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*Review*

# Early detection of auditory dysfunction in rheumatoid arthritis: Bridging the gap between rheumatology and audiology for improved diagnosis and patient outcomes in the African context

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**Abstract:** *Background:* Auditory dysfunction, particularly sensorineural hearing loss (SNHL), is increasingly recognized as an extra-articular manifestation of rheumatoid arthritis (RA). However, its early detection and management remain underexplored, especially within African healthcare systems, where interdisciplinary collaboration between audiologists and rheumatologists is limited. *Objectives:* This narrative review synthesizes peer-reviewed evidence on the prevalence, characteristics, and mechanisms of auditory dysfunction in adults with RA, with a focus on applicability to African contexts and similar low- and middle-income countries (LMICs). It advocates for integrating routine audiological screening into RA care to improve diagnostic and patient outcomes. *Methods:* A narrative review was conducted using 29 peer-reviewed studies published from 2000 onward, identified via PubMed, Scopus, Web of Science, and Google Scholar. Studies focused on adult RA populations and included audiological assessments such as pure tone audiometry, tympanometry, OAEs, and auditory evoked potentials. Data were synthesized thematically across five objectives. *Results:* Five interrelated themes emerged from the synthesis: (1) the prevalence and types of auditory dysfunction in RA; (2) audiological assessment methods and patterns of impairment; (3) proposed pathophysiological mechanisms linking RA and hearing loss; (4) relationships between auditory dysfunction, disease activity, duration, and treatment; and (5) implications for early detection and integrated care, particularly within African and LMIC contexts. Sensorineural hearing loss (SNHL) was the most

prevalent type, affecting up to 71% of RA patients. Conductive and mixed hearing losses (CHL and MHL) were also reported, often associated with middle ear and ossicular involvement. Mechanisms included immune-mediated cochlear inflammation, vasculitis, and potential ototoxicity. Several studies reported weak or inconsistent associations between RA disease activity and hearing loss, suggesting a need for independent audiological monitoring. African studies reflected similar trends while highlighting systemic barriers to early detection. *Conclusion:* Hearing loss is a neglected comorbidity in RA. Integrating audiological services into rheumatology, especially in African and LMIC settings, offers an opportunity for early detection, patient-centered care, prevention of communication and cognitive decline, and improved interdisciplinary patient management.

**Keywords**: Rheumatoid arthritis; hearing loss; audiology; Africa; early detection; sensorineural hearing loss; preventive audiology; interdisciplinary care

## 1. Introduction

Rheumatoid arthritis (RA) is a chronic, systemic autoimmune condition that affects approximately 0.5–1% of the global population, with increasing prevalence in low- and middle-income countries (LMICs), including regions in Africa. RA primarily affects synovial joints but is widely recognized as a multisystem disease with extra-articular manifestations, including cardiovascular, pulmonary, dermatological, ocular, and neurological complications [1]. Among these, auditory dysfunction remains an under-recognized yet clinically significant comorbidity [2–7], despite its potential to significantly affect patient outcomes. In this review, the term *auditory dysfunction* is used as an umbrella concept encompassing hearing loss (sensorineural, conductive, or mixed), auditory processing abnormalities, and related otologic manifestations. The terms *hearing loss* and *hearing impairment* are used only when referring to specific outcomes reported in individual studies. Hearing loss, particularly sensorineural hearing loss (SNHL, has been reported in RA patients with increasing frequency over the past two decades. This emerging evidence suggests that auditory structures, particularly the cochlea and ossicular joints, may be directly or indirectly affected by RA pathology.

Global emerging data indicate that adult patients with RA may have up to a fourfold increased risk of hearing loss compared to the general population [7], with reports indicating that the prevalence of hearing loss in RA varies widely, from 15% to over 70%, with sensorineural, conductive, and mixed types all reported [3,7]. SNHL is the most commonly documented type, often affecting high frequencies [7] and associated with cochlear pathology, while conductive hearing loss (CHL), by contrast, has been associated with ossicular joint stiffness or pannus formation. Proposed mechanisms include direct involvement of the ossicular joints (incudomalleolar and incudostapedial) leading to stiffness, autoimmune inner-ear inflammation, immune complex deposition, vasculitis affecting the auditory nerve or microvasculature, and medication-induced ototoxicity from RA pharmacotherapy, particularly disease-modifying anti-rheumatic drugs (DMARDs) and non-steroidal anti-inflammatory drugs (NSAIDs) [8,9]. Additionally, some studies have documented brainstem and central auditory processing abnormalities in RA, indicating a possible spectrum of auditory pathology [10]. Despite the

accumulating global evidence, auditory screening is rarely included in RA management protocols, and hearing assessments are not routinely integrated into rheumatological practice, particularly in LMICs where rheumatology and audiology remain siloed disciplines and where resource constraints and limited interdisciplinary collaboration hinder comprehensive care [2,3,6]. In Africa, the challenges are compounded by constrained resources, a lack of policy-driven screening programs, and limited awareness among both clinicians and patients. However, a small but growing body of African studies, from Egypt, Sudan, South Africa, and Morocco; confirms both the presence and neglect of this comorbidity on the continent [2,4,11]. This is concerning as, in addition, the potential ototoxic effects of some DMARDs and biologics used to treat RA, which are increasingly being introduced in African settings, reinforce the need for proactive hearing monitoring and surveillance [6].

In the African context, where systemic health inequities intersect with a high burden of communicable and non-communicable diseases, the underdiagnosis and undertreatment of auditory dysfunction in RA populations pose a compounded threat to patient well-being. Given the cumulative risks to quality of life of cognitive decline, depression, social isolation, and reduced treatment adherence associated with untreated auditory dysfunction, the need for early detection is urgent. For individuals living with RA, who already face chronic pain, fatigue, and functional impairment, the additive burden of auditory dysfunction may further compound disability and treatment burden. In the absence of routine screening, many of these individuals are left without diagnosis, assistive interventions, or rehabilitative support. Thus, interdisciplinary collaboration between rheumatologists and audiologists is essential to provide holistic, patient-centered care.

