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Orapuh Journal

ORIGINAL ARTICLE Journal of Oral & Public Health

Impact of dyslipidemia on cochleovestibular disorders in diabetic patients attending ENT Services at Boyambi Hospital, Kinshasa, Democratic Republic of the Congo

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ARTICLE INFO

Received: 08 April 2025
Accepted: 05 May 2025
Published: 07 June 2025

Keywords:
Dyslipidemia, hearing loss, cochleovestibular system, patient, lipidemia

Peer-Review: Externally peer-reviewed

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To cite:
Linda, H. M., Pholo, M. J., Lema, G., Mafuta, D., Mfulani, G., Matanda, C., Mbambu, E., Matanda, R., & Sokolo, G. J. (2025). Impact of dyslipidemia on cochleovestibular disorders in diabetic patients attending ENT Services at Boyambi Hospital, Kinshasa, Democratic Republic of the Congo. *Orapuh Journal*, 6(6), e1253
https://dx.doi.org/10.4314/orapj.v6i6.53

ISSN: 2644-3740

Published by Orapuh, Inc. (info@orapuh.org)

ABSTRACT

Introduction
Cochlear and vestibular disorders, particularly hearing loss, represent a public health concern in diabetic patients. Several factors may be responsible for this condition, including dyslipidemia (blood lipid imbalance).

Purpose
The aim of this study was to assess the impact of dyslipidemia on cochleovestibular disorders in diabetic patients attending ENT services at Boyambi Hospital, Kinshasa, Democratic Republic of the Congo.

Methods
A cross-sectional study with analytical aims was conducted. All subjects underwent a thorough ENT examination to screen for cochleovestibular disorders and assess lipid levels. The collected data were analysed using SPSS 26.0 software.

Results
A total of 179 diabetic patients were included in this study, of whom 145 (81%) had type 2 diabetes mellitus and 34 (19%) had type 1 diabetes. Females were more represented (107; 59.8%). The mean patient age was 53±14 years. Hearing loss was the most common cochlear disorder (93.3%), while vertigo was the most prevalent vestibular disorder (20.7%). The Barany caloric test was abnormal in 12.8% of patients.

Conclusion
Diabetes mellitus characterised by a blood sugar level from 226 mg/dl and a glycated haemoglobin level greater than 7% is correlated with the occurrence of cochleovestibular disorders.

INTRODUCTION

The prevalence of hearing loss and vestibular disorders increases with age. More than 25% of individuals over the age of 60 have disabling hearing loss, and cochlear disorders affect 19% of individuals in their forties and 85% of those over the age of 80 (World Health Organization [WHO], 2024). Dyslipidemia, a set of clinical and biological manifestations linked to the increase or decrease of one or more blood lipids, is, along with type 2 diabetes (T2D), one of the major risk factors for atherosclerosis (Gilles, 2011; Longo et al., 2008). Atherosclerosis can lead to cochleovestibular dysfunctions. Two common microvascular complications—retinopathy and neuropathy—have been shown to contribute to balance disorders and falls (Longo et al., 2008).

Dyslipidemia and Type 2 Diabetes

The prevalence of dyslipidemia is estimated at 4% of the general population and increases with age: 2.5% at age 20, and 4% to 19% from age 30 (WHO, 2016). In type 2 diabetes, the most common lipid profile is hypertriglyceridemia accompanied by low high-density lipoprotein cholesterol (HDL-C) and relatively normal plasma low-density lipoprotein cholesterol (LDL-C).

Hearing Loss in Diabetics

Even when hypertriglyceridemia is mild, LDL-C particles tend to be small and dense, making them more susceptible to oxidation. Additionally, chronic hyperglycemia promotes LDL-C glycation, and both processes increase atherogenicity (Longo et al., 2008). Diabetes has several potential clinical complications—such as retinopathy, nephropathy, and peripheral neuropathy—that reduce the health-related quality of life of affected individuals. Studies have shown that disease-specific medical factors, such as type, duration, treatment regimen, level of glycaemic control, and the presence of additional vascular complications, influence the complications resulting from diabetes mellitus (Thiombiano et al., 2015; Gilles, 2011). The rapid global rise in the incidence of diabetes mellitus has led to a concomitant increase in disabling and potentially fatal complications, with lipid abnormalities being among the most feared (International Diabetes Federation [IDF], 2021; WHO, 2016).

