitus primarily consumes top-down attentional resources, affecting only the more demanding conditions. Notably, Brueggemann et al. (2021) and others reported that higher tinnitus distress predicted greater attentional deficits, suggesting a dose–response effect.

Memory deficits in tinnitus were generally subtle. Some studies noted initial learning impairments that improved with practice (Pierce et al., 2012), indicating a capacity to compensate. Working memory (e.g. N-back tasks) showed mild declines in relation to tinnitus severity (Waechter et al., 2021), especially when hearing and mood were accounted for. Language and verbal fluency were sometimes affected: Cardon et al. (2019) found lower semantic fluency in tinnitus patients, possibly reflecting executive control difficulties rather than pure language impairment.

Mechanisms: cognitive load and neural models

The prevailing hypothesis is the **cognitive load model**, which posits that the constant phantom sound of tinnitus imposes a background load on attention (Paul et al., 2014; Burton et al., 2012). Neuroimaging supports this, showing altered activity in the fronto-insular and parietal regions in tinnitus patients (Burton et al., 2012; Lee et al., 2020). Electrophysiological studies (ERP P300) indicate slower stimulus processing and allocation of attention in tinnitus (Paul et al., 2014). Some have proposed a "cascade" or "common cause" model: tinnitus (often with hearing loss) may be a marker of accelerated neural aging, jointly affecting auditory and cognitive circuits (Waechter et al., 2021). In sum, tinnitus may both directly tax attention and reflect underlying neural vulnerability.

Hearing loss and age

Since hearing loss is strongly associated with tinnitus, disentangling their effects is a challenging task. Even mild hearing impairment can simulate cognitive slowing equivalent to several years of aging (Lin et al., 2011). Many tinnitus patients delay hearing treatment (Davis et al., 2007), potentially accelerating cognitive decline. Studies that did not control for hearing (Dupuis et al., 2015; Cuny et al., 2004) cannot isolate the effect of tinnitus alone. Some pooled analyses suggest older tinnitus patients (60+) have a particularly high risk of cognitive decline and dementia (Clarke et al., 2020). Interestingly, a recent study found improved cognition in elderly tinnitus patients with hearing loss (Hamza & Zeng, 2021), possibly reflecting a cognitive reserve or selection effect. Overall, age and hearing likely interact with tinnitus; their combined effect appears to be greater than that of tinnitus alone.

Emotional distress and somatic focus

Anxiety and depression are common in severe tinnitus (Andersson et al., 2005; Zöger et al., 2006) and independently impair cognition (Stevens et al., 2007). Chronic stress may induce a bodily-attention bias, making tinnitus sufferers more aware of lapses (Stevens et al., 2007). In some studies, working memory deficits in tinnitus patients became non-significant after adjusting for mood (Waechter et al., 2021), suggesting that distress mediates cognitive complaints. On the other hand, some deficits (e.g. dual-task slowing) persisted after controlling for anxiety/depression (Stevens et al., 2007). In practice, high tinnitus distress and mood disorders likely compound each other, exacerbating subjective cognitive difficulties.

Limitations of the evidence

The heterogeneity of methods and samples is a key limitation. Sample sizes were often small (many N<50), reducing statistical power. Most studies were cross-sectional; only Neff et al. (2021) tested the same patients over time. Variability in cognitive tests used also complicates synthesis. We did not perform a meta-analysis due to this heterogeneity; thus, no pooled effect sizes are given here. Publication bias is possible (studies finding no effect may remain unpublished). Finally, because this is a review of published data, it inherits any biases of the original studies.

Clinical implications

The interplay between tinnitus, hearing, mood, and cognition suggests a **multifaceted treatment approach**. Clinicians should screen chronic tinnitus patients reporting "brain fog" or concentration problems with brief cognitive tests (e.g., Stroop, Trail

Making) to identify deficits. Management should target comorbid factors: offer audiological evaluation and hearing rehabilitation (e.g., hearing aids or sound therapy) to address any hearing loss; provide cognitive-behavioral therapy or mindfulness to reduce tinnitus distress; and consider cognitive training exercises or attentional retraining to strengthen executive control. Addressing insomnia, stress, and substance use is also important. Some evidence (Heeren et al., 2014; Holmes & Padgham, 2011) suggests that counseling and attention retraining can improve both tinnitus symptoms and cognitive complaints.

