

Prevalence Rate of Hearing Loss in Patients with Rheumatoid Arthritis

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Abstract

Background: Rheumatoid arthritis (RA) is a common chronic inflammatory disorder that can be associated with some hearing impairments. Hence, we aimed to evaluate the prevalence rate of hearing loss (HL) in RA patients.

Materials and Methods: This study included 130 participants from February 2019 to March 2020 including 100 RA patients (78 females and 22 males) as RA group and 30 healthy cases (16 females and 14 males) as control group. All patients underwent pure tone audiometry, speech audiometry, tympanometry, acoustic reflex, and tone decay test by single operator and device. The rate of HL and contributing factors were then determined.

Results: The mean age of RA group was 53.95 ± 7.6 years, and the mean duration of disease was 12.74 years. Rheumatoid factor was positive in 54% of patients, and the frequency rates of diabetes, chronic kidney disease, hypertension, and dyslipidemia among RA patients were 14%, 1%, 26%, and 19%, respectively. These values among RA patients with HL were 18%, 1.7%, 34%, and 27.5%, respectively. HL in RA patients was related to dyslipidemia ($P = 0.011$) and age ($P = 0.0001$). Frequency rate of conductive HL in left and right ears was 2% and 5%, respectively, and these rates for sensorineural hearing loss (SNHL) were 55% and 61%, respectively. In addition, the percent of HL in low, mid, and high frequency ranges was 18%, 19%, and 57%, respectively.

Conclusions: The findings of the present research demonstrate that HL especially with SNHL and high-frequency types is common among RA patients.

Keywords: Pure tone audiometry, rheumatoid arthritis, sensorineural hearing loss, tympanometry

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INTRODUCTION

Rheumatoid arthritis (RA) is a chronic inflammatory disease affecting nearly 1% of general population^[1] diagnosed by clinical, radiological, and laboratory parameters.^[2] Bone and joint destruction would result in early mortality and socioeconomic burden.^[2] Head-and-neck involvement is reported in RA patients including laryngeal, cervical, and temporomandibular joint.^[3] The prevalence of RA in the

world is very small (1% of the people). Corresponding to community-oriented program for control of rheumatic diseases prevalence rate of this disease in Iran is 0.19%.^[4] Female gender^[5] and older ageing^[6] have higher prevalence of RA than others. In addition, the role of genetic factors is reported in 50% of cases.^[7] Despite relatively favorable therapeutic outcomes, the presence of some comorbidity such as hearing problems may occur in some cases. These patients should be treated with invasive treatments and controlling risk factors

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such as smoking, dyslipidemia, diabetes, and hypertension.^[8] The association between hearing loss (HL) and autoimmune diseases was initially described by McCabe.^[9] In addition, some studies showed that the HL occurs also in other autoimmune diseases too.^[10] HL (in all low, mid, or high frequencies) may be seen in more than 60% of RA patients.^[11,12] Middle ear involvement, vasculitis, neuritis, and drug-induced adverse effects are common causes for HL in the affected patients.^[13] Prompt diagnosis and treatment would decrease the progression of HL in RA patients.^[14] The HL problem in RA patients has been reported in many studies.^[15] The most common type of HL in RA patients is sensorineural form with the rate of 25%–80%, while the other types of HL are not common.^[16-20]

Since different rates have been reported for HL in RA patients (may be due to different types of hearing tests), the rate and type of HL in RA patients have studied here to find the effect of different hearing measurement methods on the outcomes in comparison with other studies and to better follow-up RA patients.

MATERIALS AND METHODS

In this study, one-hundred consecutive patients with RA attending Rheumatology Clinic in a training referral hospital in Tehran, Iran, in 2019 and 2020 were enrolled in addition to thirty healthy cases selected for control group. All the demographic data including the patient condition, gender, age, duration and background of disease, and type and severity of HL were determined by otolaryngologist. Only the patients with normal tympanic membrane have been entered to this study. The exclusion criteria were otorrhea, inner ear effusion, head trauma, noise exposure, previous drug-induced ototoxicity, chronic neurological disease, and Meniere syndrome.

