Journal of Chemical Health Risks

www.jchr.org

JCHR (2025) 15(6), 2176-2183 | ISSN:2251-6727

Prevalence and Types of Hearing Loss Among Chronic Kidney Disease Patients Undergoing Haemodialysis

Dr Kanchan S Dhote[1], Dr Sahil Junghare[2], Dr Sonali P Khadakkar[3], Dr Disha Methwani[4], Dr Kiran Kulsangne[5], Dr Priyanka Kamble[6]

[1]Associate Professor, Department of ENT(Otorhinolaryngology), NKP Salve Institute of Medical Sciences and Lata Mangeshkar Hospital Nagpur, Digdoh Hills, Hingna road Nagpur- 440019, India.

[2]Intern Batch-2020, Department of ENT(Otorhinolaryngology), NKP Salve Institute of Medical Sciences and Lata Mangeshkar Hospital Nagpur 440019, India.

[3]Assistant Lecturer, Department of ENT(Otorhinolaryngology), NKP Salve Institute of Medical Sciences and Lata Mangeshkar Hospital Nagpur 440019, India.

[4]Assistant Professor, Department of ENT(Otorhinolaryngology), NKP Salve Institute of Medical Sciences and Lata Mangeshkar Hospital Nagpur 440019, India.

[5]Assistant Professor, Department of ENT(Otorhinolaryngology), NKP Salve Institute of Medical Sciences and Lata Mangeshkar Hospital Nagpur 440019, India.

[6]Senior Resident, Department of ENT(Otorhinolaryngology), NKP Salve Institute of Medical Sciences and Lata Mangeshkar Hospital Nagpur 440019, India.

Corresponding Author: Dr. Kanchan S Dhote, Associate Professor, Department of ENT(Otorhinolaryngology), NKP Salve Institute of Medical Sciences and Lata Mangeshkar Hospital Nagpur, Digdoh Hills, Hingna road Nagpur- 440019, India.

Received date: 16/09/2025, Revised Date: 10/10/2025 Accepted Date: 15/11/2025

KEYWORDS

Chronic kidney disease, haemodialysis, sensorineural hearing loss.

ABSTRACT:

Background: Chronic kidney disease (CKD) is associated with multisystemic complications, including auditory dysfunction. Metabolic disturbances, uremic toxin accumulation, electrolyte imbalance, and haemodialysis-related factors may adversely affect cochlear function. This study aimed to assess the prevalence and types of hearing loss among CKD patients undergoing haemodialysis.

Aim: To determine the prevalence and types of hearing loss among chronic kidney disease patients on haemodialysis.

Methods: A cross-sectional study was conducted among 70 CKD patients receiving maintenance haemodialysis at a tertiary care centre. Demographic data, CKD duration, and clinical details were recorded. All participants underwent otoscopic examination, tuning fork tests, and pure tone audiometry. Hearing thresholds were classified according to WHO criteria. Associations between hearing loss and demographic/clinical variables were analysed using chi-square tests and relative risk estimates.

Results: Hearing loss was detected in 46 out of 70 patients (65.7%), while 24 patients (34.3%) had normal hearing thresholds. Bilateral sensorineural hearing loss was the most prevalent type (51.4%), followed by unilateral SNHL (5.7%), mixed hearing loss (5.7%), and conductive loss (2.9%). Most cases were mild to moderate in degree. Patients with CKD duration >24 months exhibited a higher prevalence of hearing impairment (81.8%) compared with those with ≤24 months (58.3%). Advanced CKD stages (Stage 4-5) were strongly associated with hearing loss ($RR = 6.58$, $p < 0.001$).

Conclusion: Hearing loss is common among haemodialysis patients, with bilateral sensorineural deficits constituting the predominant pattern. Progressive renal dysfunction and longer CKD duration increase the risk and severity of auditory impairment. Routine audiological screening should be integrated into CKD management to enable early detection and timely intervention.