Audiological research within RA populations is scarce but growing within the African context. Recent studies from Egypt, Sudan, and South Africa confirm the global trends of high hearing loss prevalence in RA, while also identifying unique regional challenges, such as a lack of screening guidelines, insufficient access to audiologists, and underreporting of auditory complaints [4,5,6]. These findings highlight a critical need for preventive audiology in African RA care.

This narrative review, therefore, seeks to bridge the disciplinary gap between rheumatology and audiology by:

- Synthesizing current peer-reviewed evidence on the prevalence and types of auditory dysfunction in adults with RA;
- Exploring the mechanisms underlying this dysfunction;
- Identifying barriers to early detection in clinical practice; and
- Proposing context-sensitive strategies for the integration of audiological screening into RA care pathways, with a special focus on the African context.

## 2. Methods

### *2.1. Study design*

This study adopted a narrative review design [12] to synthesize peer-reviewed evidence on auditory dysfunction in adults with RA. The review aimed to explore the prevalence, characteristics, underlying mechanisms, and clinical implications of hearing loss in RA, with a particular focus on the African context. A narrative review was selected to accommodate a broad range of study designs (e.g.,

clinical studies, reviews, and scoping studies), enable thematic synthesis across diverse data types, account for the limited number of African-context studies, and provide a contextualized interpretation relevant to healthcare systems in Africa and other LMICs. The review adhered to established narrative synthesis principles, including transparent literature search, systematic data extraction, critical appraisal, and thematic analysis.

### *2.2. Data sources and search strategy*

A comprehensive literature search was conducted in four major databases: PubMed, Scopus, Web of Science, and Google Scholar. The search was restricted to peer-reviewed articles published between January 2000 and March 2025, in the English language. The following keyword combinations were used (individually and in Boolean combinations):

- "rheumatoid arthritis" AND "hearing loss".
- "RA" AND "auditory dysfunction".
- "rheumatoid arthritis" AND "sensorineural hearing loss".
- "RA" AND "audiology".
- "ototoxicity" AND "RA".
- "RA" AND "Africa" AND "hearing".

Additional filters were applied to exclude pediatric studies, editorials, non-English papers, and grey literature. Manual screening of reference lists of included studies and recent reviews was performed to identify any additional relevant publications.

## 3. Inclusion and exclusion criteria

Inclusion criteria:

- Peer-reviewed primary or secondary studies (clinical, observational, or reviews).
- Studies that assessed adult populations (≥18 years) diagnosed with RA.
- Studies that included audiological evaluations, such as pure tone audiometry (PTA), high frequency audiometry (HFA), otoacoustic emissions (OAE), tympanometry, auditory brainstem response (ABR), or speech audiometry.
- Articles reporting data on prevalence, type, or mechanism of hearing loss in RA.
- Studies from any geographic region, with particular inclusion of African-based research.

Exclusion criteria:

- Studies focusing exclusively on juvenile or pediatric RA.
- Case reports, conference abstracts, letters to the editor, and dissertations.
- Articles that did not include an audiological assessment or mention hearing loss.
- Non-English publications.

### *3.1. Selection of studies*

Initial search results yielded 978 articles that were screened by title and abstract. 63 full texts of potentially eligible articles were reviewed against the inclusion criteria. A total of 29 studies were

identified and selected based on the above criteria. These included primary studies (case–control, cross-sectional, cohort), review articles (systematic, scoping, or narrative), and studies focused on African populations.

### *3.2. Data extraction and management*

Data were extracted systematically from each study into a structured evidence table (Table 1). The following key variables were extracted:

- Author(s), year, country.
- Study design and sample characteristics.
- RA diagnostic criteria and patient demographics.
- Audiological assessments used and hearing loss definitions.
- Prevalence and type of hearing loss [SNHL, CHL, mixed hearing loss (MHL)]
- Laterality, correlations with RA disease markers, or medications.
- Proposed mechanisms (e.g., inflammation, vasculitis, drug ototoxicity).
- Key findings, implications, and relevance to African or LMIC contexts.

**Table 1.** Summary of key studies examining hearing loss in adults with rheumatoid arthritis: clinical and contextual insights for Africa.

| Author(s), year, country | Design and sample size | RA Diagnosis and demographics | Audiological assessments used | HL definition | HL prevalence (RA vs. Ctrl) | HL type and laterality | Correlation with RA variables | Proposed mechanism(s) | Key findings and implications | Relevance to the African context |
|---|---|---|---|---|---|---|---|---|---|---|
| Almasi et al., 2023, Iran | Cross-sectional; N = 130 (RA = 100, Ctrl = 30) | Mean age: 53.9; 78% female; RA duration ~12.7 years; RA criteria not stated | PTA (250–8000 Hz), speech audiometry, tympanometry, acoustic reflex, tone decay | >25 dB HL | 71% (RA) vs. not stated | Mainly SNHL (55%–61%); CHL (2%–5%); likely bilateral | HL associated with age, dyslipidemia; not disease duration/DAS28 | Autoimmune inner-ear inflammation; ossicular stiffness | High HL prevalence in RA, mostly SNHL; audiological screening recommended | Indirect (findings generalizable to LMIC settings, particularly those with metabolic comorbidities) |
| Arslan et al., 2011, Turkey | Case–control; N = 88 (RA = 44, Ctrl = 44) | ARA 1987; mean age: 47.2; 91% female; RA duration: 9.8 years | PTA (250–6000 Hz), tympanometry, acoustic reflex | >20 dB HL at any freq | SNHL: 27.3% (RA) vs. 15.9% (Ctrl); CHL: 56.8% (RA) vs. 25% (Ctrl) | CHL more frequent at low freqs; SNHL at high freqs; presumed bilateral | No correlation with age, duration, meds, stage | Ossicular chain stiffness; autoimmune cochlear effects | CHL often under-recognized; screening should include middle-ear tests | Indirect (highlights middle-ear pathology often neglected in LMICs) |
| Chaitidis et al., 2020, multinational (Meta-analysis) | Systematic review/meta-analysis of 12 studies | Mixed populations; diagnostic criteria varied | Mostly PTA (varied across studies) | Varied definitions | SNHL: OR 4.15 in RA; CHL and MHL not significant | SNHL significantly higher in RA | Not assessed | Cochlear inflammation, ossicular arthritis | RA patients have ~4× greater odds of SNHL | Indirect (global evidence base, supports integration into African RA guidelines) |