Dyslipidemia's Role

Dyslipidemia, together with diabetes, constitutes one of the major risk factors for cardiovascular disease (Gilles, 2011; Longo et al., 2008). With the increasing global incidence of diabetes, particularly in sub-Saharan Africa and the Democratic Republic of the Congo (DRC), there is a rise in disabling and potentially fatal complications, including lipid abnormalities (Katchunga et al., 2012). Diabetes affects multiple organs, including the inner ear. Diabetic neuropathy, which results from microvascular complications affecting peripheral sensory and motor nerves, has a prevalence greater than 50% in diabetic patients (Silva et al., 2019; Gioacchini et al., 2018). Epidemiological studies have reported that the prevalence of vestibular dysfunction is higher in individuals with diabetes than in age-matched controls (Agrawal et al., 2009). Medical records obtained through various SNIS reports have also shown increased rates of cochlear and/or vestibular disorders.

The scarcity of ENT specialists in the DRC and the lack of adequate technical support pose significant challenges to the comprehensive management of this potentially disabling condition. Considering that the cardiovascular complications of diabetes mellitus—especially cochlear and vestibular ones—are disabling and often irreversible, and that the contributing factors are modifiable, effective prevention is essential in management.

METHODS

Type, Period, and Setting of the Study

An observational, cross-sectional, analytical study was conducted from April to June 2024 at the Boyambi/Salvation Army Hospital in the Barumbu health zone.

Figure 1:
Boyambi Hospital

Population and Sample

The study included patients aged 18 years and older, of both sexes. A convenience sampling method was employed, recruiting patients through systematic review of hospital records and direct interviews. Data collection involved physical examinations (sociodemographic, anthropometric, and ENT assessments) and additional investigations.

Audiometric Assessment

Threshold pure tone audiometry was performed in a quiet room using a Tingotone computerized screening audiometer, calibrated from 500 to 8000 Hz and -10 to 120 dB, equipped with Radio Ear DD450 headphones and a bone vibrator transducer. Average hearing thresholds were calculated from air and bone conduction thresholds at 500, 1000, and 2000 Hz, allowing confirmation and quantification of sensorineural hearing loss for each ear.

Vestibular Assessment

Clinical vestibular tests included the Romberg test, blind walk test (Babinski-Weil), and Fukuda test. The Romberg test assessed balance with the subject standing, feet together, eyes closed. The blind walk test involved the patient taking five steps forward and backward with eyes closed. The Fukuda test required the subject to take 50 steps in 30 seconds with arms extended horizontally. Inability to perform these maneuvers or occurrence of falls indicated vestibular disturbances.

Data Collection Team

Data were collected by the principal investigator, assisted by two trained ENT physicians and a medical biologist from the University Clinics of Kinshasa (CUK).

Operational Definitions

1. **Hearing Level (WHO):**
   - Normal: ≤ 25 dB
   - Mild Hearing Loss: 26–40 dB
   - Moderate Hearing Loss: 41–60 dB
   - Severe Hearing Loss: 61–80 dB
   - Profound Hearing Loss: > 80 dB
2. **Vestibular Disorders:** Characterized by dizziness, balance disturbances, and abnormal vestibular test results. Caloric vestibular test parameters:
   - Valence: Normal ≤ 45; Disorder > 45
   - Directional Preponderance: Normal ≤ 45; Disorder > 45 indicating left or right vestibular dysfunction
3. **Socioeconomic Status:** Assessed using the Assets Poverty Index (API), considering household possessions such as running water, indoor toilets, electricity, radio, TV, refrigerator, and vehicle.
   - Low: < 5/7
   - High: ≥ 5/7
4. **Educational Attainment:** Categorized into primary, secondary, higher/university, and postgraduate education based on the highest degree obtained.
5. **Tobacco Use:** Defined as current or former use of any tobacco products, including smoked or snuff forms.
6. **Alcohol Consumption:** Defined as regular intake of at least one glass of alcohol (beer) per day.
7. **Metabolic Syndrome:** Defined according to the 2009 harmonized criteria, requiring at least three of the following:
   - Blood pressure ≥ 135/80 mmHg
   - Waist circumference > 80 cm in women and > 94 cm in men
   - Fasting blood glucose ≥ 100 mg/dL
   - HDL cholesterol < 50 mg/dL in women and < 40 mg/dL in men
   - Triglycerides ≥ 150 mg/dL
8. **Blood Sample Collection:** Patients fasted before a 5 mL venous blood sample was collected into an EDTA tube.

Statistical Analysis

Data were entered using Excel 2010 and analyzed with SPSS version 24. Results were presented in tables or graphs as appropriate. Continuous variables with normal distribution were expressed as mean ± standard deviation; non-normally distributed variables were presented as median (range). Categorical variables were described using relative frequencies (%). Proportions were compared using Pearson's chi-square test. Means between groups with normal distributions were compared using ANOVA.
Receiver Operating Characteristic (ROC) curves determined thresholds for study variables, assessing sensitivity and specificity. Univariate and multivariate analyses calculated odds ratios (ORs) with 95% confidence

intervals (CIs). A multivariate logistic regression model identified independent determinants of depression and cognitive impairment, adjusting for confounders. Discriminant analysis developed a predictive model for cognitive impairment and depression.