Conclusion

In summary, chronic tinnitus in adults is associated with specific cognitive impairments, particularly in attentional control and executive function, rather than a diffuse cognitive decline. These difficulties are more pronounced in individuals with severe tinnitus and coexisting emotional distress or hearing loss. However, methodological inconsistencies across studies (in sample selection, hearing controls, and cognitive measures) preclude definitive conclusions. Future research should employ standardized cognitive batteries, recruit well-matched controls, and use longitudinal designs to disentangle causal relationships. Clinically, our findings underscore the importance of considering cognitive evaluation and treatment in conjunction with traditional tinnitus therapies. A comprehensive care plan should address tinnitus severity, hearing deficits, and psychological factors to improve both quality of life and cognitive outcomes for tinnitus patients.

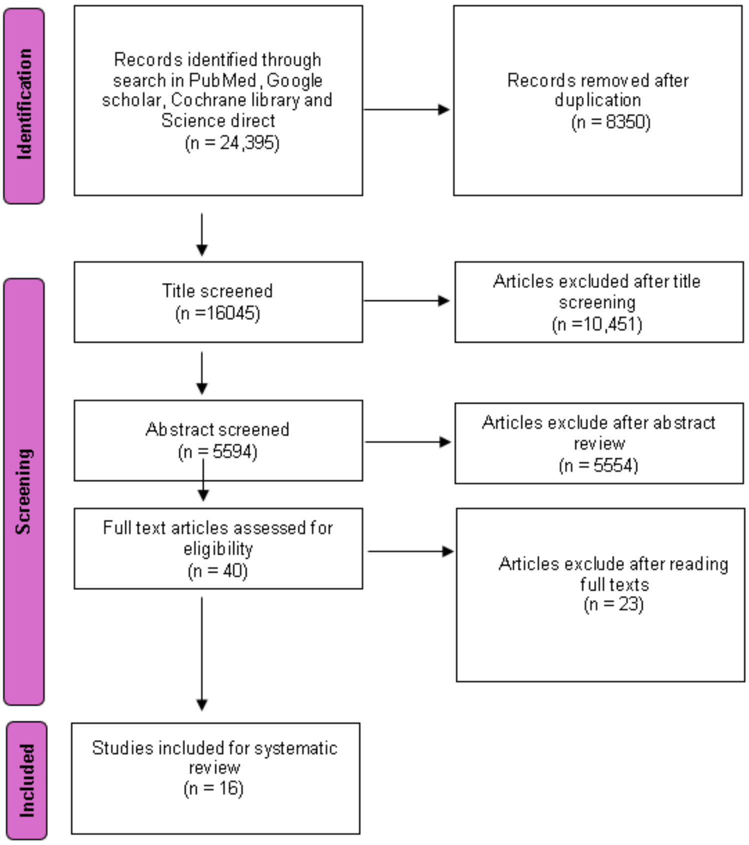

Figure 1. PRISMA Flow Chart for the identification of studies included in the systematic review

References

1. Andersson, G. (2002). Psychological aspects of tinnitus and the application of cognitive–behavioral therapy. *Clinical Psychology Review*, 22(7), 977–990. https://doi.org/10.1016/S0272-7358(01)00124-6
2. Andersson, G., Bakhsh, R., Johansson, L., Kaldo, V., & Carlbring, P. (2005). Stroop facilitation in tinnitus patients: An experiment conducted via the World Wide Web. *CyberPsychology & Behavior*, 8(1), 32–38. https://doi.org/10.1089/cpb.2005.8.32
3. Andersson, G., Lundh, L.-G., & Lyttkens, L. (2000). Tinnitus and cognitive interference: A Stroop paradigm study. *Journal of Speech, Language, and Hearing Research*. [ResearchGate]https://www.researchgate.net/publication/12264175
4. Andersson, G., & McKenna, L. (2006). The role of cognition in tinnitus. *Acta Oto-Laryngologica*, 126(suppl 556), 39–43. https://doi.org/10.1080/03655230600895226
   Baguley, D., McFerran, D., & Hall, D. (2013). Tinnitus. *The Lancet*, 382(9904), 1600–1607.https://doi.org/10.1016/S0140-6736(13)60142-7
5. Brueggemann, P., Neff, P. K. A., Meyer, M., Riemer, N., Rose, M., & Mazurek, B. (2021). On the relationship between tinnitus distress, cognitive performance and aging. In *Progress in Brain Research* (Vol. 263–285). https://doi.org/10.1016/bs.pbr.2021.01.028
6. Burton, H., Wineland, A., Bhattacharya, M., Nicklaus, J., Garcia, K. S., & Piccirillo, J. F. (2012). Altered networks in bothersome tinnitus: A functional connectivity study. *BMC Neuroscience*,13(1),3.https://doi.org/10.1186/1471-2202-13-3