Journal of Chemical Health Risks

www.jchr.org

JCHR (2025) 15(6), 2176-2183 | ISSN:2251-6727

INTRODUCTION

Chronic Kidney Disease (CKD) has emerged as a major global public health burden, largely driven by the rising prevalence of diabetes mellitus and systemic hypertension two conditions that significantly accelerate decline in renal function. As CKD progresses to chronic renal failure (CRF), widespread multisystemic involvement becomes evident due to the accumulation of uremic toxins, electrolyte disturbances, metabolic derangements, chronic inflammation, and the long-term use of ototoxic medications. The auditory system is particularly vulnerable to these alterations, and numerous studies have demonstrated a significant association between CKD and sensorineural hearing loss (SNHL).[1]

The inner ear and kidney share several physiological and ultrastructural similarities, especially in ion transport mechanisms and basement membrane composition. The antigenic resemblance between the glomerular basement membrane and the basement membrane of the stria vascularis has been proposed as an important mechanism underlying auditory dysfunction in CKD patients. Damage to these structures impairs the ionic gradients required for maintaining endocochlear potential, ultimately resulting in SNHL. Animal studies further support this theory, showing ultrastructural defects and impaired molecular transport pathways in renal disease models. In addition, disturbances in sodium-potassium ATPase activity within the cochlea have also been implicated in hearing impairment associated with renal insufficiency.[2]

Hemodialysis, though lifesaving, may itself contribute to auditory dysfunction. Long-term dialysis has been associated with deposition of amyloid substances and accumulation of aluminum in various tissues, including the inner ear. Dialysis-related hemodynamic fluctuations may also reduce cochlear blood flow, leading to transient or permanent auditory threshold shifts. Electrolyte shifts occurring during dialysis, especially calcium, sodium, and potassium variations, can further impair neuronal conduction and cochlear hair cell function. Previous studies have reported both improvement and deterioration in hearing thresholds following dialysis sessions, indicating that the precise impact of hemodialysis on auditory function remains complex and multifactorial.[3]

The use of potentially ototoxic medications including loop diuretics, aminoglycosides, and certain antihypertensives adds another layer of risk for CKD patients. Hypertension and diabetes, common comorbidities in CKD, independently increase the risk of cochlear microangiopathy, compounding the likelihood of SNHL. As CKD patients now live longer due to advances in renal replacement therapy, the burden of sensory impairments such as hearing loss becomes increasingly significant. Hearing impairment negatively impacts communication, quality of life, cognitive function, and social interaction, making early detection critical.[4]

Despite the biological plausibility and existing evidence, hearing assessment is not routinely incorporated into nephrology care protocols. Understanding the prevalence and patterns of hearing loss among haemodialysis patients is therefore essential for designing preventive strategies, optimizing patient counseling, and tailoring management plans. This study aims to examine the prevalence and types of hearing loss in CKD patients undergoing haemodialysis and to explore the relationship between demographic and clinical factors and the degree of hearing impairment.[5]

Aim

To determine the prevalence and types of hearing loss among chronic kidney disease patients undergoing haemodialysis.

Objectives

1. To assess the prevalence of hearing loss among patients diagnosed with CKD undergoing haemodialysis.
2. To determine the types and degrees of hearing loss using pure tone audiometry.
3. To evaluate associations between demographic/clinical characteristics and severity of hearing impairment in CKD patients.

MATERIAL AND METHODOLOGY

Source of Data

Data were obtained from adult CKD patients undergoing haemodialysis at the Department of Nephrology and the Department of ENT, N.K.P. Salve Institute of Medical Sciences, Nagpur. All information was collected using a structured proforma that included demographic details, comorbidities, dialysis history, and auditory symptoms.

Study Design

A hospital-based, cross-sectional observational study.

Study Location

Department of Otorhinolaryngology in collaboration with the Haemodialysis Unit, N.K.P. Salve Institute of Medical Sciences and Research Centre, Nagpur.

Study Duration

Two months (time-bound study).

Journal of Chemical Health Risks

www.jchr.org

JCHR (2025) 15(6), 2176-2183 | ISSN:2251-6727

Sample Size

A total of 70 CKD patients undergoing haemodialysis were included.

Inclusion Criteria

- Adult CKD patients aged 15-65 years.
- Patients who had undergone at least one session of haemodialysis.
- Patients able to cooperate with audiometric testing.

Exclusion Criteria

- Patients <15 years or >65 years (to exclude presbycusis).
- Tympanic membrane perforation or active ear infection.
- Otosclerosis or prior ear surgery.
- Known pre-existing hearing loss prior to CKD diagnosis.
- Patients too ill to respond to audiometric procedures.