A p-value < 0.05 was considered statistically significant.

Ethical Considerations

The study adhered to international bioethical standards, particularly the Declaration of Helsinki, and received approval from the French National Health Ethics Committee (Comité National d'Éthique de la Santé), Approval No. 528/CNES/BN/PMM.

RESULTS

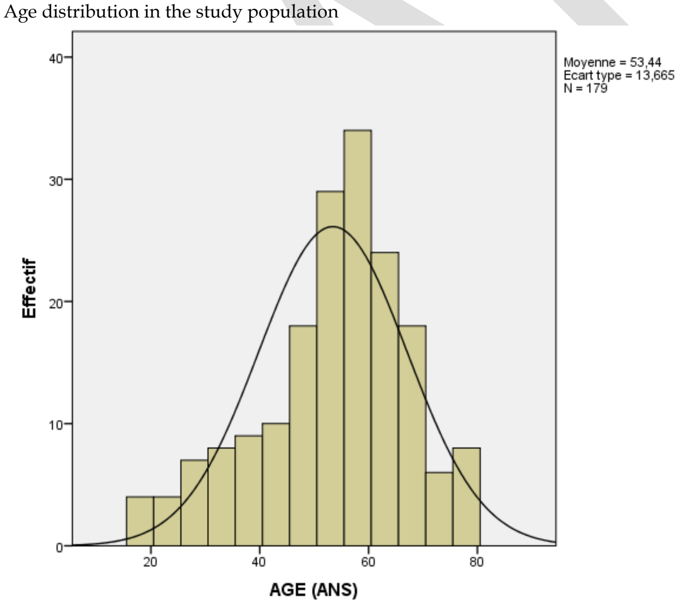
Study Population

A total of 179 patients diagnosed with diabetes mellitus participated in the study. Of these, 145 (81%) had type 2 diabetes mellitus and 34 (19%) had type 1 diabetes mellitus. All patients underwent a thorough ENT physical examination to assess their audiological and vestibular status, and to determine any correlation with their lipid profiles.

Age Distribution

The mean age of the patients was 53 ± 14 years. The age distribution followed a normal curve (Figure 2).

Figure 2:
Age distribution in the study population



ENT Physical Examination

Female patients were slightly more represented than male patients, accounting for 59.8% and 40.2% respectively (sex ratio: 0.67 males to 1 female). Most anthropometric and haemodynamic parameters were within normal limits.
ENT examination findings were as follows:

Table 1:
ENT physical examination findings

Features	n (%)
Tympanic membrane otoscopy	
- Normal	124 (69.3%)
- Tympanic dullness	24 (11.2%)
- Congestive tympanic membrane	20 (13.4%)
Anterior rhinoscopy	
- Normal	160 (89.4%)
- Congested mucosa	9 (5.0%)
- Pallor	8 (4.5%)
- Polypoid growth	2 (1.1%)
Oropharyngeal examination	
- Normal	167 (93.3%)
- Congestive	11 (6.1%)
- Eroded	1 (0.6%)
Altered general condition	
- Asthenia	4 (2.2%)
- Weight loss	4 (2.2%)

Clinical and Caloric Vestibular Tests

Among patients who reported vertigo, vestibular assessments were conducted. Most clinical balance tests showed normal results:

Table 2:
Clinical and caloric vestibular test results

Variables	n (%)
Romberg test	
- Normal	162 (90.5%)
- Pathological	17 (9.5%)
• Deviated left	8 (4.5%)
• Deviated right	9 (5.0%)
Babinski-Weil test	
- Normal	179 (100%)
Fukuda test	
- Normal	178 (99.4%)
- Pathological	1 (0.6%)

Caloric test results:

- Not done: 127 (70.4%)
- Normal: 29 (16.2%)

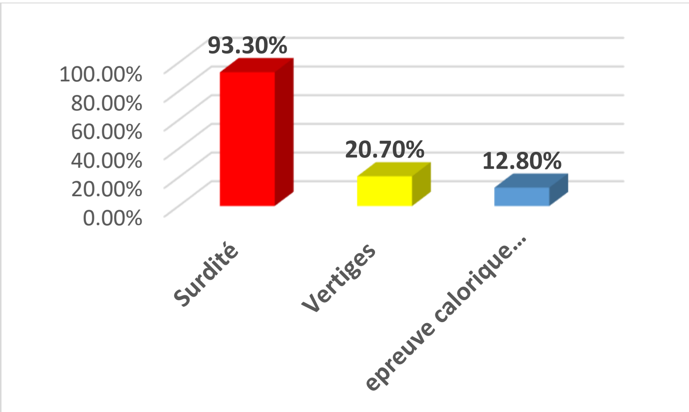
https://dx.doi.org/10.4314/orapj.v6i6.53

- Areflexia (right): 6 (3.4%)
- Areflexia (left): 3 (1.7%)
- Bilateral areflexia: 2 (1.1%)
- Excluded: 12 (6.7%)

Cochleo-Vestibular Disorders

Vertigo was reported in 20.7% of patients, and 12.8% showed pathological findings on the Barany caloric test.

