



## Assessment of degree of hearing loss in chronic kidney disease patients

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### ABSTRACT:

**Objectives:** To identify patients in different stages of chronic kidney disease. To correlate the degree of hearing loss in different stages of chronic kidney disease. **Method:** It is a prospective study done on 50 chronic kidney disease patients in a tertiary care center. Hearing will be assessed using pure tone audiogram and correlation coefficient between different stages of chronic kidney disease and degree of hearing loss will be assessed using chi-square test. **Result:** There is a statistical positive correlation between higher stages of chronic kidney disease and degree of hearing loss. **Conclusion:** Statistical significance has been proven, yet future studies has to be done with a larger study population to know it's practical correlations. **Key Words:** Chronic kidney disease, Reduced kidney function, estimated GFR, Hearing loss, Pure tone audiogram

### INTRODUCTION:

Hearing loss in adults brings about communication difficulties in daily life. It also impairs an individual's cognitive and psychosocial function. Hearing impairment could lead to individual isolation, social deprivation ,mental depression and it invariably affects the individual's quality of life(1-3). Most of the causes of hearing loss are acquired but are preventable .Hence early identification of the risk factors has greater significance in prevention and further progression of the hearing loss.

Kidney disease has been a major health concern worldwide for a long period of time. Several congenital syndromes such as Alport's syndrome, Fabry disease, branchio-oto-renal syndrome, Alstrom syndrome, Bartter syndrome are known to cause sensorineural hearing loss .Hence,these syndromes are known to cause both hearing and kidney manifestations(4-6) . Several studies have assessed the auditory function of patients with chronic kidney disease and in patients undergoing dialysis.

Meena et al. (7) studied 50 patients of end stage renal disease and found out that 28% of them had sensorineural hearing loss. They also studied 50 healthy volunteers for comparison of the hearing loss with chronic kidney disease patient and only 6% of them had hearing loss. Zeigelboim et al.(8) compared the chronic kidney disease patients with healthy volunteers and found that the hearing thresholds of the chronic kidney disease patients are higher than that of the volunteers. Here the hearing threshold refers to the minimum level of sound with which an auditory sensation can be evoked.

Renda et al.(9) also found a significant association between hearing loss in children with chronic kidney disease and the duration of hemodialysis.

The relationship between hearing loss and chronic kidney disease maybe explained by sharing of the common antigenicity between kidney and the cochlea .They share similar physiologic mechanisms involving the transport of fluid and electrolytes, which might also explain the

hearing loss in patients with chronic kidney disease(10) . Hypertension, use of ototoxic drugs, electrolyte disturbances, hemodialysis are some possible causative factors related to hearing loss in kidney failure patients. Ageing has a significant impact in adult onset hearing loss and is found to be the leading cause of hearing loss.

Here ,we did a prospective study to find out the prevalence of hearing loss in chronic kidney disease patients and correlate the degree of hearing loss with the different stages of chronic kidney disease.

#### METHODOLOGY:

It is a prospective study done on 50 chronic kidney disease patients in a tertiary care center in Kancheepuram after obtaining ethical clearance from the institutional committee and an informed consent from all the participants. The details of patients with Chronic kidney disease were collected from nephrology OPD and dialysis center and they were subjected to pure tone audiogram to assess the degree of hearing loss. The details of these patients are formulated in an Excel sheet and data were analysed.

**INCLUSION CRITERIA:** Patients who have been already diagnosed with chronic kidney disease. Patients with intact tympanic membrane.

**EXCLUSION CRITERIA:** Patients with hearing loss even before being diagnosed with chronic kidney disease. Patients with other comorbidities which can cause sensorineural hearing loss like diabetes mellitus, systemic hypertension, hypothyroidism. Patients using ototoxic drugs. Patients who are aged >65 years. Patients with recent head injury.

#### CHRONIC KIDNEY DISEASE

The subjects included in this study are those who have been diagnosed with chronic kidney disease. These subjects were categorised on the basis of different stages of CKD(1-5) using KDIGO guidelines. Various details like age, sex, urea and creatinine level of the subject was collected. e-GFR was calculated with the creatinine value using Cockcroft and Gault formula and the patients were categorized into different stages of CKD.

**Table 1:** KDIGO guidelines for CKD

Stage 1	Normal	e-GFR $\geq$ 90
Stage 2	Mildly decreased	e-GFR 60-89
Stage 3	Moderately decreased	e-GFR 30-59
Stage 4	Severely decreased	e-GFR 15-29
Stage 5	Kidney failure	e-GFR <15

#### HEARING LOSS

All the patients who were willing for the study were assessed for their hearing using pure tone audiogram and the values were recorded. The degree of hearing loss and the type of hearing loss(conductive ,sensorineural or mixed) were assessed using audiometry.

**Table 2:** WHO grading for hearing loss

GRADE OF HEARING IMPAIRMENT	HEARING THRESHOLD IN DECIBELS	DESCRIPTION
0	$\leq$ 25	No impairment
1	26-40	Slight impairment
2	41-60	Moderate impairment
3	61-80	Severe impairment

4	>80	Profound hearing loss
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The chi-square test has been applied to find out the relation between the stages of CKD and the degree of hearing loss.

### RESULTS:

Based on the observations and interpretations, we found that patients having higher stages of CKD have significant association of developing hearing loss. A total of 50 patients were included in the final dataset for analysis. The prevalence of hearing loss is found to be different in different stages of CKD.