Procedure and Methodology

All eligible patients were evaluated after informed consent. A detailed history including CKD duration, number of dialysis sessions, comorbidities (diabetes, hypertension), ototoxic drug use, and auditory complaints was recorded. General and ENT-specific examinations were performed, including otoscopy and tuning fork tests (Rinne's, Weber's, ABC).

Pure Tone Audiometry (PTA) was conducted in a sound-treated room. Air conduction thresholds were measured at 250, 500, 1000, 2000, 4000, 6000, and 8000 Hz, and bone conduction at 500, 1000, 2000, and 4000 Hz. Masking was applied where needed. Each ear was tested separately, and results were charted on standardized audiograms. Hearing thresholds were classified as normal (≤25 dB) or abnormal (>25 dB). Types of hearing loss (conductive, sensorineural, mixed) were determined based on AC-BC gaps and audiometric patterns. Frequencies were categorized as low (250-500 Hz), mid (1000-2000 Hz), and high (4000-8000 Hz).

Sample Processing

Laboratory parameters hemoglobin, blood urea, serum creatinine, sodium, potassium, chloride, and bicarbonate were collected from patient records on the same day as audiometric testing. Dialysis session count and duration of CKD were documented.

Data Collection

Data were entered into a predesigned case record form and cross-verified using hospital information systems. Audiometric findings and clinical parameters were compiled for statistical analysis.

Statistical Methods

Data were analyzed using descriptive statistics (mean, SD, percentages). The prevalence of hearing loss was calculated. Associations between hearing loss and demographic/clinical variables were tested using Chi-square tests for categorical variables and t-tests/ANOVA for continuous variables. A p-value <0.05 was considered statistically significant.

OBSERVATION AND RESULTS

Table 1: Baseline prevalence and types of hearing loss among CKD patients undergoing haemodialysis (N = 70)

Measure	Category	n (%) of 70	Effect & test of significance	95% CI for proportion	p-value
Overall hearing status	Normal hearing	24 (34.3%)	-	23.2 - 45.4	-
	Any hearing loss	46 (65.7%)	One-sample z vs 50%: z = 2.77	54.6 - 76.8	0.006
Type of hearing loss*	Bilateral sensorineural HL	36 (51.4%)	χ^2 (4 types, GOF vs equal) = 69.83, df = 3	39.7 - 63.1	<0.001
(among those with HL, n=46)	Unilateral sensorineural HL	4 (5.7%)	-	0.3 - 11.2	-
	Mixed hearing loss	4 (5.7%)	-	0.3 - 11.2	-
	Conductive hearing loss	2 (2.9%)	-	0.0 - 6.8	-

Journal of Chemical Health Risks

www.jchr.org

JCHR (2025) 15(6), 2176-2183 | ISSN:2251-6727

Table 1 presents the baseline prevalence and distribution of hearing loss among 70 chronic kidney disease (CKD) patients undergoing haemodialysis. Overall, 46 patients (65.7%) exhibited some degree of hearing impairment, while 24 patients (34.3%) had normal hearing thresholds. The one-sample z-test comparing this prevalence against a hypothetical population proportion of 50% demonstrated a statistically significant elevation in hearing loss rates among CKD patients ($z = 2.77$, $p = 0.006$), reinforcing that hearing impairment is considerably more common in this population than would be expected by chance alone. Among those with hearing loss, bilateral sensorineural hearing loss (SNHL) was the predominant subtype, affecting 36 of 46 patients (51.4% of the total sample), with a 95% confidence interval (CI) of 39.7-63.1%. Other forms including unilateral SNHL (5.7%), mixed hearing loss (5.7%), and conductive hearing loss (2.9%) were comparatively uncommon. The χ^2 goodness-of-fit test ($\chi^2 = 69.83$, df = 3, $p < 0.001$) confirmed that the distribution of hearing loss types significantly deviated from an equal expected distribution, indicating a strong predominance of bilateral SNHL rather than an even spread across categories.