Figure 3:
Distribution of patients with cochleo-vestibular disorders



Audiological Characteristics

Of the 179 diabetic patients, 54.7% had mild hearing loss.

Table 3:
Audiometric characteristics.

Characteristic	n (%)
Normal	12 (6.7%)
Mild hearing loss	98 (54.7%)
Moderate hearing loss	60 (33.5%)
Severe hearing loss	7 (3.9%)
Profound hearing loss	2 (1.1%)

Factors Associated with Vestibular Disorders

Multivariate analysis identified headaches, insomnia, head heaviness, and alcohol consumption as significant determinants of abnormal caloric test results.

Table 4:
Factors associated with vestibular disorders.

Determinants	Univariate p	OR (95% CI)	Multivariate p	aOR (95% CI)
Headaches	<0.001	3.5 (1.6–7.7)	0.001	3.1 (2.0–5.9)
Palpitations	0.047	2.1 (1.1–3.8)	0.066	0.2 (0.05–1.0)
Insomnia	0.046	1.9 (1.0–3.7)	0.042	3.4 (2.0–9.9)
Head heaviness	0.040	2.0 (1.1–3.6)	0.043	2.7 (1.7–9.8)
Alcohol consumption	0.002	1.3 (1.0–2.5)	0.004	2.6 (1.5–4.6)

Biological Characteristics

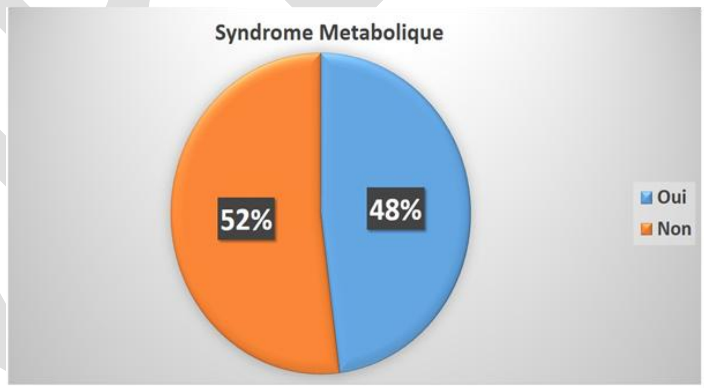
Table 5:
Biological characteristics of patients.

Variable	Mean ± SD	Min - Max
Fasting blood glucose (mg/dL)	232.4 ± 72.9	120 – 449
HbA1c (%)	10.89 ± 2.9	4 – 16
LDL (mg/dL)	173.7 ± 52.35	43 – 220
HDL (mg/dL)	47.14 ± 22.6	30.1 – 139.15
Triglycerides (mg/dL)	141.1 ± 50.08	8 – 301.6
Total cholesterol (mg/dL)	249.57 ± 63.77	85.75 – 324.20
LDL/HDL ratio	4.45 ± 1.86	0.32 – 6.35
Triglyceride/HDL ratio	3.51 ± 1.65	0.17 – 6.03

Metabolic Syndrome Prevalence

A total of 86 patients (48%) presented with clinical and biological markers indicative of metabolic syndrome.

Figure 4:
Glycaemic threshold associated with cochleo-vestibular disorders



Audiometric Testing vs Glycaemic and Lipid Status

Patients with hearing loss showed significantly higher values of fasting blood glucose, HbA1c, LDL, and triglycerides.

Table 6:
Correlation between hearing loss and glycaemic/lipid status

Variable	No HL (Mean ± SD)	HL (Mean ± SD)	p-value
Fasting blood glucose	132.7 ± 7.8	239.6 ± 70.1	<0.001
HbA1c (%)	6.2 ± 1.3	11.2 ± 2.7	0.004
LDL (mg/dL)	52.4 ± 7.6	182.4 ± 42.4	0.002
HDL (mg/dL)	114.9 ± 10	42.3 ± 13.7	0.566
Triglycerides (mg/dL)	124.8 ± 76.1	142.4 ± 47.8	0.008
Total cholesterol (mg/dL)	139.2 ± 58.6	257.5 ± 56.5	0.606

Vestibular Testing vs Glycaemic and Lipid Status

Vestibular abnormalities correlated with higher LDL, triglyceride, and cholesterol levels.