Demographic and clinical data including Disease Activity Score 28 (DAS28) results for disease severity were recorded. All patients underwent pure tone audiometry (PTA), speech audiometry, tympanometry, acoustic reflex, and tone decay test by single operator and device. Furthermore, the CBC results, rheumatoid factor (RF), anticyclic citrullinated peptide (anti-CCP) status, and erythrocyte sedimentation rate (ESR) were assessed. The rate of HL and contributing factors were determined. Audiometry and tympanogram tests have been performed based on the method presented in ASHA guideline.^[21] Acoustic reflex is recorded as present or absent. Type of HL based on audiometry is classified to normal, sensorineural hearing loss (SNHL), conductive hearing loss (CHL), and deafness. The threshold of PTA has been measured at different frequencies as 250, 500, 1000, 2000, 4000, and 8000 Hz and the severity of HL is determined according to Table 1. In addition, based on the shape of tympanogram, various middle ear dysfunctions can be classified into five types as defined in Table 2.

Data analysis was done by SPSS Version 20.0 software (SPSS Inc., Chicago, IL, USA). The frequency and percent were reported for categorical data, and the mean and standard

Table 1: Hearing loss grading in patients based on audiometry sensitivity

Level	Hearing range (dB-HL)
Normal	10-15
Slight	16-25
Mild	26-40
Moderate	41-55
Moderately severe	56-70
Severe	71-90
Profound	>90

Table 2: Hearing loss grading in patients based on tympanogram

Type	Definition
A (normal)	Normal middle ear functioning Compliance from 0.3 to 1.5 ml
As (shallow)	A less compliant middle ear system Compliance <0.3 ml
Ad (deep)	A highly compliant middle ear system Compliance >1.5 ml
B	Middle ear involvement from fluid There is no identifiable peak Ear canal volume is normal
C	Eustachian tube dysfunction Peak <100 daPa Compliance from 0.3 to 1.5 ml

deviation were calculated for numerical variables. The utilized tests were Chi-square and independent-sample *t*-test. In addition, $P < 0.05$ was considered statistically dependent.

RESULTS

As discussed in introduction, many studies have reported more hearing impairments in RA patients than in healthy people in general population. Recent studies also confirm this finding,^[22-28] for example, a recent large study in Korea found that RA people were 40% more likely to develop SNHL than others without the condition.^[22] Chaitidis *et al.* reported that RA patients had nearly fourfold increased odds of SNHL compared with control group.^[23] In another study, Huang *et al.* reported that the incidence density of HL was approximately twofold greater in RA than in non-RA group.^[24] Since the hearing impairment in RA patients has been proved in many studies, the main concern of our study is analyzing the hearing problems only in RA patients. However, similar to the previous studies, a control group is selected at first here in addition to RA group to compare the hearing impairments between RA and non-RA persons. After a simple comparison between RA and control groups, the condition of HL in RA patients will be discussed in more details.

In this research, thirty healthy cases (53% female and 47% male) and 100 RA patients (78% female and 22% male) are selected as control and RA groups, respectively. *P* value of

Table 3: Mean value of pure tone audiometry threshold for different frequencies in rheumatoid arthritis and control groups

Frequency (Hz)	Right ear			Left ear		
	RA group (dB)	Control group (dB)	P	RA group (dB)	Control group (dB)	P
250	19	10	<0.001	20.35	10	0.005
500	19.85	10.66	<0.001	18.85	11.66	0.001
1000	20.55	9.66	<0.001	21.05	11.33	0.009
2000	17.2	10.16	<0.001	19.05	10	0.022
4000	25.45	10.66	<0.001	28.7	9	<0.001
8000	32.19	10	<0.001	35.5	11	<0.001

RA: Rheumatoid arthritis

these data is 0.009 (less than 0.05) that confirms a statistically significant condition. The mean values of PTA thresholds in different frequencies are presented in Table 3 for both RA and control groups. It is clear that these data are statistically dependent for all the frequencies in both right and left ears. As anticipated, it can be seen that the hearing thresholds in RA patients are generally higher than those of controls at all the frequencies. In addition, the hearing problem is more significant at higher frequencies and the most severe condition occurs at the frequency of 8000 Hz. This is also compatible with the previous studies.^[25-27] Based on a similar finding, Gamal *et al.* proposed recently an extended high frequency audiometry test from 10,000–20,000 Hz to early diagnose HL in RA patients.^[27]

In the selected RA group, 78% of participants were female and 22% were males. The mean age was 53.95 ± 7.6 years, and the mean duration of disease was 12.74 years. RF, CRP, ESR, and anti-CCP were positive in 54%, 35%, 65%, and 80%, respectively. Smoking, hypertension, diabetes mellitus, chronic kidney disease (CKD), and dyslipidemia were reported in 13%, 26%, 14%, 1%, and 19%, respectively. Furthermore, 4% had rheumatoid nodule. As shown in Figure 1, the patients were in remission phase in 58%.

