

# Hearing Assessment among Sudanese Rheumatoid Arthritis Patients versus Non-Rheumatoid Arthritis Individuals

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## Abstract

**Background:** Rheumatoid arthritis (RA) disease is one of the most common chronic autoimmune diseases that affect many body systems including the auditory system. **Objectives:** To assess hearing thresholds and to ascertain types of hearing loss among Sudanese rheumatoid arthritis patients attending rheumatology clinic in Omdurman military hospital and matching them with non-rheumatoid arthritis subjects. **Methodology:** This descriptive and analytic (comparative) hospital based cross sectional study conducted from October 2020 to April 2021 which include 66 RA patients with age range (21 - 60 years) matched with 41 non-rheumatoid arthritis group sharing same characteristics (nation, gender and age). Pure tone audiometry, tympanometry and acoustic reflexes were done for all RA patients and matched groups. Statistical analysis of the data was carried out using the association and correlation tests for associations and t-test for independent samples. **Results:** Thirty-six (54.5%) of RA patients had hearing impairment versus 9 (22%) non-RA in PTA test. Twenty-four RA cases (36.3%) showed asymmetrical hearing threshold and graph in PTA between right and left ears. Thirty-four (51.5%) right and 36 (54.5%) left ears were normal degree followed by 23 (34.8%) in the right and 24 (36.4%) in the left ears were mild degree hearing loss. Among hearing impaired RA patients; 20 right ears (62.5%) and 19 left ears (65.5%) had sensorineural hearing loss (SNHL), conductive hearing loss 11 (34.4%) right ears and 9 (31%) left ears. Mixed HL was in 1 right ear (3.1%) and 1 left ear (3.5%). The most common degree of SNHL type was mild in (75%) and (78.9%) in right and left ears respectively, moderate and moderate severe were (20%) in the right and (15.7%) in the left ears. Fifty-eight right ears (87.9%) and 56 left ears (84.8%) had type A tympanogram while 7

(10.6%) right ears and 9 left ears (13.6%) were type As tympanogram, one right and one left ears had type Ad tympanogram. Acoustic reflex was impaired in 17 right ears and 17 left ears (25.8% for both). There were significant statistical differences in most of the specific frequency means between the study group and non-rheumatoid group in the right and left ears  $p$ -value  $< 0.05$ ). Tympanometry and acoustic reflex measures were also different in right and left ears between the two study groups. Association between hearing threshold and disease activity degrees among study RA group was statistically insignificant ( $p > 0.05$ ). Also there was no significant statistical association between anti-rheumatic drugs used and hearing threshold of RA patients ( $p$ -value  $> 0.05$ ). **Conclusion:** Hearing impairment especially sensorineural type is common in Sudanese rheumatoid arthritis patients. Conductive hearing loss is less common and most likely due to ossicles diarthrodial joint stiffness. No influence of the disease activity or used anti-rheumatic drugs on hearing threshold of the RA patients was detected in this study.

### Keywords

Rheumatoid Arthritis, Sensorineural Hearing Loss, Conductive Hearing Loss, PTA, Tympanometry, Acoustic Reflex

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## 1. Introduction

Rheumatoid arthritis is the most common autoimmune disease. It is a chronic multi-systemic inflammatory disease that is characterized by persistent inflammatory synovitis; usually involves peripheral joints, it typically presents with joints pain, stiffness and swelling that often get worse at rest, the wrist and hands are involved unilaterally or bilaterally [1]. Besides the intra-articular involvement RA also have extra-articular manifestations [2]. RA disease is more common in females [3]. Auditory system functions may be affected during the course of RA disease due to different pathologies [4].