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| Author(s), year, country | Design and sample size | RA Diagnosis and demographics | Audiological assessments used | HL definition | HL prevalence (RA vs. Ctrl) | HL type and laterality | Correlation with RA variables | Proposed mechanism(s) | Key findings and implications | Relevance to the African context |
|---|---|---|---|---|---|---|---|---|---|---|
| Chen et al., 2024, multinational | Systematic review; 16 studies | Mixed; RA criteria varied | PTA, HFA, OAEs, ABR | Varied | SNHL: 24%–72% | SNHL common (esp. high freq); CHL/MHL less frequent | Not assessed | MMP-related cochlear damage; TNF-α vasculitis | SNHL is the dominant HL type in RA; early high-freq loss common | Indirect (highlights mechanisms relevant in African RA care planning) |
| Demir et al., 2024, Turkey | Case–control; N = 75 (RA = 35, Ctrl = 40) | Mean age: 44.3; RA duration not stated | PTA (125–16,000 Hz), tympanometry, OAEs, efferent suppression | HL if PTA >15 dB | 15.7% (RA); 0% controls | SNHL only; 4 bilateral, 3 unilateral | Not significant | Cochlear inflammation; middle-ear pannus (theoretical) | Subclinical HL detected via OAE; PTA may miss early damage | Indirect (stresses value of HFA/OAEs in early detection, applicable to LMICs) |
| Deswal et al., 2021, India | Case–control; N = 50 (RA = 25, Ctrl = 25) | ACR 1987; 100% female; all >5 yrs RA | PTA (250–8000 Hz) | >25 dB HL | HL: 36% (RA); control group not reported | SNHL: 24 | | | | |
| El Dessouky et al., 2017, Egypt | Case–control; ~N = 80 (RA ≈40; Ctrl ≈40) | RA diagnosis method not reported; demographics not clearly specified | PTA (0.5–8 kHz), tympanometry, speech audiometry, ENG/VNG | Not specified | RA had significantly poorer high-frequency thresholds | SNHL at high frequencies; vestibular dysfunction in 30% | No correlation with disease duration, vertigo, or lab parameters | Immune-mediated inner ear damage | Audiovestibular dysfunction common in RA; highlights need for comprehensive testing | Yes (North African study; directly applicable to African context) |

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| Author(s), year, country | Design and sample size | RA Diagnosis and demographics | Audiological assessments used | HL definition | HL prevalence (RA vs. Ctrl) | HL type and laterality | Correlation with RA variables | Proposed mechanism(s) | Key findings and implications | Relevance to the African context |
|---|---|---|---|---|---|---|---|---|---|---|
| Eldin et al., 2023, Sudan | Case–control; N = 107 (RA = 66, Ctrl = 41) | ACR/EULAR 2010; mean age ~40.8; 92% female | PTA (0.125–8 kHz), tympanometry, acoustic reflex testing | >25 dB HL | 54.5% (RA) vs. 22% (Ctrl) | SNHL most common (~60%); CHL (~30%); mixed (~3%) | No correlation with disease activity or medications | Ossicular stiffness; cochlear inflammation | RA patients had significantly more HL; both SNHL and CHL present | Yes (only Sub-Saharan African dataset; essential to regional relevance) |
| Elnagdy et al., 2022, Egypt | Cross-sectional; N = 50 RA | ACR/EULAR 2010; age: 16–50; median disease duration: 8 years | PTA, extended high-frequency audiometry (9–16 kHz), OAEs, tympanometry | >25 dB HL | 20% had HL (PTA); 46% had abnormal OAEs | SNHL implied; subclinical HL detected via OAE | Not assessed | Cochlear inflammation or drug-induced damage suspected | Subclinical cochlear damage in RA even with normal PTA; OAEs valuable | Yes (North African study; supports early detection in African RA care) |
| Emamifar et al., 2016, Denmark | Narrative review | Broad inclusion; not population-specific | Varied across included studies: PTA, OAE, ABR | Varied | HL in RA commonly reported; SNHL dominant | SNHL > CHL; laterality varies by study | Some studies found correlation with disease duration, age | Autoimmune cochlear damage; ossicular arthritis; ototoxicity | Recommends audiological monitoring in RA patients | Indirect (reinforces case for integrated screening models in Africa) |
| Emamifar & Hansen, 2018, Denmark | Narrative review | Global review of published evidence | PTA, OAEs, tympanometry, ABR (varies by study) | Varied | HL in RA reported widely | SNHL most common; CHL and MHL also observed | Some studies link HL with longer RA duration and/or older age | Vasculitis, ossicular joint inflammation, drug toxicity | Strong recommendation for regular hearing testing in RA | Indirect (supports inclusion of HL monitoring in African RA protocols) |