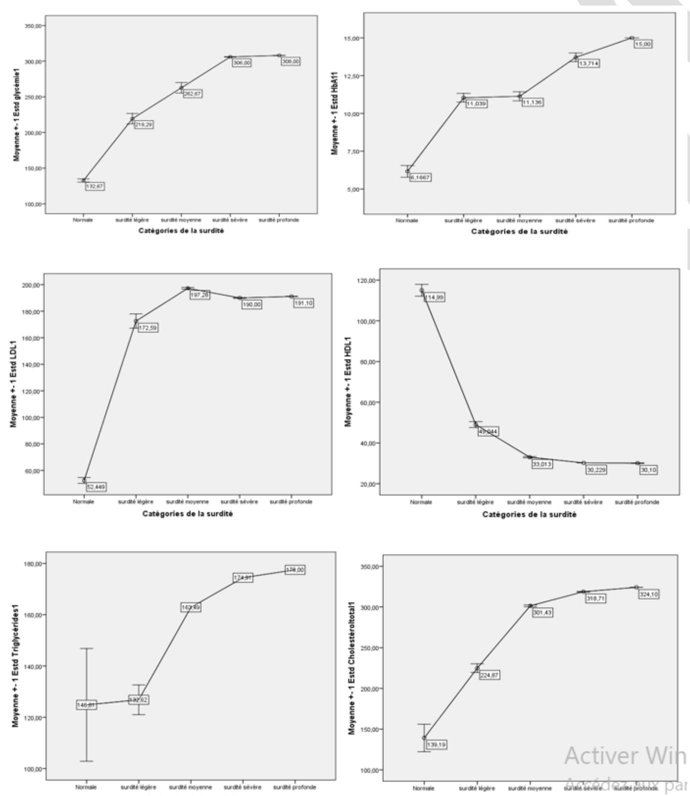
Table 7:
Vestibular test correlation with biomarkers.

Variable	Normal (Mean ± SD)	Abnormal (Mean ± SD)	p-value
Fasting blood glucose	254.7 ± 73.1	224.9 ± 64.9	0.816
HbA1c (%)	11.3 ± 2.7	10.9 ± 2.5	0.731
LDL (mg/dL)	174.9 ± 51.8	191.4 ± 31.5	0.007
HDL (mg/dL)	45.9 ± 22.2	38.4 ± 7.4	0.106
Triglycerides (mg/dL)	155.6 ± 46.8	128.9 ± 52.9	0.024
Total cholesterol (mg/dL)	247.9 ± 64.1	270.1 ± 50.7	0.049

Univariate Analysis: Biomarkers and Hearing Loss

As blood glucose, HbA1c, LDL, triglycerides, and total cholesterol increased, hearing worsened. Conversely, lower HDL levels were associated with more severe hearing loss.

Figure 5:
Univariate analysis of biomarkers associated with hearing loss.



Multivariate Analysis: Hearing Loss and Caloric Abnormalities

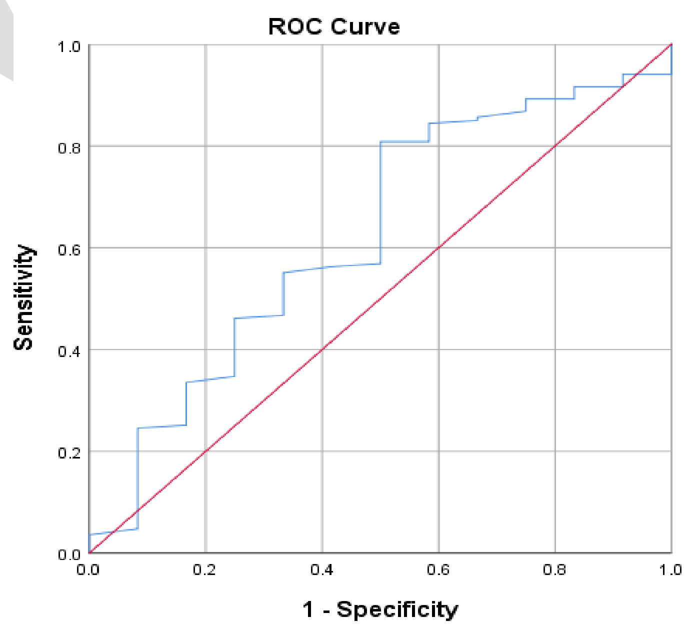
Table 8:
Determinants of hearing loss and vestibular dysfunction in diabetics.