Audiometry results showed abnormal hearing in 71% of patients. In the left ear, the HL was sensorineural, conductive, and deafness in 55%, 2%, and 1%, respectively, and in the right ear, the HL was sensorineural, conductive, and deafness in 61%, 5%, and 1%, respectively. The severity of HL was slight, mild, moderate, severe, and profound in 34%, 12%, 9%, 1%, and 2%, respectively, in the left ear and 46%, 12%, 8%, 1%, 0%, respectively, in the right ear. The results of other tests are shown in Table 4.

The age frequency distribution according to severity and type of HL in both sides is shown in Table 5 that demonstrates type and severity had significant differences ($P = 0.0001$). The disease duration frequency distribution according to severity and type of HL in the ears are shown in Table 6 that demonstrates type and severity had significant differences ($P = 0.0001$). Categorical variables according to audiometry-type are also presented in Table 7.

As shown in Figure 2, the type of HL for the patients with positive and negative rheumatoid nodules is presented. Vertical axis in this figure shows the number of patients and the

Table 4: Percentage of other hearing tests across the rheumatoid arthritis group

Test	Right ear	Left ear
Tympanogram		
An	86	87
B	2	1
C	3	4
As	8	6
Ad	1	2
Acoustic reflex		
Present	73	72
Absent	27	28

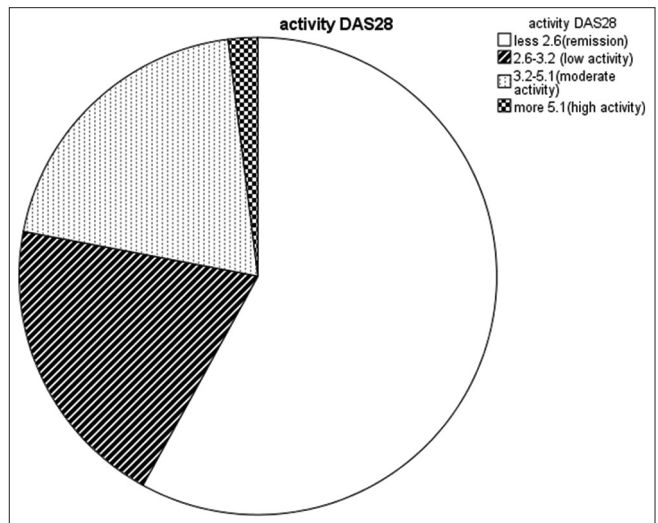


Figure 1: Disease activity according to Disease Activity Score 28

horizontal axis shows the presence of rheumatoid nodules. It can be seen that most of the patients with rheumatoid nodules has a HL problem. Furthermore, the number of the patients based on the type and severity of their HL are demonstrated in Figure 3.

The percentage of different variables is presented in Table 8 for all patients and patients with HL contributed in this study. For the RA patients with HL, these values are compared with other studies in Table 9. In this table, the values in the parenthesis show the variable among the RA patients with HL and the values out of the parenthesis relate to all RA patients.

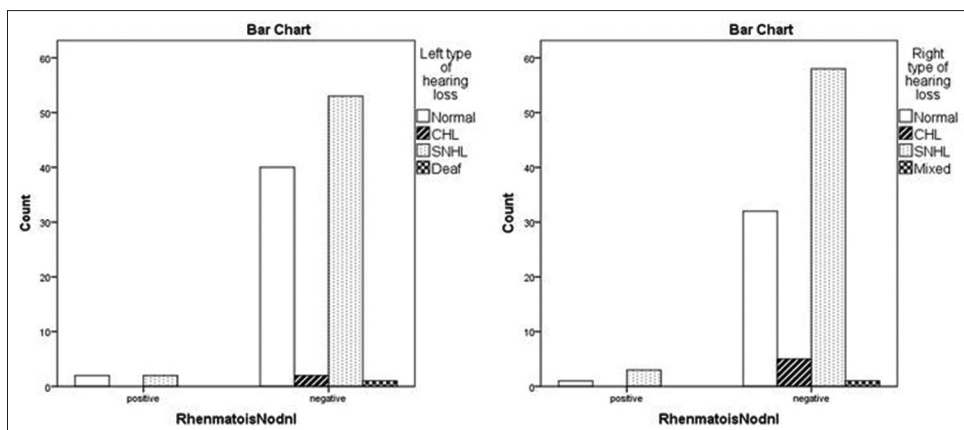


Figure 2: Number of patients based on the type of hearing loss and rheumatoid nodule