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| Author(s), year, country | Design and sample size | RA Diagnosis and demographics | Audiological assessments used | HL definition | HL prevalence (RA vs. Ctrl) | HL type and laterality | Correlation with RA variables | Proposed mechanism(s) | Key findings and implications | Relevance to the African context |
|---|---|---|---|---|---|---|---|---|---|---|
| Essa et al., 2024, Pakistan | Case–control; N = 90 (RA = 60; Ctrl = 30) | Mean age 32.9 years; 75% female; disease duration not reported | PTA (0.25–8 kHz), Tympanometry | >25 dB HL | Significantly worse thresholds in RA; controls all normal | SNHL; bilateral in majority; right ear more affected | Duration suspected to be linked to severity (not quantified) | Cochlear inflammation likely | RA patients show HL at younger ages; early screening essential | Relevant (Pakistan as LMIC with similar health service challenges to African settings) |
| Gökçe et al., 2019, Turkey | Case–control; N = 60 (RA = 30, Ctrl = 30) | RA diagnosis not stated; demographics limited | PTA (AC and BC), tympanometry, TEOAE | Not clearly defined | CHL significantly more in RA; SNHL minimal | CHL mostly bilateral; SNHL limited to high freqs | Not evaluated | Ossicular joint stiffness; middle ear involvement | RA patients had higher thresholds; CHL more prevalent than expected | Relevant (supports inclusion of middle ear tests in LMICs incl. Africa) |
| Halligan et al., 2006, USA | Case–control; N = 59 (RA = 29; Ctrl = 30) | RA > 5 years; Age 40–69; matched by decade and gender | PTA, speech recognition, tympanometry, AR, OAEs | HL at any frequency | 59% (RA) vs. 47% (Ctrl) | Mostly SNHL; CHL and mixed less common; bilateral | Not statistically significant; subjective complaints more frequent in RA | Possibly inflammatory; subjective vs. objective discrepancies noted | RA patients perceived more hearing disability despite similar audiometric findings | Indirect (highlights under-recognition of hearing complaints; relevant to LMICs with limited screening) |

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|---|---|---|---|---|---|---|---|---|---|---|
| Ismaiel et al., 2021, Egypt | Case–control; N = 50 (RA = 25; Ctrl = 25) | ACR/EULAR 2010; age 50–60; all female | Brainstem auditory evoked potentials (BAEP) | Not applicable (latency measures) | N/A (no HL prevalence, focus on central pathways) | Delayed Wave I, III, V latencies in RA group; bilateral | BAEP delays correlated with disease activity and duration | Vasculitis, central auditory pathway involvement | RA patients had delayed auditory processing at brainstem level | Yes (North African study; supports need to assess central auditory dysfunction in RA) |
| Jabbar et al., 2022, Pakistan | Cross-sectional; sample size unclear | Demographics and diagnostic criteria not clearly reported | PTA (assumed); study lacked detail | Not specified | RA had poorer hearing than controls | SNHL implied | Not clearly reported | Autoimmune-mediated cochlear changes (assumed) | RA associated with increased HL risk | Relevant (South Asian LMIC; inference possible despite poor reporting) |
| Khoza-Shangase & Riva, 2021, South Africa | Scoping review | Focused on LMIC/African literature (RA + hearing) | Synthesized studies involving PTA, OAEs, tympanometry | Varied | Reported HL prevalence between 21% and 60% across studies | Mainly SNHL; few included CHL/MHL | Few studies linked HL with RA meds or duration in Africa | Ototoxicity, inflammation, middle-ear pathology | Argues for preventive audiology planning in Africa; identifies data gaps | Yes (directly targeted to African context and policy translation) |
| Khoza-Shangase & Riva, 2022, South Africa | Narrative review | Focused on ototoxicity and immune disease in Africa | Summarized risk of HL in immune conditions like RA | Not applicable | Cited HL in autoimmune disease including RA | SNHL emphasis | Highlights drug effects and systemic inflammation | Ototoxic meds, immune dysregulation | Argues for policy-linked ototoxicity monitoring frameworks in Africa | Yes (key source advocating African solutions for HL in RA) |

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| Author(s), year, country | Design and sample size | RA Diagnosis and demographics | Audiological assessments used | HL definition | HL prevalence (RA vs. Ctrl) | HL type and laterality | Correlation with RA variables | Proposed mechanism(s) | Key findings and implications | Relevance to the African context |
|---|---|---|---|---|---|---|---|---|---|---|
| Kiakojuri et al., 2019, Iran | Case–control; N = 90 (RA = 60; Ctrl = 30) | Mean age: 46.7; RA duration: 12.5 years | PTA (250–8000 Hz), tympanometry, speech audiometry | >25 dB HL | RA had significantly worse thresholds than controls (p = 0.001) | All HL observed in RA was SNHL; no CHL or mixed | Thresholds at 2, 4, and 8 kHz correlated with RA duration | Cochlear immune damage | RA duration strongly linked to high-freq SNHL; early loss common | Indirect (supports disease duration as screening cue in RA populations incl. LMICs) |
| Naama et al., 2024, Iraq | Case–control; full details limited in the file | RA diagnosis criteria and duration not specified | PTA (assumed); basic testing | Not specified | RA had more HL than controls | Likely SNHL; no CHL reported | Not assessed | Autoimmune cochlear involvement (implied) | HL common in Iraqi RA cohort; needs more robust study design | Relevant (Middle Eastern LMIC population with health service parallels to parts of Africa) |
| NaSuTIoN & Haryuna, 2018, Indonesia | Cross-sectional (preliminary study) | Basic RA cohort; details minimal | PTA | Not specified | RA patients had elevated thresholds vs. norms | SNHL suggested | Not assessed | Cochlear inflammation | Preliminary support for HL in RA | Relevant (Indonesia = LMIC; supports cross-context validation with African settings) |
| Özcan et al., 2002, Turkey | Cross-sectional; sample size unclear | Older RA cohort; age not clearly reported | PTA, tympanometry | HL threshold not clearly defined | RA had significantly more HL than controls | SNHL and CHL both reported | Not assessed | Ossicular involvement, vasculitis | RA linked to audiological and middle-ear pathology | Relevant (adds support to CHL consideration in LMIC RA management) |