Determinants	Univariate p	OR (95% CI)	Multivariate p	aOR (95% CI)
Hearing loss				
- HDL (pathological)	0.034	1.8 (1.0–2.1)		
- Metabolic syndrome	0.004	1.1 (1.0–2.1)	–	*Significant*
Caloric abnormalities				
- Otorrhoea	0.021	2.9 (2.0–4.2)	<0.001	3.5 (1.6–7.7)
- Headaches	0.047	2.1 (1.1–3.8)	0.001	3.1 (2.0–5.9)
- Palpitations	0.046	1.9 (1.0–3.7)	0.066	0.2 (0.05–1.0)
- Insomnia	0.040	2.0 (1.1–3.6)	0.042	3.4 (2.0–9.9)
- Head heaviness	0.002	1.3 (1.0–2.5)	0.043	2.7 (1.7–9.8)
- Alcohol use	–	–	0.004	2.6 (1.5–4.6)

Glycaemic Threshold Predisposing to the Occurrence of Cochleovestibular Disorders

With an area under the ROC curve of 0.624 [95% CI (0.455–0.792)], the glycaemic threshold associated with metabolic syndrome and predictive of cochleovestibular disorders was determined to be 226 mg/dL. This threshold corresponds to a sensitivity of 50.9%, specificity of 91%, positive predictive value (PPV) of 98.8%, negative predictive value (NPV) of 11.8%, and an overall diagnostic efficacy of 53.6%.

Figure 6:
Glycaemic Threshold Predicting the Onset of Cochleovestibular Disorders



DISCUSSION

Cochlear and Vestibular Disorders

Hearing loss was the most prevalent cochlear disorder in diabetic patients, followed by vestibular conditions such as vertigo and abnormal Barany caloric responses. These findings are in concordance with the study by Chávez-Delgado *et al.* (2012). Experimental evidence suggests the stria vascularis is particularly susceptible to ischaemia due to its high energy demands, surpassing those of the vestibular system (Nagaratnam *et al.*, 2002). Hearing loss correlated positively with elevated fasting blood glucose, glycated haemoglobin (HbA1c), LDL cholesterol, and triglycerides, as well as the presence of metabolic syndrome.

The severity of hearing loss was proportionate to increased levels of glycaemia, HbA1c, LDL, triglycerides, and total cholesterol, while longer duration of diabetes mellitus also showed a significant correlation. Regarding vestibular function, elevated levels of LDL ($p = 0.007$), triglycerides ($p = 0.024$), and cholesterol ($p = 0.049$) were also associated with vestibular dysfunction.

The glycaemic threshold at which over 90% of cochleovestibular disorders were observed was 226 mg/dL, with HbA1c levels exceeding 7%, further reinforcing the role of metabolic syndrome in these disorders.

Type of Diabetes Mellitus

Among the 179 diabetic patients in this study, **81% (n = 145)** had type 2 diabetes mellitus (T2DM), while **19% (n = 34)** had type 1 diabetes mellitus (T1DM), echoing findings by Pillay *et al.* (2019), who reported an 89.2% prevalence of T2DM in their cohort.

Histological investigations of T2DM have documented demyelination of the auditory nerve, degeneration of spiral ganglion and cochlear hair cells, atrophy of the central auditory pathways, and vascular wall thinning in the stria vascularis—factors that compromise glucose and oxygen supply and predispose to oxidative stress and endolymphatic hydrops, resulting in auditory dysfunction (Pérez *et al.*, 2001; Fukushima *et al.*, 2006). Nonetheless, the exact mechanisms remain uncertain.

Sociodemographic Characteristics

The mean age of patients was 53 ± 14 years, with most (48.6%) aged between 48 and 62 years. These findings are comparable to those from Risasi *et al.* (2021), who reported a mean age of 55.5 ± 11.6 years. However, Pillay *et al.* (2019) observed median ages of 29.5 years for T1DM and 59 years for T2DM.

In our cohort, females (59.8%) slightly outnumbered males (40.2%), yielding a sex ratio of 0.67:1. Pillay *et al.* (2018) also reported a female predominance, while Utkal *et al.* (2024) documented a male predominance (55.9%).

Most patients were unemployed (39.1%) and had secondary education (48.6%).

Clinical Characteristics

Approximately 27.4% of patients reported headaches, and 36.9% had a history of hypertension. The most common lifestyle factor noted was the use of headphones.

Hearing loss affected 93.3% of patients, reflecting its strong association with both microvascular and macrovascular complications, as well as lifestyle factors (Chávez-Delgado *et al.*, 2012). Studies consistently report high-frequency hearing loss in diabetic patients, attributed to damage to the cochlear base (Rozanska-Kudelska, 2008). Age-related (ARHL) and noise-induced hearing loss (NIHL) may confound these findings.

