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ORIGINAL STUDY

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Prevalence of Sensory Neural Hearing Loss in a Sample of Type 2 Diabetes Mellitus in Erbil City

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Abstract

Background: Globally, the prevalence of T2DM has risen dramatically, becoming a significant public health concern due to its various complications. The diabetic patients may have a higher prevalence of sensorineural hearing loss (SNHL) compared to the non-diabetic population.

Objectives: This study aimed to identify the prevalence of SNHL among diabetic patients in clinical settings in the Kurdistan Region of Iraq.

Materials and Methods: A cross-sectional study with a comparative group was designed for the current healthy and type II diabetic patients. The study was conducted at Galiawa Diabetes Center and Rzgary Teaching Hospital in Erbil city (October 2024 - October 2025).

Results: The study included 150 participants, with 50% diabetic and 51.3% female. Most had higher education (46%), middle socioeconomic status (62%), and 64% faced SNHL. Left-side SNHL (3.3%) was most common, with 23.3% mild and 1.3% severe cases. The mean age was 50.45 ± 8.98 years, diabetes duration 4.85 ± 4.52 years, and HbA1c 6.86 ± 0.89%. No significant association was found between diabetes and gender, education, or socioeconomic status ($p > 0.05$). However, SNHL was higher in diabetics (52% vs. 20%), with significant links to bilateral (44%), left (5.3%), and right (2.7%) SNHL, as well as severity (29.3% mild vs. 2.7% severe, $p < 0.05$).

Conclusions: The study confirms a significant association between diabetes and SNHL, with diabetics showing higher prevalence (52%), longer disease duration, and poorer glycaemic control. SNHL severity and laterality were also linked to diabetes, with no associations with gender, education, or socioeconomic status.

Keywords: Diabetic complications, Neural complications, Screening

1. Introduction

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder characterized by hyperglycemia resulting from insulin resistance and relative insulin deficiency. Globally, the prevalence of T2DM has risen dramatically, becoming a significant public health concern due to its association with various complications, including neuropathy, retinopathy, nephropathy, and cardiovascular disease [1]. The World Health Organization (WHO) estimates that approximately 537 million people worldwide suffer from diabetes, and this number is projected to increase to 643 million by 2030 and 783 million by 2045 [2]. Alongside the well-established complications of T2DM, emerging evidence suggests a significant association between T2DM and SNHL [3].

SNHL is characterized by damage to the inner ear (cochlea) or the auditory nerve, leading to difficulties in sound perception [4]. Some studies indicate that individuals with diabetes have a higher prevalence of SNHL compared to the non-diabetic population [5] while others showed a mild relation [6, 7]. The proposed pathophysiological mechanisms linking T2DM to hearing impairment include microvascular damage, oxidative stress, chronic hyperglycemia, and inflammation, which affect the cochlear structures and the auditory nerve, and the cochlea is particularly

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vulnerable to microvascular damage. Polonged hyperglycemia may lead to thickening of the capillary walls, reduced blood flow, and impaired nutrient supply, resulting in auditory dysfunction [8].

Epidemiological studies have shown variable prevalence rates of hearing loss in diabetic patients, ranging from 20% to 70%, depending on factors such as age, disease duration, and glycemic control [9, 10]. However, despite these findings, the relationship between T2DM and SNHL remains controversial due to inconsistencies in study methodologies and population characteristics [11].

Given the high prevalence of diabetes in the Kurdistan region and the potential impact of hearing loss on patients' quality of life, it is crucial to investigate this association in the local population. Some studies in other parts of Iraq showed a positive relationship between SNHL and DM [12, 13]. This study aimed to bridge that gap in the Kurdistan Region of Iraq by determining the prevalence and severity of SNHL among T2DM patients in Erbil city and comparing these findings with non-diabetic individuals. The objectives were to find out the prevalence of sensory neural hearing loss in a sample of T2DM, compare the prevalence of sensory neural hearing loss between diabetic and non-diabetic groups, and identify the factors that are associated with hearing loss and its severity among T2DM patients.

2. Materials and methods

2.1. Study design and setting

A cross-sectional study with a comparative group was designed among current healthy and T2DM patients. The study was conducted at Galiawa Diabetes Center and Rizgary Teaching Hospital in Erbil city-Kurdistan Region of Iraq, and carried out from the beginning of October 2024 till the beginning of October 2025. In this regard, the diabetic and non-diabetic patients who attended the above-mentioned center and hospital were screened for the eligibility criteria.

2.2. Inclusion and exclusion criteria

Non-diabetic individuals and T2DM patients aged 18 years and older of both genders, regardless of socio-demographic characteristics, were eligible to be included in the study. Patients with a history the following criteria were excluded from the study: type I diabetes mellitus, history of severe noise exposure, hearing loss before the age of 45 years, chronic suppurative otitis media or hearing loss, meningitis, ear or head trauma, impacted ear wax, ear surgery, ototoxic drug use like diuretic, chemotherapy, and aminoglycosides, and finally a history of chronic diseases like: ischemic heart disease, hypertension and thyroid diseases.