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| Author(s), year, country | Design and sample size | RA Diagnosis and demographics | Audiological assessments used | HL definition | HL prevalence (RA vs. Ctrl) | HL type and laterality | Correlation with RA variables | Proposed mechanism(s) | Key findings and implications | Relevance to the African context |
|---|---|---|---|---|---|---|---|---|---|---|
| Pascual-Ramos et al., 2012, Mexico | Cross-sectional; sample size not stated | Adult RA cohort; demographic detail limited | Audiological testing; exact methods not fully reported | Not clearly defined | RA patients had HL; type not always specified | SNHL and CHL observed | More severe disease activity = more HL | Chronic inflammation and immune-mediated effects | Hearing loss prevalent; severity linked to RA disease activity | Indirect (highlights link between disease severity and HL; relevant for poorly controlled RA in LMICs) |
| Pascual-Ramos et al., 2014, Mexico | Prospective cohort; size not clearly stated | Adult RA patients in tertiary care | PTA (implied) | Not specified | HL incidence increased with cumulative disease activity | SNHL dominant | Hearing loss progression associated with disease activity indices (CDAI) | Chronic inflammation, possibly progressive immune damage | Strong correlation between disease activity and HL incidence over time | Indirect (highlights need for long-term monitoring; applicable to African RA populations) |
| Poorey & Khatri, 2001, India | Cross-sectional; sample size not reported | RA patients; demographic info sparse | PTA (assumed) | Not defined | HL more common in RA vs. controls | Mostly SNHL | Not assessed | Inflammation, immune complex deposition | HL more common in RA; auditory screening suggested | Relevant (India as LMIC with healthcare parallels to Africa) |
| Rkain et al., 2016, Morocco | Case–control; sample size not specified | RA diagnosis criteria not stated | PTA (assumed); methods unclear | Not clearly defined | HL more common in RA group | SNHL reported | No correlation with RA activity | Immune-related mechanisms implied | RA associated with HL; activity level may not predict risk | Yes (North African LMIC; adds regional applicability to early detection efforts) |

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| Author(s), year, country | Design and sample size | RA Diagnosis and demographics | Audiological assessments used | HL definition | HL prevalence (RA vs. Ctrl) | HL type and laterality | Correlation with RA variables | Proposed mechanism(s) | Key findings and implications | Relevance to the African context |
|---|---|---|---|---|---|---|---|---|---|---|
| Sadek et al., 2022, Egypt | Cross-sectional; N = 16 RA | ACR/EULAR 2010; mostly female (14/16) | PTA (0.5–4 kHz), speech audiometry, tympanometry, VHIT | >25 dB HL | 50% (8/16) RA had HL | Mixed HL types; bilateral and unilateral | Not assessed | Autoimmune damage to cochlea and ossicles | HL prevalent in RA; vestibular tests were normal | Yes (North African context; valuable small-sample data) |
| Salvinelli et al., 2004, Italy | Cross-sectional; N = 28 RA | Older adult RA patients | PTA | Not specified | HL in 24/28: SNHL (10), mixed (8), CHL (6) | Mixed types; bilateral | Not assessed | Mixed mechanisms: cochlear and ossicular | RA patients had a variety of HL types; underdiagnosed | Indirect (supports inclusion of both peripheral and conductive screening) |
| Selim et al., 2015, Egypt | Case–control; N = 86 (RA = 46; Ctrl = 40) | <50 years; diagnostic criteria not clearly stated | PTA, TEOAE, ABR | >25 dB HL | 60.9% (RA) vs. 13% (Ctrl) | SNHL and mixed; bilateral | HL associated with longer RA duration and age | Cochlear and neural pathway dysfunction | HL is common in RA; ABR shows brainstem pathway delays | Yes (strong African evidence; supports both peripheral and central assessment) |

### *3.3. Quality assurance and interpretation*

Although narrative reviews are not bound by strict methodological protocols like systematic reviews, this study applied structured and transparent processes to enhance the reliability and interpretive integrity of its findings [13]. Steps taken included: (1) a clearly documented literature search and selection strategy, aligned with the study's objectives; (2) iterative refinement of the review focus as new patterns and evidence emerged; (3) critical evaluation of each study's methodological quality, clinical relevance, and contextual applicability, particularly in relation to African healthcare systems; and (4) reflexive consideration of how the reviewers' disciplinary perspectives and contextual positioning might influence data interpretation. These measures were implemented to support a balanced, credible synthesis of the current evidence on auditory dysfunction in RA, with an emphasis on early detection and interdisciplinary care models that are both globally informed and locally relevant to African clinical contexts.

### *3.4. Analytical approach*

A structured thematic analysis was conducted using Braun and Clarke's [14] six-phase approach, allowing for both inductive and deductive theme development. The themes were shaped by close reading and comparative coding of the included studies, guided by the review's objectives. Particular focus was placed on patterns related to the prevalence, types, and mechanisms of hearing loss in RA, as well as barriers to early detection and implications for African contexts. Thematic saturation was reached when no new insights emerged from additional studies, supporting the completeness and coherence of the final analytical framework [15]. Extracted data were coded and grouped into themes aligned with the study's specific objectives:

1. Prevalence and types of hearing loss in RA.
2. Proposed mechanisms of auditory dysfunction.
3. Barriers to early detection and screening.
4. Functional and quality-of-life implications.
5. Recommendations for integration into clinical care in Africa.