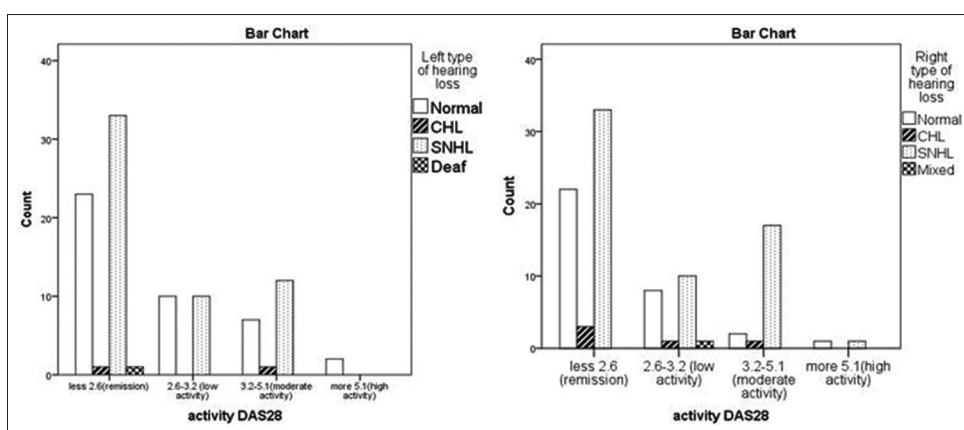


Figure 3: Number of patients based on the type of hearing loss and disease activity

Table 5: Mean age of the patients with type and grade of hearing loss in rheumatoid arthritis group

Test	Right ear	Left ear	P
Audiometry type			
Normal	44	45.72	0.001
SNHL	53	57.0	
CHL	59	65.1	
Deaf	65	46	
Audiometry severity			
Normal	44.8	45	0.001
Slight	57.8	59	
Mild	58.8	59	
Moderate	65.4	64	
Profound	-	60	
Tympanogram			
An	53.98	53.8	0.822
B	54	58.0	
C	62.3	64.2	
As	54.7	49.8	
Ad	47	60	
Acoustic reflex			
Present	53.5	52.4	0.339
Absent	56.3	58.9	

SNHL: Sensorineural hearing loss, CHL: Conductive hearing loss

In addition, different reported percentages for the type of HL are compared with the results of our study in Table 10. These results will be discussed in the next section.

DISCUSSION

Hearing problems are common among patients with RA in nearly two-third of patients.^[11] Among the patients with RA, there are numerous causes for HL.^[13] The presence of such comorbidities would decrease the quality of life.^[14] In our study, 78% of RA patients were female, the mean age of patients was 53.95 years, and mean disease duration was 12.74 years. It is noticeable that these values are nearly compatible with the other studies referred here. For example, the mean age of RA patients in the studies done by Kastanioudakis *et al.*, Reiter *et al.*, Lobo *et al.*, and Jeong *et al.* was 53, 58, 49, and 56.7 years, respectively, and most of the patients have been female in all of these studies.^[11-13,20] In our study, age was related to HL ($P = 0.0001$), but duration of disease was not related to HL ($P = 0.142$). In addition, the gender was not related to HL as shown in Table 8. Similarly, the study in Japan showed a significant association between age and HL.^[16] Study by Lobo *et al.* showed that RF was positive in

Table 6: Mean of disease duration according to the type and grade of hearing loss

Test	Right ear	Left ear	P
Audiometry type			
Normal	9.8	11.7	0.142
SNHL	19.2	26.5	
CHL	14	13	
Deaf	5	11	
Audiometry severity			
Normal	9.8	11.7	0.006
Slight	13.5	11.5	
Mild	12.2	12.6	
Moderate	21.6	21.2	
Profound		18.5	
Tympanogram			
An	12.7	12	0.900
B	15.5	30	
C	10	19.3	
As	14.4	14.5	
Ad	12	17	
Acoustic reflex			
Present	12	11.9	0.160
Absent	14.9	15	

SNHL: Sensorineural hearing loss, CHL: Conductive hearing loss

55% of patients and the anti-CCP was positive in 80% of patients.^[20] However, in our study, ESR, RF, CRP, and anti-CCP were not related to HL.