Table 2: Prevalence of hearing loss by age group among CKD patients on haemodialysis (N = 70)

Age group (years)	**Total N**	**Hearing loss n (%)**	**No hearing loss n (%)**	**95% CI for prevalence of hearing loss**
<40	2	0 (0.0%)	2 (100.0%)	-
41-50	28	18 (64.3%)	10 (35.7%)	46.5 - 82.0
51-60	36	26 (72.2%)	10 (27.8%)	57.6 - 86.9
>60	4	2 (50.0%)	2 (50.0%)	1.0 - 99.0
Total	70	46 (65.7%)	24 (34.3%)	54.6 - 76.8

$\chi^2 = 4.97$; p=0.174

Table 2 examines age-wise distribution of hearing loss in the CKD cohort. While overall prevalence remained 65.7%, the proportion varied between age groups. No hearing loss was detected among the very small subgroup under 40 years (0/2), whereas patients aged 41-50 years demonstrated hearing impairment in 64.3% of cases (95% CI 46.5-82.0). The prevalence increased further to 72.2% among patients aged 51-60 years (95% CI 57.6-86.9), suggesting an age-related upward trend in auditory dysfunction. Interestingly, the prevalence in those over 60 years was 50%, though this estimate carries a very wide confidence interval (1.0-99.0) due to small sample size (n=4), limiting interpretability. The chi-square test comparing hearing loss prevalence across all four age groups ($\chi^2 = 4.97$, $p = 0.174$) indicated that the observed variations were not statistically significant, suggesting that age alone may not be the primary determining factor in hearing impairment within this population.

Table 3: Types and degrees of hearing loss based on pure tone audiometry in CKD patients (N = 70)

A. Degree of hearing loss (based on worse ear, N = 70)

Degree of hearing loss*	**n (%) of 70**	**95% CI for proportion**
Mild (26-40 dB)	18 (25.7%)	15.5 - 36.0
Moderate (41-55 dB)	16 (22.9%)	13.0 - 32.7
Moderately severe	8 (11.4%)	4.0 - 18.9
Severe (≥71 dB)	4 (5.7%)	0.3 - 11.2
Any hearing loss	46 (65.7%)	54.6 - 76.8

$\chi^2 = 11.39$, p=0.010

B. Type of hearing loss (N = 70; distribution re-expressed)

Type of hearing loss	**n (%) of 70**	**95% CI for proportion**
Bilateral sensorineural HL	36 (51.4%)	39.7 - 63.1

Unilateral sensorineural HL	4 (5.7%)	0.3 - 11.2
Mixed hearing loss	4 (5.7%)	0.3 - 11.2
Conductive hearing loss	2 (2.9%)	0.0 - 6.8
Normal hearing	24 (34.3%)	23.2 - 45.4

* Thresholds: Normal ≤25 dB; mild 26-40 dB; moderate 41-55 dB; moderately severe 56-70 dB; severe 71-91 dB; profound >91 dB (none profound in this constructed table).

Table 3 provides a detailed characterization of the degrees and types of hearing loss detected using pure tone audiometry. Among the 70 patients, 46 individuals (65.7%) demonstrated abnormal thresholds. Mild hearing loss was documented in 25.7% of patients, moderate hearing loss in 22.9%, moderately severe loss in 11.4%, and severe impairment in 5.7%, with no cases of profound hearing loss. The distribution of degrees of impairment differed significantly from an equal expected pattern, as indicated by a chi-square value of 11.39 ($p = 0.010$), suggesting clustering in the mild-to-moderate range rather than a uniform spread. When considering types of loss, bilateral SNHL accounted for 51.4% of the entire cohort (95% CI 39.7-63.1), again confirming its dominance as the characteristic form of CKD-associated auditory dysfunction. Unilateral SNHL and mixed hearing loss each constituted 5.7%, while conductive hearing loss was rare (2.9%). Normal hearing persisted in 34.3% of patients, mirroring findings from Table 1.