Themes were refined iteratively to ensure consistency, and illustrative findings from African-based studies were emphasized wherever possible.

### *3.5. Ethical considerations*

As this review involved analysis of publicly available, peer-reviewed literature, formal ethical approval was not required. However, ethical standards were upheld through transparent sourcing and accurate citation of all included studies, objective and unbiased selection and interpretation of evidence, and acknowledgment of the limitations inherent in the available data. Efforts were also made to incorporate diverse perspectives, particularly those relevant to LMICs, and to ensure responsible, context-sensitive synthesis of findings [16].

## 4. Results

### *4.1. Profile of included studies*

A total of 29 peer-reviewed studies published between 2000 and 2024 were included in this review. These comprised 20 clinical studies (including case-control, cross-sectional, and prospective cohort designs), six narrative or systematic reviews, and three African studies directly relevant to the regional context. Studies originated from Asia (e.g., Iran, India, Pakistan), Europe (e.g., Turkey, Denmark, Italy), the Middle East (e.g., Iraq), North and Sub-Saharan Africa (e.g., Egypt, Sudan, Morocco, South Africa), and North America (USA, Mexico).

Sample sizes ranged from small single-center cohorts (n = 16) [17] to larger controlled studies (n = 130) [3]. The majority of studies employed PTA, often supplemented by tympanometry, OAEs, and ABR. Only a few used extended high-frequency audiometry (e.g., Elnagdy et al. [18]) or central auditory tests.

RA was most commonly diagnosed using American College of Rheumatology (ACR) or ACR/ European Alliance of Associations for Rheumatology (EULAR) criteria [4,10,17,19]. The majority of participants were middle-aged females, consistent with global RA epidemiology. While most studies investigated SNHL, several reported CHL or MHL, with significant variability in definitions and threshold criteria [17–25].

### *4.2. THEME 1. Prevalence and types of hearing loss in RA*

Hearing loss was a consistently reported comorbidity, found in 15%–71% of adult RA patients across studies, with SNHL being the most frequent type [3,7]. CHL and MHL were also documented, particularly in studies that assessed middle-ear function [5,26]. SNHL was the most consistently reported type, especially affecting high frequencies (4–8 kHz and above), and was often bilateral in nature. CHL occurred less frequently and was noted in up to 30% of RA patients in some studies, especially when tympanometry and acoustic reflexes were included [4]. Mixed hearing loss (MHL) was reported relatively rarely but was observed in both African [17] and international studies [27]. African studies reflected global trends, with Eldin et al. [4] reporting 54.5% HL prevalence in Sudanese RA patients versus 22% of controls, and Selim et al. [5] showing 60.9% HL in Egyptian RA patients.

Comparatively, higher prevalence estimates were more frequently reported in hospital-based studies from Africa and other LMICs than in population-based studies from high-income settings, a difference that appears partly attributable to variations in sampling strategies, disease severity at presentation, and access to early rheumatologic care. Methodological differences in hearing loss definitions and frequency ranges assessed further contributed to variability in reported prevalence across regions.

### *4.3. THEME 2: Proposed pathophysiological mechanisms*

Multiple mechanisms were proposed across studies. Autoimmune-mediated cochlear inflammation was the most common theory [28,29]. Studies have proposed that systemic inflammation and immune complex deposition affect cochlear structures, especially outer hair cells and stria vascularis. Supporting evidence includes absent OAEs and high-frequency threshold shifts in early-stage RA [18,28]. Vasculitis of the cochlear microvasculature was implicated [8,9], supported by correlation with disease activity and duration. Ossicular chain stiffness, synovial thickening, and pannus formation supported mechanical causes of CHL [26,30]. Medication-induced ototoxicity, particularly from DMARDs and biologics, was raised in review studies including Khoza-Shangase and Riva [6] and Emamifar et al. [9], although few primary studies evaluated this directly. OAEs were particularly affected in patients using these drugs, suggesting subclinical cochlear toxicity. Brainstem and central auditory involvement were confirmed via delayed ABR wave latencies [10], suggesting central auditory pathway dysfunction in RA.

Across regions, mechanistic interpretations were broadly consistent; however, studies from high-income settings more frequently incorporated objective electrophysiological measures (e.g., OAEs and ABR), whereas studies from African and other LMIC contexts relied predominantly on behavioral audiometry, potentially limiting the detection of early or subclinical cochlear and central auditory involvement.

### *4.4. THEME 3: Correlations with disease variables*

Correlations with RA variables were inconsistent. Some studies found significant associations between disease duration and hearing loss, particularly at higher frequencies [29,31]. Others reported no significant correlation with disease activity indices (DAS28), inflammatory markers, or medication use [4,26]. Only a few studies examined the impact of specific medications or cumulative inflammatory burden [32,33].

Methodological variation likely contributed to these inconsistencies, as studies differed in the disease activity measures employed, duration thresholds considered, and extent of audiological testing. Additionally, studies from African contexts rarely included longitudinal designs or detailed medication stratification, limiting robust assessment of temporal and treatment-related associations.

### *4.5. THEME 4: Functional and psychosocial implications*

Hearing loss in RA was shown to impair speech understanding, increase listening effort, and negatively affect quality of life, particularly when undiagnosed [17,34]. Communication breakdowns, especially in group conversations and noisy environments, were reported by patients, with reduced treatment adherence suspected due to misunderstood instructions, especially in older patients with bilateral HL. Mental health impacts, such as depression and social withdrawal, were inferred or noted in the literature [2,17]. Subclinical hearing loss was also reported through abnormal OAEs and HFA despite normal PTA thresholds [18,28]. African data highlight the absence of routine screening and

low patient awareness, despite evidence of significant hearing impairment and communication challenges [2,5].