7. Cardon, E., Jacquemin, L., Mertens, G., van de Heyning, P., Vanderveken, O., Topsakal, V., Hertogh, W., Michiels, S., van Rompaey, V., & Gilles, A. (2019). Cognitive performance in chronic tinnitus patients: A cross-sectional study using the RBANS-H. *Otology&Neurotology*,40(9),E876–E882. https://doi.org/10.1097/MAO.0000000000002403
8. Ciências, F. M. em, Pelo, F. L. D., Acrani, I. O., & Pereira, L. D. (2010). Resolução temporal e atenção seletiva de indivíduos com zumbido. *Revista Brasileira de Otorrinolaringologia*,22(3).
9. Clarke, N. A., Henshaw, H., Akeroyd, M. A., Adams, B., & Hoare, D. J. (2020). Associations between subjective tinnitus and cognitive performance: Systematic review and meta-analyses.*Trends in Hearing*, 24,2331216520918416. https://doi.org/10.1177/2331216520918416
10. Cuny, C., Norena, A., El Massioui, F., & Chéry-Croze, S. (2004). Reduced attention shift in response to auditory changes in subjects with tinnitus. *Audiology and Neurotology*, 9(5), 294–302.https://doi.org/10.1159/000080267
11. Davis, A., Smith, P., Ferguson, M., Stephens, D., & Gianopoulos, I. (2007). Acceptability, benefit and costs of early screening for hearing disability. *Health Technology Assessment*, 11(42). https://doi.org/10.3310/hta11420
12. Dupuis, K., Pichora-Fuller, M. K., Chasteen, A. L., Marchuk, V., Singh, G., & Smith, S. L. (2015). Effects of hearing and vision impairments on the Montreal Cognitive Assessment. *Aging, Neuropsychology, and Cognition*, 22(4), 413–437. https://doi.org/10.1080/13825585.2014.968084
13. Fetoni, A. R., de Cesare, T., Settimi, S., Sergi, B., Rossi, G., Malesci, R., Marra, C., Paludetti, G., & De Corso, E. (2021). The evaluation of global cognitive and emotional status of older patients with chronic tinnitus. *Brain and Behavior*, 11(8). https://doi.org/10.1002/brb3.2074
14. Holmes, S., & Padgham, N. D. (2011). "'Ringing in the ears'": Narrative review of tinnitus and its impact. *Biological Research for Nursing*, 13(1), 97–108. https://doi.org/10.1177/1099800410382290
15. Gudwani, S., Munjal, S. K., Panda, N. K., & Kohli, A. (2017). Association of chronic subjective tinnitus with neuro-cognitive performance. *International Tinnitus Journal*, 21(2). https://doi.org/10.5935/0946-5448.20170018
16. Hallam, R. S., Mckenna, L., & Shurlock, L. (2004). Tinnitus impairs cognitive efficiency. *International Journal of Audiology*, 43(4), 218–226. https://doi.org/10.1080/14992020400050030
17. Hamza, Y., & Zeng, F.-G. (2021). Tinnitus is associated with improved cognitive performance in non-Hispanic elderly with hearing loss. *Frontiers in Neuroscience*, 15, 735950.https://doi.org/10.3389/fnins.2021.735950
18. Han, B. I., Lee, H. W., Kim, T. Y., Lim, J. S., & Shin, K. S. (2009). Tinnitus: Characteristics, causes, mechanisms, and treatments. *Journal of Clinical Neurology*, 5(1), 11–19. https://doi.org/10.3988/jcn.2009.5.1.11
19. Heeren, A., Maurage, P., Perrot, H., Van de Volder, A., Renier, L., Araneda, R., Lacroix, E., Decat, M., Deggouj, N., & Philippot, P. (2014). Tinnitus specifically alters the top-down executive control sub-component of attention: Evidence from the Attention Network Test. *Behavioural Brain Research*, 269, 147–154. https://doi.org/10.1016/j.bbr.2014.04.043
20. Jackson, J. G., Coyne, I. J., & Clough, P. J. (2014). A preliminary investigation of potential cognitive performance decrements in non-help-seeking tinnitus sufferers. *International Journal of Audiology*, 53(2), 88–93. https://doi.org/10.3109/14992027.2013.846481
21. Jarach, C. M., Lugo, A., Scala, M., Van den Brandt, P. A., Cederroth, C. R., Odone, A., Garavello, W., Schlee, W., Langguth, B., & Gallus, S. (2022). Global prevalence and incidence of tinnitus. *JAMA Neurology*, 79(9), 888. https://doi.org/10.1001/jamaneurol.2022.2189
22. Jastreboff, P. J. (1990). Phantom auditory perception (tinnitus): Mechanisms of generation and perception. *Neuroscience Research*, 8(4), 221–254. https://doi.org/10.1016/0168-0102(90)90031-9
23. Jastreboff, P. J., & Hazell, J. W. P. (2004). *Tinnitus retraining therapy*. Cambridge University Press. https://doi.org/10.1017/CBO9780511544989
24. Lee, S. Y., Lee, J. Y., Han, S. Y., Seo, Y., Shim, Y. J., & Kim, Y. H. (2020). Neurocognition of aged patients with chronic tinnitus: Focus on mild cognitive impairment. *Clinical and Experimental Otorhinolaryngology*, 13(1), 8–14. https://doi.org/10.21053/ceo.2018.01914
25. Lin, F. R., Ferrucci, L., Metter, E. J., An, Y., Zonderman, A. B., & Resnick, S. M. (2011). Hearing loss and cognition in the Baltimore Longitudinal Study of Aging. *Neuropsychology*, 25(6), 763–770. https://doi.org/10.1037/a0024238 Neff, P., Simões, J., Psatha, S., Nyamaa, A., Boecking, B., Rausch, L., Dettling-Papargyris,
26. J., Funk, C., Brueggemann, P., & Mazurek, B. (2021). The impact of tinnitus distress on cognition. *Scientific Reports*, 11(1), 2563. https://doi.org/10.1038/s41598-021-81728-0
27. Paul, B. T., Bruce, I. C., Bosnyak, D. J., Thompson, D. C., & Roberts, L. E. (2014). Modulation of electrocortical brain activity by attention in individuals with and without tinnitus. *Neural Plasticity*, 2014, 127824. https://doi.org/10.1155/2014/127824
28. Pierce, K. J., Kallogjeri, D., Piccirillo, J. F., Garcia, K. S., Nicklaus, J. E., & Burton, H. (2012). Effects of severe bothersome tinnitus on cognitive function measured with standardized tests. *Journal of Clinical and Experimental Neuropsychology*, 34(2), 126–134.https://doi.org/10.1080/13803395.2011.623120
29. Qi, M., Liang, Y., Zhao, J., Huang, T., Zhang, S., Li, L., Zeng, X., & Li, Z. (2024). The impact of sleep quality on cognitive function in patients with chronic subjective tinnitus. *Journal of International Advanced Otology*, 20(1), 57–61. https://doi.org/10.5152/iao.2024.231179
30. Rossiter, S., Stevens, C., & Walker, G. (2006). Tinnitus and its effect on working memory and attention. *Journal of Speech, Language, and Hearing Research*, 49(1), 150–160. https://doi.org/10.1044/1092-4388(2006/012)
31. Stevens, C., Walker, G., Boyer, M., & Gallagher, M. (2007). Severe tinnitus and its effect on selective and divided attention. *International Journal of Audiology*, 46(5), 208–216. https://doi.org/10.1080/14992020601102329