The relationship between hearing impairment and RA has been discussed in many studies but the exact pathological association is not very clear. Many studies concluded the prevalence of hearing loss among RA patients and the sensorineural hearing loss (SNHL) is the most common type [5] [6] [7] [8]. Conductive hearing loss (CHL) or mixed hearing loss among rheumatoid arthritis patients have also been reported less frequently while other studies obsoleted the rheumatoid arthritis implementation in conductive hearing impairment [9] [10]. Rheumatoid arthritis may have different clinical presentations and genetic variations worldwide that may influence different degrees and types of hearing impairment among Sudanese patients.

## 2. Objective

The main objective of this study was the hearing assessment among Sudanese RA patients.

### 3. Methods

This descriptive and analytic (comparative) hospital based cross sectional study was conducted from October 2020 to April 2021 in Omdurman military hospital at rheumatology and audiology departments. The study group included 66 RA patients who were diagnosed according to the American College of Rheumatology and European League against Rheumatism 2010 criteria. Selection of RA cases was from all patients who attended hospital within the study period. RA cases had ages ranged from (21 - 60 years); matched with 41 non-rheumatoid arthritis groups who were sharing same general characteristics (nationality, gender and age) participated from the hospital health workers and patients' families. Infections (either acute or chronic), other chronic illnesses, hospitalized or very ill patients, hearing loss prior to rheumatoid arthritis illness, noise exposure and old patients (above 60) all were excluded. Pure tone audiometry, tympanometry and acoustic reflexes were done for all RA and non-RA groups then their results were matched<sup>1,2</sup>. Online DAS 28 system was used to calculate the RA disease activity score<sup>3</sup>. [11]

Statistical analysis of the data was carried out using the association and correlation tests for associations and t-test for independent samples.

### 4. Ethical Clearance

All the patients were fully informed about the aim and benefit of this study and consented. The participation was voluntary; and patients had the right to withdraw at any time. Consent was obtained from hospital managers and from SMBS ethical committee.

### 5. Results

A total number of 66 RA cases included in this study; and the most of them 61 (92.4%) were females. About (60%) of cases had ages ranged between 40 and 60 years. Most of RA cases 49 (74.2%) were seropositive. The most anti-rheumatic drugs used by RA cases in combination or in monotherapy were hydroxychloroquine, methotrexate, prednisolone and only two patients were using other drugs (**Table 1**). Thirty-six (54.5%) of RA patients versus 9 (22%) non-RA individuals had hearing impairment in PTA test. Twenty-four (36.3%) of RA group showed asymmetrical hearing degree and configuration in PTA graph between right and left ears. Among the RA cases 34 (51.5%) right and 36 (54.5%) left ears were normal degree followed by 23 (34.8%) in the right and 24 (36.4%) in the left ears were mild degree hearing loss (**Figure 1**). Among hearing impaired RA patients; 20 right ears (62.5%) and 19 left ears (65.5%) had SNHL, conductive hearing loss 11 (34.4%) right ears and 9 (31%) left ears. Mixed HL was in 1 right ear (3.1%) and 1 left ear (3.5%) (**Figure 2**). Regarding the sensorineural hearing impairment type among RA; the degrees of hearing impairment were mild

<sup>1</sup>PTA device: Audiometer Interacoustics AD229, 100-240 V.

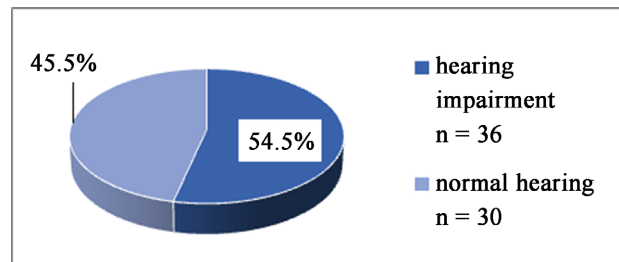
<sup>2</sup>Tympanogram device: MAICOMI-26 tympanometry and ipsilateral reflexes.

<sup>3</sup><https://www.merckmanuals.com/medical-calculators/RheumatoidArthritisDAS28.htm>.