Patients with vertigo underwent vestibular assessment. The majority displayed normal results in balance tests: 90.5% (Romberg), 100% (Babinski-Weil), and 99.4% (Fukuda). As not all patients had vestibular complaints, the frequency of vestibular dysfunction may be underestimated. Some vestibular lesions may occur without vertigo, warranting comprehensive neuro-otological, neurological, and immunological evaluations (Jáuregui-Renaud *et al.*, 2013).

Biological Characteristics

Of the study population, **48% (n = 86)** met the clinical and biological criteria for metabolic syndrome (MS), a cluster of risk factors that increase the likelihood of cerebrovascular disease and diabetes. Lipid profile abnormalities are prevalent in African populations.

Correlation between Cochleovestibular Disorders and Biological Markers

Comparative analysis revealed that patients with hearing loss had significantly higher levels of fasting blood glucose ($p < 0.001$), HbA1c ($p = 0.004$), LDL ($p = 0.002$), triglycerides ($p = 0.008$), and a higher prevalence of metabolic syndrome ($p = 0.004$).

ANOVA showed that more severe hearing loss correlated with progressively higher levels of glycaemia, HbA1c, LDL, triglycerides, and total cholesterol. Conversely, lower HDL levels were associated with more severe hearing loss, suggesting a complex interplay between dyslipidaemia and auditory dysfunction. **Table 8** and **Figure 6** provide further statistical detail.

Factors Associated with Cochleovestibular Disorders in Diabetics

In univariate analysis, vertigo was associated with a variety of symptoms including: otalgia, hearing loss, otorrhoea, tinnitus, nausea, headaches, palpitations, insomnia, fatigue, memory loss, a history of otitis media, and metabolic syndrome.

Multivariate analysis identified metabolic syndrome as the sole determinant of hearing loss, while the pathological caloric test was associated with otorrhoea, headaches, insomnia, fatigue, and alcohol consumption.

Diagnostic Glycaemic Threshold

The glycaemic threshold of 226 mg/dL, coupled with HbA1c **>7%**, marks the point at which over 90% of cochleovestibular disorders were detected. This diagnostic value—associated with metabolic syndrome—exhibited a ROC AUC of 0.624 [95% CI (0.455–0.792)], sensitivity of 50.9%, specificity of 91%, PPV of 98.8%, NPV of 11.8%, and overall efficacy of 53.6%.

Study Limitations

This study lacked a control group of non-diabetic individuals. Future studies should include comparisons between diabetic and non-diabetic populations. Moreover, advanced audiological and vestibular assessments such as speech audiometry, brainstem auditory evoked responses, and videonystagmography were not employed but are recommended for future research.

CONCLUSIONS

Diabetes mellitus, a major contributor to cardiovascular complications, also predisposes patients to ENT manifestations, particularly hearing loss and vertigo. These disorders are closely linked to hyperglycaemia, elevated HbA1c, and dyslipidaemia, particularly in the context of metabolic syndrome and long-standing diabetes.

Early ENT screening in diabetic patients is crucial to prevent irreversible complications. We advocate for routine otorhinolaryngological assessments in all diabetic care settings to enable early detection and management of these underdiagnosed but impactful complications.

Ethical Approval: Ethical clearance approval was obtained from the Academic Secretariat of ISTM/Kinshasa (Certificate No. 022/0873/LR).

Conflicts of Interest: None declared.

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REFERENCES

Agrawal, Y., Carey, J. P., Della Santina, C. C., Schubert, M. C., & Minor, L. B. (2009). Disorders of balance and vestibular function in US adults: Data from the National Health and Nutrition Examination Survey, 2001–2004. *Archives of Internal Medicine*, *169*(10), 938–944. https://doi.org/10.1001/archinternmed.2009.66

Chávez-Delgado, M. E., Vázquez-Granados, I., Rosales-Cortés, M., & Velasco-Rodríguez, D. (2012). Disfunción cócleo-vestibular en pacientes con diabetes mellitus, hipertensión arterial sistémica y dislipidemia. *Acta Otorrinolaringológica Española*, *63*(2), 93–101. https://doi.org/10.1016/j.otorri.2011.09.001

Fukushima, H., Cureoglu, S., Schachern, P. A., Paparella, M. M., Harada, T., & Oktay, M. F. (2006). Effects of type 2 diabetes mellitus on cochlear structure in humans. *Archives of Otolaryngology–Head & Neck Surgery*, *132*(9), 934–938. https://doi.org/10.1016/j.otohns.2005.02.004

Gilles, C. (2011). *Les dyslipidémies: Dépistage, diagnostic et traitement* (2nd ed.). Québec. ISBN: 978-2-923362-18-2

Gioacchinni, F. M., Albera, R., Scarpa, A., & Cassandro, C. (2018). Hyperglycemia and diabetes mellitus are related to vestibular organs dysfunction: Truth or suggestion? A literature review. *Acta Diabetologica*, *55*(12), 1201–1207. https://doi.org/10.1007/s00592-018-1183-2