#### *Stage 2 wise distribution*

Stage 2 wise distribution of CKD patients with hearing loss were presented in table 3. Among the 24 patients, 9 had no hearing impairment, 12 had slight hearing impairment and 3 had moderate hearing loss.

TABLE 3

DEGREE OF HEARING LOSS	NUMBER OF PATIENTS
No impairment	9
Slight impairment	12
Moderate impairment	3
Severe impairment	0
Profound hearing loss	0

#### *Stage 3 wise distribution*

Stage 3 wise distribution of CKD patients with hearing loss were presented in table 4. Among the 9 patients, 3 had no hearing loss, 4 had slight impairment, 1 had moderate impairment and 1 had severe impairment.

TABLE 4

DEGREE OF HEARING LOSS	NUMBER OF PATIENTS
No impairment	3
Slight impairment	4
Moderate impairment	1
Severe impairment	1
Profound hearing loss	0

#### *Stage 4 wise distribution:*

Stage 4 wise distribution of CKD patients with hearing loss is presented in the table 5. Among the 8 patients, 1 patient had normal hearing, 2 had slight hearing loss, 1 had moderate hearing loss, 3 patient had severe hearing loss and 1 had profound hearing loss

TABLE 5

DEGREE OF HEARING LOSS	NUMBER OF PATIENTS
No impairment	1
Slight impairment	2

Moderate impairment	1
Severe impairment	3
Profound hearing loss	1

### Stage 5 wise distribution

Stage 5 wise distribution of patients with hearing loss were presented in table 6. Among the 9 patients, 2 had slight hearing loss and 3 had moderate hearing loss and 4 had profound hearing loss.

TABLE 6

DEGREE OF HEARING LOSS	NUMBER OF PATIENTS
No impairment	0
Slight impairment	2
Moderate impairment	3
Severe impairment	0
Profound hearing loss	4

In addition ,the study also compared the prevalence of hearing loss in different age groups. The study had 8 patients in the age group of 25-35 years ,11 patients in the age group of 36-45 years, 23 patients in the age group of 46-55 years and 8 patients in the age group of 56-65 years. Out of which, the prevalence of hearing loss in patients above 45 years is more(27/31) when compared with patients less than 45 years of age.

## DISCUSSION

The results of our study indicated that the prevalence of hearing loss increases with age. The study also indicates that degree of hearing loss increases with increasing stages of CKD .The lower the e-GFR ,higher is the degree of hearing loss.

In many hearing related studies,self reporting of hearing impairment and pure tone audiometry are the two common ways for assessment of hearing(11-15). Pure tone audiometry tests the hearing threshold at certain specific frequencies. Most of the hearing related studies performed pure-tone audiometry at 0.5, 1, 2, and 4 kHz. According to the WHO's recommendations , hearing loss is defined as an average hearing threshold of > 25 dB hearing level (HL) in the better-hearing ear .Disabling hearing loss is defined as an average hearing threshold of > 40 dB HL in the better-hearing ear .

Sun et al.(16) reported that around 11% of the older population( $\geq 60$  years) could be diagnosed with disabling hearing loss (> 40 dB HL) in China. In 2015, Gong et al. (11) conducted a study in older population ( $\geq 60$  years) which states that the prevalence of hearing loss (> 25 dB HL) was 58% the prevalence of disabling hearing loss (> 40 dBHL) was 24.1% Amieva et al.(14) conducted a study from the general French population using a short questionnaire survey to assess hearing loss in elderly participants ( $\geq 65$  years) and reported that 4% of the participants had major hearing loss and 31% had moderate hearing loss. Approximately onethird of the population aged over 65 years worldwide suffer from disabling hearing loss ,says a WHO report. Damage to inner hair cells of cochlea and decreased functioning of the stria vascularis results in hearing loss in elderly.

Vilayur et al.(17)stated in their study that patients with eGFR < 60 mL/min/1.73 m<sup>2</sup> had an independent association with hearing loss. Similarly ,in a study conducted by Seo et al.(18) they proved that patients with eGFR < 60 mL/min/1.73 m<sup>2</sup> had a significant influence on the hearing status of adults.

Our study provided valid evidence of the association between reduced kidney function and hearing loss in patients attending dialysis centre and nephrology OPD . We classified CKD patients according to their eGFR into five groups and found that participants in two eGFR groups, particularly, those with eGFR of 15-29 and  $<15 \text{ mL/min/1.73 m}^2$  have higher chances of hearing loss, compared with participants with  $\text{eGFR} \geq 60 \text{ mL/min/1.73 m}^2$  .Our study also showed that 3 patients in CKD stage 2 also had moderate hearing impairment. Hence, not only the CKD patients at stage 3–5, but also those at stage 2 have an increased risk of hearing loss .Hence ,all CKD patients should be addressed as early as possible for their hearing status,so that suitable interventions can be made at an appropriate time to reduce the disease burden.

Several studies have demonstrated the possible association between chronic kidney disease and hearing loss .Several physiological and pathological similarities exist in the stria vascularis of cochlea and the glomerulus of the kidney. Both are epithelial structures that are associated with the vascular system and a number of ion channels and transporters involved in potassium cycling and endolymphatic sodium ,potassium ,calcium homeostasis expressed in both the inner ear and kidney. Yassin et al.(19) in their study stated that the level of body sodium is directly related to the degree of hearing loss. They also found out that correcting sodium levels and improving kidney function greatly improves hearing.

#### CONCLUSION:

We conclude our study by stating that the degree of hearing loss is strongly associated with worsening renal function. Hence assessment of hearing should be included in the integral management of chronic kidney disease patients for early diagnosis and prompt treatment.

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