In our study, low, mid, and high-frequency HL was 18%, 19%, and 57%, respectively. In both ears, the HL was mainly SNHL. Totally, 71% of patients had HL. Kastanioudakis *et al.* reported that 35% of patients had bilateral SNHL.^[13] In the study in Pennsylvania, 48 patients had SNHL.^[11] Furthermore, Ozcan *et al.* reported that 35.1% of patients had SNHL.^[19] The study by Lobo *et al.* revealed that HL was present in 46.5% of RA patients that was SNHL in 80%.^[20] The study in Japan revealed that 36.1% of patients had SNHL that was bilateral in 28%.^[16] More recent studies also confirm that RA is significantly associated with SNHL, and it is not associated with CHL and MHL.^[23,25,26]

The study in Spain revealed that HL was high frequency and sensorineural in 70% of RA patients. In their study, the acoustic reflex was absent in 27% of patients.^[29] In the study in Korea, the mid/low-frequency and high-frequency were seen in 21.1% and 43.3%, respectively.^[12] Kastanioudakis *et al.* reported acoustic reflex latency in 10%.^[13] It was seen in 15% in the study by Ozcan *et al.*^[19] In our study, the tympanogram was abnormal in 14%, but they reported it in 38%. In Japanese study, the abnormal results were reported in 19.5%.^[16] In 16.7% of their RA patients, the type of HL was As, and in 2.8%, it was Ad subtype, while in the control group, these rates were 1.4% and 11.1%, respectively. In our study, the HL rate was 16% and 14% according to PTA and SRT, respectively. The study by Ozcan *et al.* showed that PTA was abnormal in 51.4% and it was 43% in Spanish study.^[19,29]

Table 7: Categorical variables according to audiometry-type

Test	Right ear	Left ear	P
Male/female ratio			
Normal	7/26	7/34	0.500
SNHL	0/5	0/2	
CHL	15/45	15/40	
Deaf	0/1	0/1	
Smoker/nonsmoker			
Normal	4/29	6/35	0.772
SNHL	0/0	0/0	
CHL	9/51	7/48	
Deaf	0/1	0/1	
Hypertensive/normotensive			
Normal	4/29	6/36	0.110
SNHL	2/3	1/1	
CHL	19/42	19/36	
Deaf	1/0	0/1	
Diabetic/nondiabetic			
Normal	1/32	3/39	
SNHL	0/5	1/1	0.190
CHL	13/48	10/45	0.0
Deaf	0/1	0/1	
CKD/non-CKD			
Normal	1/32	0/42	0.886
SNHL	0/5	1/1	
CHL	13/48	0/55	
Deaf	0/1	0/1	
Dyslipidemic/normolipidemic			
Normal	2/31	3/39	0.280
SNHL	1/4	0/2	
CHL	16/45	16/39	
Deaf	1/0	0/1	

SNHL: Sensorineural hearing loss, CHL: Conductive hearing loss, CKD: Chronic kidney disease

In our study, smoking was reported by 12% of RA patients with HL, but there was no significant association. Furthermore, diabetes, CKD, and hypertension were not related to HL. However, dyslipidemia was related to HL with $P=0.011$. In our study, hypertension, diabetes, CKD, dyslipidemia, rheumatoid nodule, and smoking were seen in 26%, 14%, 1%, 19%, 4%, and 13% of RA patients, respectively, as reported in Table 8. In the Korean study hypertension and diabetes were seen in 28% and 12%, respectively, and the GFR was under 60 in 7% with smoking rate of 10%.^[12] In our study, RF, anti-CCP, ESR, CRP, and nodule were seen in 54%, 83%, 65%, 35%, and 4% of RA patients, respectively. In the study by Lobo *et al.*, the RF was positive in 56.5% and anti-CCP was positive in 34.78%.^[20] The disease was in remission in 58%, and the disease was low, moderate, and high activity according to DAS28 in 20%, 20%, and 2%, respectively. The disease activity was not related to HL. The study by Lobo *et al.* also showed no association between these factors.