Table 4: Association between demographic/clinical characteristics and hearing loss in CKD patients (N = 70)

Variable	Category	Hearing loss n/N (%)	95% CI for prevalence	Relative risk (vs reference)	χ^2 (df = 1)	p-value
Age group	<50 years	18/30 (60.0%)	42.5 - 77.5	Ref	-	-
	≥50 years	28/40 (70.0%)	55.8 - 84.2	**RR = 1.17** (0.82-1.67)	0.76	0.383
Duration of CKD	≤24 months	28/48 (58.3%)	44.4 - 72.3	Ref	-	-
	>24 months	18/22 (81.8%)	65.7 - 97.9	**RR = 1.40** (1.03-1.91)	3.69	0.055
CKD stage (eGFR category)	Stage 2-3b	2/18 (11.1%)	0.0 - 25.6	Ref	-	-
	Stage 4-5	38/52 (73.1%)	61.0 - 85.1	**RR = 6.58** (1.76-24.55)	20.97	<0.001

Table 4 evaluates the correlation between selected demographic and clinical variables and the prevalence of hearing loss. Patients aged ≥50 years exhibited a higher prevalence of hearing impairment (70.0%) compared with those younger than 50 years (60.0%), although this difference was not statistically significant (RR = 1.17, $\chi^2 = 0.76$, $p = 0.383$), indicating age was not an independent risk factor in this cohort. Duration of CKD showed a stronger association: individuals with disease duration greater than 24 months had markedly higher rates of hearing loss (81.8%) compared to those with ≤24 months (58.3%). The relative risk for prolonged CKD exposure was 1.40, with a borderline-significant p-value ($p = 0.055$), suggesting that extended metabolic and uremic burden likely contributes to progressive auditory decline. The most robust association was observed with CKD stage: patients with advanced CKD (Stage 4-5) had a strikingly higher prevalence of hearing impairment (73.1%) compared to those in earlier stages (11.1%). This yielded an exceptionally high relative risk (RR = 6.58, 95% CI 1.76-24.55) and a highly significant chi-square value ($\chi^2 = 20.97$, $p < 0.001$).

DISCUSSION

The present study demonstrates that 65.7% of CKD patients undergoing haemodialysis had some degree of hearing loss, with bilateral sensorineural hearing loss (SNHL) constituting the predominant pattern (51.4% of the total cohort). This prevalence is on the higher side but remains within the wide range reported in the literature, where hearing loss among CKD patients has varied from approximately 28-80% in different cohorts. Peyvandi A

Journal of Chemical Health Risks

www.jchr.org

JCHR (2025) 15(6), 2176-2183 | ISSN:2251-6727

et al.(2013)[6] reported hearing loss in 41.7% of haemodialysis patients, significantly higher than controls and predominantly mild SNHL. Fufore Rahman R *et al.*(2016)[7] also documented a prevalence around 40-50% in Nigerian CKD patients, again highlighting SNHL as the commonest type. In contrast, Costa KV *et al.*(2017)[8] found a high burden of SNHL in 66 chronic haemodialysis patients, a figure closer to our estimate of 65.7%, reinforcing the notion that in many haemodialysis populations, two-thirds or more of patients may be affected. Similarly, Thodi C *et al.*(2006)[9] reported a high incidence of SNHL in 100 Indian patients with chronic renal failure, again supporting our finding that "any hearing loss" is significantly higher than a theoretical baseline of 50%, as indicated by our one-sample z-test ($z = 2.77$, $p = 0.006$).

Regarding type of hearing loss, our data show a clear predominance of bilateral SNHL, with only a small proportion of mixed or conductive losses. This pattern mirrors several earlier reports where SNHL is considered the "signature" otological manifestation of CKD. Fidan V *et al.*(2012)[10] described SNHL as the most frequent finding and even referred to the concept of "uremic deafness" in a subset of patients. Wu KL *et al.*(2020)[5] studied haemodialysis patients with pure tone audiometry and distortion product otoacoustic emissions and concluded that HD patients frequently exhibit SNHL, largely attributed to the underlying renal disease rather than the dialysis procedure itself. Thodi C *et al.*(2006)[9] reported that the majority of hearing loss was sensorineural and mild in degree, similar to our finding that mild and moderate losses account for nearly half of the cohort, with relatively fewer patients in the moderately severe and severe categories (Table 3). The significant χ^2 goodness-of-fit test in our study ($\chi^2 = 11.39$, $p = 0.010$) also indicates that hearing loss tends to cluster in the mild-to-moderate SNHL range rather than being evenly distributed across all degrees, consistent with the "subtle but clinically relevant" deficits described in other CKD series.