32. Vielsmeier, V., Lehner, A., Strutz, J., Steffens, T., Kreuzer, P. M., Schecklmann, M., Landgrebe, M., Langguth, B., & Kleinjung, T. (2015). The relevance of high-frequency audiometry in tinnitus patients with normal hearing in conventional audiometry. *BioMed Research International*, 2015, 302515. https://doi.org/10.1155/2015/302515
33. Vanneste, S., Van de Heyning, P., & De Ridder, D. (2011). The neural network of phantom sound changes over time: A comparison between recent-onset and chronic tinnitus patients. *European Journal of Neuroscience*, 34(5), 718–731. https://doi.org/10.1111/j.1460-9568.2011.07793.x
34. Waechter, S., Wilson, W. J., & Brännström, J. K. (2021). The impact of tinnitus on working memory capacity. *International Journal of Audiology*, 60(4), 274–281. https://doi.org/10.1080/14992027.2020.1822550
35. Yetiser, S., Tosun, F., Satar, B., Arslanhan, M., Akçam, T., & Özkaptan, Y. (2002). The role of zinc in management of tinnitus. *Auris Nasus Larynx*, 29(4), 329–333. https://doi.org/10.1016/S0385-8146(02)00023-8
36. Zöger, S., Svedlund, J., & Holgers, K.-M. (2006). Relationship between tinnitus severity and psychiatric disorders. *Psychosomatics*, 47(4), 282–288. https://doi.org/10.1176/appi.psy.47.4.282