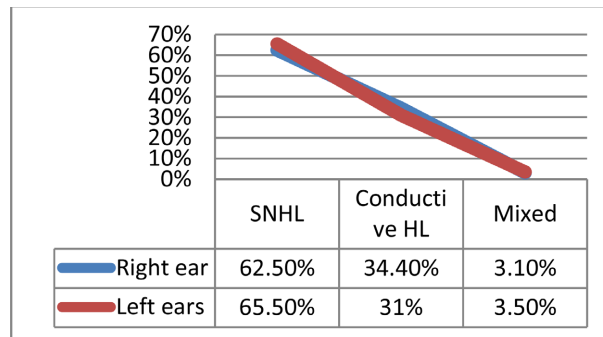
**Table 1.** Socio-demographic and clinical characteristics of study groups.

Characteristics		*RA cases N (%)	Non RA N (%)
Gender	Male	5 (7.6)	4 (9.8)
	Female	61 (92.4)	37 (90.2)
Age	21 - 39 years	27 (40.9)	17 (41.5)
	40 - 60 years	39 (59.1)	24 (58.5)
Serological RA type	Seropositive RA	49 (74.2)	
	Seronegative RA	17 (25.8)	
Disease activity	Inactive	15 (27.7)	
	Low activity	23 (34.8)	
	Moderate activity	28 (42.4)	
Anti-rheumatic drugs	HCQ* + MTX*	24 (36.4)	
	HCQ+ MTX + oral prednisolone	12 (18.2)	
	MTX + oral prednisolone	10 (15.2)	
	HCQ only	9 (13.6)	
	HCQ + oral prednisolone	7 (10.6)	
	Others: AZP*, leflunomide	2 (3.0)	
Total		66 (100)	41 (100)

\*RA: rheumatoid arthritis; HCQ: hydroxychloroquine; MTX: methotrexate; AZP: azathioprine.

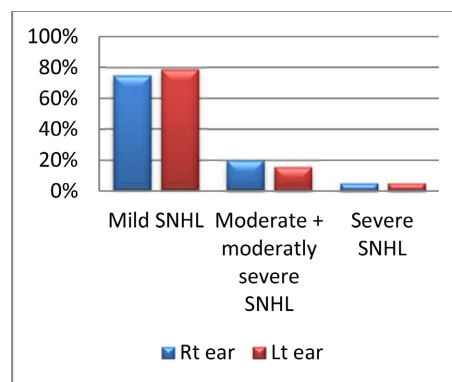
**Figure 1.** Distribution of hearing condition among RA patients according to PTA test.

(75%), (78.9%) in the right and left ears respectively, moderate and moderate severe were (20%) in the right (15.7%) in the left ears (**Figure 3**). There were significant statistical differences measured in the most of specific frequency means between study group and non- rheumatoid group in the right and left ears ( $P$ -value < 0.05). There was more significant difference at 8 K frequencies ( $P$  value < 0.001) between the two study groups (**Figure 4(a)**, **Figure 4(b)**). Among RA cases 58 right ears (87.9%) and 56 left ears (84.8%) had type A tympanogram while 7 (10.6%) right ears and 9 left ears (13.6%) were type As tympanogram, one right and one left ears had type Ad tympanogram (**Table 2**). Acoustic reflexes among RA cases were impaired in 17 right ears and 17 left ears (25.8%