International Diabetes Federation. (2021). *IDF diabetes atlas* (10th ed.). International Diabetes Federation. https://diabetesatlas.org/atlas/tenth-edition

Jáuregui-Renaud, K., Gutierrez-Marquez, A., Viveros-Rentería, L., Ramos-Toledo, V., & Gómez-Alvarez, F. (2013). Neurotology symptoms at referral to vestibular evaluation. *Journal of Otolaryngology - Head & Neck Surgery*, *42*, 55. https://doi.org/10.1186/1916-0216-42-55

Katchunga, P., Masumbuko, B., Belma, M., Kashongwe, M. Z., Hermans, M. P., & M'buyamba-Kabangu, J. R. (2012). Age and living in an urban environment are major determinants of diabetes among South Kivu Congolese adults. *Diabetes & Metabolism*, *38*(4), 324–331. https://doi.org/10.1016/j.diabet.2012.02.008

Longo-Mbenza, B., Vangu, N. D., Nahimana, D., Mupepe, M. D., Mbungu, F. S., Ekwanzala, F., & Beya, C. (2008). Screen detection and the WHO STEPwise approach to the prevalence and risk factors of arterial hypertension in Kinshasa. *European Journal of Cardiovascular Prevention & Rehabilitation*, *15*(5), 503–508. https://doi.org/10.1097/HJR.0b013e3282f21640

Mitchell, P., Gopinath, B., McMahon, C., & Metal. (2009). Relationship of type 2 diabetes to the prevalence, incidence and progression of age related hearing loss. *Diabetic Medicine*, *26*(5), 483–488. https://doi.org/10.1111/j.1464-5491.2009.02710.x

Nagaratnam, N., Mak, J., Phan, T., & Kalouche, H. (2002). Sudden permanent hearing loss following anterior inferior cerebellar artery infarction. *International Journal of Clinical Practice*, *56*(2), 153–154. https://doi.org/10.1111/j.1742-1241.2002.tb11216.x

Organisation mondiale de la Santé. (2016). *Rapport mondial sur le diabète*. https://iris.who.int/handle/10665/254648

Organisation mondiale de la Santé. (2024, February). *Surdité et déficience auditive*.

Pérez, R., Ziv, E., Freeman, S., Sichel, J. Y., & Sohmer, J. (2001). Vestibular end-organ impairment in an animal model of type 2 diabetes mellitus. *The Laryngoscope*, *111*(1), 110–113. https://doi.org/10.1097/00005537-200101000-00019

Pillay, S., Aldous, C. M., Singh, D., & Pillay, D. (2019). Validation and effect on diabetes control of glycated haemoglobin (HbA1c) point-of-care setting. *South African Medical Journal*, *109*(2), 112–116. https://doi.org/10.7196/SAMJ.v109i2.13447

Puepet, F. H., Agaba, E. K., & Chuhwak. (2003). Some metabolic abnormalities in type 2 diabetic patients in Jos, North Central Nigeria. *Nigerian Journal of Medicine*, *12*(4), 19–27. PMID: 14768192

Risasi Etutu, R. J., Lukusa, M. A., & Motuta, A. C. (2021). Profil épidémiologique, clinique et facteurs de risque de diabète sucré: Cas de l'Hôpital Provincial Général de Référence de Kinshasa. *Congo Research Papers*, *1*(7), 98–115. https://doi.org/10.59937/AUYE9198

Rozanska-Kudelska, M. (2002). Hearing loss in patients with diabetes mellitus type II. *Otolaryngologia Polska*, *56*(5), 607–610. https://doi.org/10.1016/j.arcmed.2008.10.003

Silva, E. M. T., Lima Filho, B. F., Mantello, E. B., Sousa, A. G. P., Diniz Júnior, J., & Gazzola, J. M. (2019). Diseases and symptoms associated with changes in postural balance in diabetics: An integrating literature review. *Revista CEFAC*, *21*(6), 1–8. https://doi.org/10.1590/1982-0216/201921617318

Sun, H., Saeedi, P., Karuranga, S., Pinkepank, M., Ogurtsova, K., Duncan, B. B., et al. (2021). IDF diabetes atlas: Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. *Diabetes Research and Clinical Practice*, *183*, 109119. https://doi.org/10.1016/j.diabres.2021.109119

Thiombiano, L. P., Mbaye, A., Saw, S. A., Ngaide, A. A., Kane, A. B., Diao, M., et al. (2015). Prévalence de la dyslipidémie dans la population rurale de Guéoul (Sénégal). *Annales de Cardiologie et d'Angéiologie*, *64*(6), 389–395. https://doi.org/10.1016/j.ancard.2015.09.045