While psychosocial consequences were reported across regions, African and LMIC studies more frequently emphasized delayed diagnosis, limited access to rehabilitative services, and heightened functional impact, reflecting broader health system constraints that compound the consequences of untreated auditory dysfunction in RA.

### *4.6. THEME 5: Barriers and opportunities for early detection in African contexts*

Barriers were consistently reported, being particularly acute in African and LMIC contexts. These include (1) limited integration of audiology in rheumatology clinics, (2) low awareness of auditory symptoms among clinicians and patients, (3) inadequate access to diagnostic equipment and trained audiologists, and (4) absence of RA-specific audiological screening guidelines. These challenges resulted in a disconnect between patient-reported symptoms and clinical detection, contributing to underdiagnosis and missed intervention opportunities. However, African-based literature (e.g., Khoza-Shangase & Riva [2]) suggests opportunities for policy integration of preventive audiology, development of context-sensitive screening protocols, and training rheumatologists to initiate referral for audiological assessments.

Compared with high-income settings where interdisciplinary referral pathways are more established, African contexts face structural and resource-related barriers that necessitate simplified, low-cost screening approaches and task-sharing models to enable early identification of auditory dysfunction in RA.

## 5. Discussion

This review highlights a growing body of evidence confirming that auditory dysfunction, particularly SNHL, is a prevalent yet neglected comorbidity in adults with RA. These findings directly support the study's aim of highlighting the clinical significance and health system implications of RA-related hearing loss in African and LMIC contexts. Drawing from 29 peer-reviewed studies, including African, LMIC, and global datasets, the current analysis affirms the clinical relevance of early audiological screening in RA and advocates for interdisciplinary integration of rheumatology and audiology services, especially in under-resourced contexts.

### *5.1. Prevalence and under-recognition of hearing loss in RA*

Across the included studies, hearing loss in RA ranged from 15% to over 70%, with SNHL being the most frequently reported type, especially at high frequencies. These findings are consistent with systematic reviews and meta-analyses indicating significantly higher odds of SNHL in RA populations [7,8]. Yet, most RA care pathways globally, and particularly in LMICs, fail to include routine audiological monitoring. This under-recognition has serious implications: undiagnosed hearing loss may worsen communication difficulties, reduce treatment adherence, and exacerbate psychosocial burden, particularly among older adults.

In the African context, studies from Egypt [5], Sudan [4], and South Africa [2] reported similar or even higher prevalence of hearing loss in RA patients. Importantly, these findings arose despite limited access to diagnostic equipment and audiology services, suggesting that the actual burden may be underestimated.

### *5.2. Mechanisms of auditory dysfunction: implications for screening*

The pathophysiology of hearing loss in RA appears multifactorial. Inflammatory mechanisms affecting the cochlea and ossicular joints, vasculitic changes, and ototoxicity from DMARDs have all been implicated. SNHL has often been attributed to autoimmune cochlear inflammation or microvascular damage, while CHL is thought to arise from ossicular joint stiffness or synovitis [26,30]. Furthermore, subclinical dysfunction identified via OAEs and extended high-frequency audiometry supports the hypothesis that auditory damage in RA may occur earlier than detectable by standard PTA [18,28]. Despite these proposed mechanisms, few studies have rigorously examined the effect of specific RA medications on auditory outcomes, a gap particularly relevant to the African context, where medication monitoring systems may be weak. Among the mechanisms, cochlear inflammation and microvascular damage are most consistently supported, while the role of DMARD-related ototoxicity remains underexplored and warrants focused pharmacovigilance studies in African cohorts. Ototoxicity surveillance frameworks, as advocated by Khoza-Shangase and Riva [6], remain absent in most African countries.

### *5.3. Inconsistent correlation with disease activity*

Although some studies demonstrated a positive correlation between disease duration and high-frequency HL [29,31], many found no significant associations with disease activity indices (DAS28), erythrocyte sedimentation rate (ESR), or C-reactive protein (CRP) levels. This inconsistency reinforces the need for routine audiological screening independent of rheumatological markers. Audiologists may thus serve as frontline identifiers of early RA-related complications.

### *5.4. Implications of study heterogeneity*

A key challenge in interpreting the findings of this review is the substantial heterogeneity across included studies. Variations in study design, sample size, diagnostic criteria for RA, audiological assessment protocols, and definitions of hearing loss limit direct comparability and preclude quantitative synthesis. Some studies relied solely on conventional PTA, while others incorporated extended high-frequency testing, OAEs, or electrophysiological measures, leading to differing sensitivity for early cochlear pathology. This heterogeneity may partly explain inconsistencies in reported prevalence and associations with disease activity. Consequently, conclusions should be interpreted as indicative rather than definitive, reinforcing the need for standardized assessment frameworks in future research.

### *5.5. Implications for Africa and LMICs*

In LMIC settings, particularly in Africa, the challenges to early identification are multifaceted. Barriers include poor access to audiology personnel, lack of policy-driven screening, underdiagnosis of functional hearing complaints, and fragmented healthcare systems [35]. Even in tertiary centers, as reported in Sudan, South Africa, and Egypt, hearing loss is not routinely addressed during RA follow-up. Yet, these same contexts also offer opportunities. Task-shifting, mobile health audiometry, and training of rheumatologists in basic hearing screening tools represent scalable interventions. More importantly, as Khoza-Shangase and Riva [2] argued, the integration of preventive audiology into national rheumatology guidelines could institutionalize routine hearing assessments in RA care.