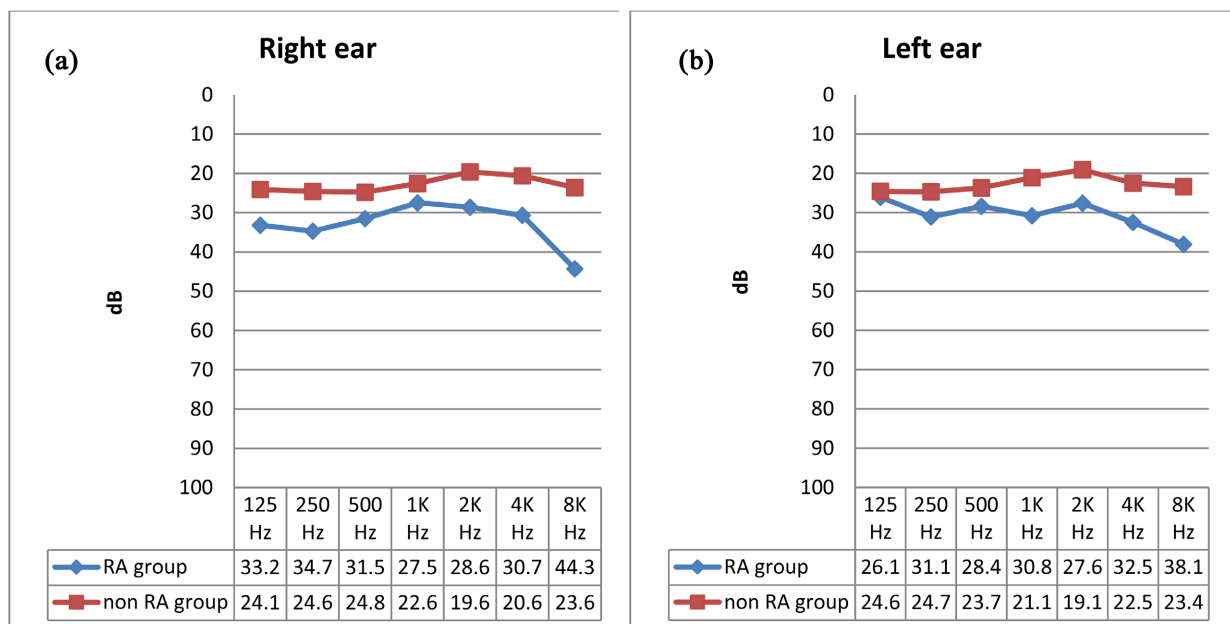
\*SNHL: Sensorineural Hearing Loss.

**Figure 2.** Types of hearing impairment in the right and left ears among hearing impaired RA patients.



\*SNHL: Sensorineural Hearing Loss.

**Figure 3.** Degrees of SNHL among rheumatoid arthritis patients in the right and left ears.



\*RA: Rheumatoid Arthritis.

**Figure 4.** Comparison between means of hearing thresholds at different PTA frequencies in RA and non-RA groups in the right and left ears. Independent t-test P value < 0.05.

for both) (**Table 3**) Tympanometry and acoustic reflex measurements were also different in the right and left ears between the two study groups (**Table 2, Table 3**). The association between hearing threshold and disease activity degrees among study RA group was statistically insignificant ( $p > 0.05$ ). Also there was no statistically significant association between anti-rheumatic drugs used and hearing conditions PTA results of the RA patients ( $p$ -value  $> 0.05$ ).

## 6. Discussion

Near two third of RA patients (60%) never complained of hearing loss while hearing deficit presented in a various degrees and types; revealing more than half of the study group (54.5%). Most of the hearing loss patients had mild degree hearing loss that explains incidence of the subclinical hearing loss showing significant variance between hearing loss complaints and audiometric results. These results were consistent with Halligan and Raut *et al.* [12] [13]. The Mean hearing thresholds in dB for tested frequencies (125 Hz - 8 KHz) were greater than of rheumatoid free group; this gave a hint that RA disease may affect any part of cochlea (basal and apical parts) or the auditory nerve pathway. These results agree with Ahmadzadeh's results [14]. This study observed more increase in the means of hearing thresholds at 8000 Hz in bilateral ears among RA group

**Table 2.** Comparison of tympanogram types between the RA group and control non-RA group in the right and left ears.

Tympanogram type	Right ear		Left ear	
	*RA group N (%)	Non-RA group N (%)	RA group N (%)	Non-RA group N (%)
type A	58 (87.9)	38 (92.7)	65 (84.8)	38 (92.7)
type As	7 (10.6)	2 (4.9)	9 (13.6)	2 (4.9)
type Ad	1 (1.5)	1 (2.4)	1 (11.5)	1 (2.4)
Total	66 (100.0)	41 (100)	66 (100.0)	41 (100)

\*RA: Rheumatoid Arthritis.