Totally, according to the obtained results in this study, it can be concluded that HL is a common problem among patients

Table 8: Percentage of different variables in all rheumatoid arthritis patients and patients with hearing loss

Variables	All RA patients	RA patients with HL	P
Mean age (years)	53.95	58.6	0.000
Female (%)	78	77	0.572
Mean duration of disease (years)	12.74	13.4	0.142
ESR>11	65	67	0.33
Positive RF	54	55	0.22
Positive anti-CCP	83	80	0.30
Positive CRP	35	37	0.60
Diabetes	14	18	0.191
CKD	1	1.7	0.886
HTN	26	34	0.110
Smoking	13	12	0.900
Dyslipidemia	19	27.5	0.0111
Active phase disease (DAS-28)	42	62.6	0.297

RA: Rheumatoid arthritis, ESR: Erythrocyte sedimentation rate, RF: Rheumatoid factor, Anti-CCP: Anti cyclic citrullinated peptide, CRP: C-reactive protein, CKD: Chronic kidney disease. HTN: Hypertension, DAS-28: Disease Activity Score 28, HL: Hearing loss

Table 9: Comparison the percentage of variables across the studies

RA patients (RA patients with HL)	This study	1980 Pennsylvania ^[11]	1995 Greece ^[13]	2002 Ozcan ^[19]	2005 Japan ^[16]	2016 Korea ^[12]	2012 Lobo ^[20]	2016 Spain ^[29]	2019 Iran ^[28]	2021 Huang ^[24]
Mean age (years)	53.95 (58.6)	58	52.5	-	62	56.7	48.8 50.9	-	-	(49)
Female (%)	78 (77)	-	93.3	-	80.6 (76)	75.4	(95)	-	56.7	(73)
Mean disease duration (years)	12.74 (13.4)	-	-	8.2	8.2 (14)	-	10.3 (13.3)	-	-	-
ESR >11	65 (67)	-	-	-	(61)	-	-	-	-	-
Positive RF	54 (55)	-	32	-	-	-	-55	-	52.9 (92.3)	-
Anti-CCP >5	83 (80)	-	-	-	-	-	56.6 (80)	-	46.7 (69.2)	-
CRP >5	35 (37)	-	-	-	-	-	-	-	-	-
Diabetes	14 (18)	-	-	-	-	11.7	-	-	-	-
CKD	1 (1.7)	-	-	-	-	7.4	-	-	-	(14)
HTN	26 (34)	-	-	-	-	27.9	-	-	-	-
Smoking	13 (12)	-	-	-	-	10	-	-	-	-
Dyslipidemia	19 (27.5)	-	-	-	-	-	-	-	-	(25)
DAS28 (active)	42 (62.6)	-	-	-	-	-	-	-	-	-

RA: Rheumatoid arthritis, ESR: Erythrocyte sedimentation rate, RF: Rheumatoid factor, Anti-CCP: Anti cyclic citrullinated peptide, CRP: C-reactive protein, CKD: Chronic kidney disease. HTN: Hypertension, DAS-28: Disease Activity Score 28, HL: Hearing loss

Table 10: Comparison the percentage of the type of hearing loss across the studies

RA patients (RA patients with HL)	This study	1980 Pennsylvania ^[11]	1995 Greece ^[13]	2002 Ozcan ^[19]	2005 Japan ^[16]	2016 Korea ^[12]	2012 Lobo ^[20]	2016 Spain ^[29]	2019 Iran ^[28]	2021 Huang ^[24]
Low frequency	18	-	-	-	-	-	-	13.2	-	-
Mid frequency	19	-	-	-	-	21	-	17	-	-
High frequency	57	-	-	-	-	43	-	56	-	-
CHL	5	13	-	24.3	-	-	-	-	-	(0.2)
SNHL	61	48	35.5	35.1	36.1	-	85	69.8	-	(33.6)
MHL	1	-	-	-	-	-	-	-	-	(66.2)
No acoustic reflex	27	-	6.6	-	-	-	-	-	-	-
Abnormal tympanogram	14	-	13.2	37.8	19.5	-	-	-	-	-
HL by PTA	16	-	-	-	-	-	-	-	43.3	-
HL by SRT	14	-	-	51	-	-	-	43	-	-

RA: Rheumatoid arthritis, SNHL: Sensorineural hearing loss, CHL: Conductive hearing loss, CKD: Chronic kidney disease, HL: Hearing loss, PTA: Pure tone audiometry, SRT: Speech recognition threshold

with RA, especially with sensorineural and high-frequency types. In addition, the rate of HL in RA patients depends on

different factors such as the age and gender of patients as well as the duration of disease and the method of audiometry

tests. Therefore, further studies with larger sample size and multicenter samplings are required to attain more definite results in comparison with our studies.

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Conflicts of interest

There are no conflicts of interest.

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