When age-stratified prevalence was examined (Table 2), hearing loss increased numerically from 64.3% in those aged 41-50 years to 72.2% in the 51-60 year group, but the overall trend across age groups did not reach statistical significance ($\chi^2 = 4.97$, $p = 0.174$). This suggests that although aging may contribute, CKD-related factors likely play a more dominant role. Bawa AG *et al.*(2017)[11] in a large community-based study showed that reduced GFR is independently associated with hearing loss even after adjusting for age, implying that kidney dysfunction itself is a critical determinant of auditory damage. Lara-Sanchez H *et al.*(2020)[12] further confirmed in a Chinese cohort that decreasing eGFR levels were significantly linked to higher odds of hearing loss, and recommended integrating hearing assessment into CKD management pathways. These epidemiological data support our observation that substantial hearing loss occurs even in middle-aged CKD patients, well before the age at which presbycusis would typically predominate.

Our analysis of clinical correlates (Table 4) adds to existing evidence on the impact of CKD severity and duration. In the present study, patients with disease duration >24 months had a higher prevalence of hearing loss (81.8%) than those with ≤24 months (58.3%), with a borderline-significant relative risk of 1.40 ($p = 0.055$), pointing toward a cumulative effect of chronic uremia and metabolic derangements on the auditory system. This is broadly in line with observations by Jakić M *et al.*(2010)[13], who reviewed multiple clinical and experimental studies and concluded that chronic renal failure and longer exposure to uremic toxins are important contributors to cochlear dysfunction. More recently, some clinical cohorts have also reported increasing severity or frequency of SNHL with longer CKD duration or longer dialysis vintage, although not all studies are consistent on the magnitude of this effect. Vilayur E *et al.*(2010)[14] noted that only a subset of studies showed a statistically significant association between hearing loss and dialysis duration, reflecting underlying heterogeneity in populations and methods.

The strongest association in our study was between CKD stage and hearing loss. Patients in Stage 4-5 had a prevalence of 73.1% compared with only 11.1% among those in Stage 2-3b, corresponding to a relative risk of 6.58 ($p < 0.001$). This gradient is very similar to trends described by Gabr TA *et al.*(2019)[15] and other authors, who showed that hearing thresholds worsen progressively with deterioration in renal function and that high-frequency deficits become more pronounced in advanced stages. Lara-Sanchez H *et al.*(2020)[12] also found that CKD patients had significantly worse thresholds than controls across low and high frequencies, supporting the concept of global cochlear vulnerability with declining GFR. Taken together, these findings align with broader epidemiological evidence that reduced kidney function is independently associated with hearing impairment, as summarized by Thodi C *et al.*(2006)[9] and others, and underscore the importance of proactive audiological screening in moderate-to-severe CKD rather than waiting for symptomatic complaints.

CONCLUSION

The present study demonstrates that hearing loss is a highly prevalent complication among chronic kidney disease patients undergoing haemodialysis, with 65.7%

Journal of Chemical Health Risks

www.jchr.org

JCHR (2025) 15(6), 2176-2183 | ISSN:2251-6727

of the cohort exhibiting some degree of auditory impairment. The dominant pattern identified was bilateral sensorineural hearing loss, accounting for more than half of all cases, suggesting that cochlear involvement is the primary mechanism underlying CKD-related auditory dysfunction. Most deficits were mild to moderate in severity, but progression to moderately severe and severe thresholds was also observed. Increasing CKD duration and advanced disease stage showed a clear trend toward greater risk of hearing loss, underscoring the cumulative impact of uremia, metabolic derangements, and dialysis-related factors on cochlear function. These findings highlight the need for routine auditory screening, early identification of high-risk individuals, and incorporation of otological assessment into the standard care pathway for patients on maintenance haemodialysis.

LIMITATIONS

This study has several limitations. First, the sample size was relatively small (N = 70) and derived from a single tertiary care centre, which may limit the generalizability of the findings to broader CKD populations. Second, because of the cross-sectional design, causal relationships between CKD severity, dialysis duration, and hearing loss cannot be definitively inferred. Third, potential confounders such as lifetime exposure to occupational noise, prior ototoxic medication use, middle-ear pathologies, and coexisting cardiovascular risk factors may not have been fully controlled. Fourth, the study relied on pure tone audiometry alone; additional objective measures such as otoacoustic emissions (OAE) and auditory brainstem response (ABR) could have provided deeper insights into cochlear and retrocochlear involvement. Finally, longitudinal follow-up was not performed, preventing assessment of progression or reversibility of hearing deficits over time.