**Table 3.** Comparison of acoustic reflex threshold frequencies and percentages between the RA group and control Non-RA group in the right and left ears.

Acoustic reflex	Right ear		Left ear	
	*RA group N (%)	Non-RA group N (%)	RA group N (%)	Non-RA group N (%)
Present	48 (72.7)	36 (87.8)	48 (72.7)	36 (87.8)
Impaired	17 (25.8)	2 (12.3)	17 (25.8)	2 (12.3)
Absent	1 (1.5)	0 (0)	1 (1.5)	0 (0)
Total	66 (100.0)	41 (100)	66 (100.0)	41 (100)

\*RA: Rheumatoid Arthritis.

and this indicates the affection of the high frequencies hearing threshold is more than the rest of frequencies as observed previously by Treviño [15].

The most common type of hearing loss found in this study was the sensorineural hearing loss; which is probably explained by the affection of the cochlea or the auditory nerve pathway through systemic inflammation and tissue injury as mentioned by Harris and many others studies [5] [7] [16] [17].

The incidence of the conductive hearing loss among RA group in spite of exclusion of other causes of conductive hearing impairment in this study gives us a clue about the presence of middle ear abnormalities that might be due to chronic inflammation effects on diarthrodial joints of the ossicles. This result was in the same line of Resna Chen experiment and inconsistent with others [17] [18] [19]. A part of normal tympanometry results which was the commonest type there were 16 ears out of 132 tested ears had type As and only two ears had type Ad. The difference in type As tympanogram results was more clear between rheumatoid arthritis group and matched non-RA group. This result harmonizes the theory of stiffness of Alonso and Takatsu results rather than ossicular joint laxity or discontinuity that was mentioned by Moffat and Ozcan [6] [9] [10] [20].

Ipsilateral acoustic reflexes were normal for both right and left ears in about three-quarters of RA group but about one-quarter had abnormal impaired reflexes mainly in the sensorineural hearing loss type. This strengthens sensorineural hearing affection by the disease. This result agrees with Christine and Kastanioudakis's studies. [12] [21] [22].

The stat activity and acute relapse of the RA disease did not associate with the incidence of hearing loss; progression of decreased hearing may be slow over a long time regardless of RA disease activity as the disease is a chronic inflammatory disease in contrast to autoimmune inner disease that causes rapid deterioration of hearing in high disease activity. This study result is in line with Tavernier and not keeping with others [6] [23].

In this study the results showed no exact relationship ( $p > 0.05$ ) between anti-rheumatic drugs used and audiological hearing levels, however, the prescribed combination of two or more drugs and the diversity of drug types taken by RA cases make the suspicion of ototoxicity effect.

Observation of hearing status among nine RA patients who were taking only HCQ showed no significant association with hearing loss. This study result was in keep with Polanski who denied the effect of HCQ ototoxicity and in contrast to Prayuenyong's case reports review [24].

## 7. Conclusion

Rheumatoid arthritis disease affects hearing system, mainly the sensorineural part. Conductive hearing also may be affected by chronic inflammation of small ossicles diarthrodial joint causing ossicular stiffness. High-frequency hearing impairment especially at 8 K is more noticeable. The hearing loss process is not associated with current activity of the disease it may occur due to chronic in-

flammation in opposition to autoimmune inner disease that causes sudden drop in hearing sense with relapse of the disease. No clear association between drugs used by RA patients and hearing loss was detected.

## 8. Study Limitation

The duration of the study was short; that limited audiological follow up for the study group.

Combined RA therapy restricts the assessment of the exact effect of each drug on hearing distinctly.

No high disease activity was encountered among RA patients during the period of the study.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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