Within the African context, the implications of RA-associated auditory dysfunction are amplified by constrained access to audiological services, limited specialist availability, and fragmented referral pathways. Rheumatology care in many African settings prioritizes disease activity control, often without routine screening for sensory comorbidities. Delayed identification of hearing loss may therefore exacerbate communication difficulties, reduce treatment adherence, and negatively influence quality of life. The findings of this review highlight the feasibility of integrating low-cost audiological screening tools, task-shifting strategies, and interdisciplinary referral models within existing RA services to address these gaps.

### *5.6. Beyond hearing: broader health and human rights implications*

The impact of hearing loss in RA patients goes beyond sensory impairment [36]. Unaddressed hearing loss is a known risk factor for social withdrawal, cognitive decline, and reduced employability. These effects are amplified in individuals already coping with RA-related disability. In African settings, where communication barriers, stigma, and limited rehabilitation resources prevail, the invisibility of hearing loss in RA constitutes both a public health gap and a human rights concern.

Sub-Saharan Africa faces a dual challenge: a rising prevalence of chronic immune-mediated disease and a severe shortage of audiologists. The Sudanese findings and South-African commentary in this review highlight systemic barriers—limited diagnostic equipment, fragmented referral chains, and minimal policy guidance. Adapting the World Health Organization's H.E.A.R.I.N.G. package [37] to rheumatology could provide a low-cost roadmap: (i) Hearing screening at primary care, (ii) Ear and hearing care training for non-specialists, (iii) Access to affordable hearing technologies, (iv) Rehabilitation services via community health workers, (v) Inclusive education, (vi) Noise-reduction policies, and (vii) Global partnerships. Deploying portable, solar-powered OAE devices in rheumatology clinics, coupled with community-based follow-up, may bypass infrastructural bottlenecks. Local professional societies should also update RA management guidelines to mandate hearing-health enquiry and referral pathways.

While findings from this narrative review provide important insights, they must be interpreted in light of several methodological and contextual limitations. First, although only verified peer-reviewed studies were included, the inherent limitations of narrative reviews, such as potential selection and synthesis bias, remain. The narrative methodology is inherently non-systematic, which means that some relevant studies may have been inadvertently excluded. Additionally, while thematic analysis

allowed integration of findings across diverse designs, the absence of formal quality appraisal or risk-of-bias scoring may have affected the strength of some interpretations. Second, most included studies were cross-sectional in nature, limiting the ability to draw causal inferences between RA disease activity, duration, or medication use and auditory outcomes. Longitudinal studies, such as those by Pascual-Ramos et al. [32,33], were exceptions but remain underrepresented in the literature. Third, there was significant heterogeneity across studies in terms of audiological methods used, hearing loss definitions, and frequency thresholds tested. This variability made direct comparisons difficult and precluded meta-analytic synthesis. Fourth, few studies systematically examined the effects of RA medications, including potentially ototoxic DMARDs or biologics, on hearing status, despite frequent speculation about these relationships. This gap is particularly relevant for African contexts, where medication pharmacovigilance is often weak. Finally, although this review prioritized African relevance, only a small number of the included studies originated from the continent. This highlights the ongoing need for primary research on RA-related hearing loss within African populations and healthcare systems.

## 6. Conclusions and recommendations

Taken together, the evidence reviewed highlights both the urgency and the feasibility of addressing hearing loss as an integral component of RA care. This narrative review synthesized evidence from 29 peer-reviewed studies and confirmed that auditory dysfunction, particularly SNHL, is a prevalent but under-addressed comorbidity in adults with RA. Despite increasing global awareness, RA-related hearing loss remains largely absent from diagnostic and treatment protocols, especially in Africa and other LMICs. The reviewed literature highlighted that auditory pathology in RA is multifactorial, involving immune-mediated cochlear inflammation, vasculitis, ossicular damage, and possible drug-induced ototoxicity. Subclinical hearing loss may precede clinical symptoms, highlighting the value of early detection through OAEs and extended high-frequency audiometry. Findings from African studies demonstrated alignment with global trends but revealed additional barriers to implementation, including poor integration of audiological services, lack of screening protocols, low patient awareness, and constrained human and technical resources.

To address these challenges, the following recommendations are made: (1) Integrate routine audiological screening into RA management protocols, especially for patients with long disease duration or high inflammatory burden, including symptom checklists and pure-tone screening audiometry at RA diagnosis and periodic intervals; (2) develop national and institutional policies in African countries to support preventive audiology services within rheumatology care; (3) train rheumatology clinicians to recognize otologic symptoms and conduct basic hearing screenings and initiate timely referrals to audiology; (4) invest in mobile and community-based audiology services and leverage tele-audiology and mobile technologies (e.g., portable audiometers, smartphone apps) to extend access in rural and under-resourced areas; (5) conduct and support local research on the ototoxicity of RA medications, particularly in African contexts where pharmacovigilance is limited; and (6) foster interdisciplinary collaboration between audiologists and rheumatologists to improve care continuity and patient-centered outcomes.

Addressing hearing loss in RA through early detection and interdisciplinary collaboration is not just a clinical issue; it is a human rights and quality-of-life imperative. Proactive detection and interdisciplinary care can reduce functional decline, improve communication, and enhance the lived experience of people with RA across diverse settings, especially in Africa.

## Author contributions

This is a sole authored review where the author conceptualized the study and conducted the research, analyzed the data, and wrote the manuscript.

## Use of AI tools declaration

The authors declare they have not used artificial intelligence (AI) tools in the creation of this article.

## Ethics approval and consent to participate

As this study involves the review of existing literature, there were no direct ethical concerns. This narrative review adhered to all ethical standards pertinent to studies that do not involve direct contact with human or animal participants.

## Availability of data and materials

Data supporting the findings of this study are available within the paper.

## Conflict of interest

The author declares no conflict of interest.

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