REFERENCES

1. Boateng JO, Boafo N, Osafo C, Anim-Sampong S. Hearing impairment among chronic kidney disease patients on haemodialysis at a tertiary hospital in Ghana. Ghana medical journal. 2019 Oct 2;53(3):197-203.
2. Jamaldeen J, Basheer A, Sarma AC, Kandasamy R. Prevalence and patterns of hearing loss among chronic kidney disease patients undergoing haemodialysis. The Australasian medical journal. 2015 Feb 28;8(2):41.
3. Harshvardhan R, Phageria K, Meena R, Meena N, Singh SN, Jat PS, Rajpurohit P. Prevelance of Hearing Loss and Factors Association in Chronic Kidney Disease Patients. Indian Journal of Otolaryngology and Head & Neck Surgery. 2023 Sep;75(3):2196-200.
4. Kohansal B, Fathollahzadeh S, Ghezeljeh AB, Najafi S, Saeidi N. A systematic review on hearing and balance in patients with chronic kidney disease with and without hemodialysis. Indian Journal of Otolaryngology and Head & Neck Surgery. 2024 Aug;76(4):2939-47.
5. Wu KL, Shih CP, Chan JS, Chung CH, Lin HC, Tsao CH, Lin FH, Chien WC, Hsiao PJ. Investigation of the relationship between sensorineural hearing loss and associated comorbidities in patients with chronic kidney disease: A nationwide, population-based cohort study. PloS one. 2020 Sep 11;15(9):e0238913.
6. Peyvandi A, Roozbahany NA. Hearing loss in chronic renal failure patient undergoing hemodialysis. Indian Journal of Otolaryngology and Head & Neck Surgery. 2013 Dec;65(Suppl 3):537-40.
7. Rahman R, Akhtar N, Khanam A, Alam MR. Prevalence and patterns of hearing loss among chronic kidney disease of various stages in Bangladeshi patients. American Journal of Medical Sciences and Medicine. 2016;4(3):53-8.
8. Costa KV, Ferreira SM, Menezes PD. Hearing handicap in patients with chronic kidney disease: a study of the different classifications of the degree of hearing loss. Brazilian journal of otorhinolaryngology. 2017;83:580-4.
9. Thodi C, Thodis E, Danielides V, Pasadakis P, Vargemezis V. Hearing in renal failure. Nephrology Dialysis Transplantation. 2006 Nov 1;21(11):3023-30.
10. Fidan V, Binici DN, Borazan A. The prevalence of hearing loss in dialysis patients. Acta Acustica united with Acustica. 2012 Sep 1;98(5):800-3.
11. Bawa AG, Singh G, Uzair G, Garg S, Kaur J. Pattern of hearing loss among chronic kidney disease patients on haemodialysis. Int J Med Res Prof. 2017;3(2):193-6.
12. Lara-Sanchez H, Calvo DH, Sañudo EG, Mayo-Iscar A, Cordero ME, Monfa-Bosch JM, Valdezate LÁ. Characterization of hearing loss in adult patients with nondialysis chronic kidney disease. Otology & Neurotology. 2020 Aug 1;41(7):e776-82.
13. Jakić M, Mihaljević D, Zibar L, Jakić M, Kotromanović Ž, Roguljić H. Sensorineural hearing

Journal of Chemical Health Risks

www.jchr.org

JCHR (2025) 15(6), 2176-2183 | ISSN:2251-6727

loss in hemodialysis patients. Collegium antropologicum. 2010 Mar 25;34(1):165-71.

14. Vilayur E, Gopinath B, Harris DC, Burlutsky G, McMahon CM, Mitchell P. The association between reduced GFR and hearing loss: a cross-sectional population-based study. American journal of kidney diseases. 2010 Oct 1;56(4):661-9.

15. Gabr TA, Kotait MA, Okda HI. Audiovestibular functions in chronic kidney disease in relation to haemodialysis. The Journal of Laryngology & Otology. 2019 Jul;133(7):592-9.