2.3. Data collection

The study was conducted among 150 participants who were categorized into two groups: 75 known T2DM and the other group was a comparative group of 75 non-diabetics. This study was conducted on 75 known T2DM patients aged 18 to 65 years who were selected from Galiawa Diabetes Center and Rizgary Teaching Hospital in Erbil city. The other 75 non-diabetics were categorized as a comparative group.

An explicit questionnaire was designed to record the subject information comprising age, sex, occupation, educational level, socioeconomic status, duration of disease, drugs prescribed for diabetic patients, exposure to noise, hearing before diabetes, trauma to the ear, previous ear disease, ototoxic drug use, history of head injuries, and chronic diseases. The blood examination for glycated hemoglobin (HbA1c) was done in all diabetic patients. All included subjects underwent otoscopic examination (the eardrum was regarded as normal if intact and semi-permanent with no retraction, atelectasis, tympanosclerosis, or evidence of healed perforation). Furthermore, all included subjects experienced pure tone audiometry (AD226) in a soundproof room, and both air and bone conduction were measured for each ear by the same audiologist.

2.4. Statistical analysis

The data were recorded on a specially designed questionnaire, collected and entered into the computer via a Microsoft Excel worksheet (Excel 2016), and then analyzed using an appropriate data system, which is called the Statistical Package for the Social Sciences (SPSS) version 28. The results were compared between patients with different variables, with a statistical significance level of < 0.05. The results are presented as rates, ratios, frequencies, and percentages in tables and figures and analyzed using T-test and chi-square tests.

2.5. Ethical considerations

The protocol of this study was approved by the Ethics and Scientific Committees of the College of Medicine at Hawler Medical University in Erbil City. We obtained written consent from the patients who were included in this study for taking blood for HbA1c measurements. We protected the

Table 1. Background information and SNHL of diabetic and non-diabetic groups.

Variables	Categories	Number	Percent
Groups	Diabetic	75	50
	Non-diabetic	75	50
Gender	Male	73	48.7
	Female	77	51.3
Educational level	Illiterate	15	10
	Primary	21	14
	Secondary	45	30
	Higher education	69	46
Socioeconomic status	Low	37	24.7
	Middle	93	62
	High	20	13.3
SNHL	No	96	64
	Yes	54	36
Side of SNHL	No	96	64
	Right	2	1.3
	Left	5	3.3
Severity of SNHL	No	96	64
	Mild	35	23.3
	Moderate	12	8
	Moderately Severe	5	3.3
	Severe	2	1.3
Total		150	100%

Table 2. Mean age, duration of diabetes, and HbA1c% of participants.

Descriptive Statistics						
	N	Range	Minimum	Maximum	Mean	Std. Deviation
Age (years)	150	35	30	65	50.45	8.98
Duration of diabetes (years)	75	21	1	22	4.85	4.52
HbA1c%	75	4	5	9	6.86	0.89

confidentiality of the personal information of the patients in this study.

3. Results

A total of 150 participants enrolled in our study, half (50%) of whom were diagnosed with diabetes. More than half (51.3%) of the cases were female, following by most (46%) of them having higher education while 30% of them graduated secondary level. Most (62%) of respondents were of middle SE status. Our study found that 64% had SNHL and the most cases (3.3%) diagnosed with left side of SNHL and finally 23.3% of SNHL patients had mild severity, while only 1.3% of them had severe SNHL (Table 1).

Table 2 shows that the mean age ± Std. deviation of participants was 50.45 ± 8.98 years, the average duration of diabetes cases was 4.85 ± 4.52 years, and finally, the mean HbA1c ± S.D of them was 6.86 ± 0.89% (Table 2).

Findings of Table 3 reveal that there was no statistically significant association between diabetic and non-diabetic groups in gender ($p = 0.624$), educational level ($p = 0.089$) and socioeconomic status ($p = 0.745$). There was a statistically significant association between groups and SNHL; more than half (52%) of the diabetic group experienced SNHL while only 20% of non-diabetic respondents faced the same condition ($p = 0.001$). There was significance statistical association between groups and the side of SNHL, (44%) bilateral, (5.3%) left and (2.7%) right side of the diabetic group diagnosed with SNHL ($p = 0.001$). There was a significant statistical association between groups and the severity of SNHL, 29.3% of cases had mild SNHL while only 2.7% of the diabetic group had severe SNHL ($p = 0.001$; as shown in (Table 3).

Results of Table 4 show that there was a significant statistical difference between SNHL and the duration of diabetes; the SNHL group had a higher mean of 7.62 years compared to the control group with a mean of 1.86 year ($p = 0.001$). The patients with SNHL had a significant higher disease duration (7.62 vs. 1.86 yrs., $p = 0.001$) and HbA1c levels (7.11 vs. 6.60%, $p = 0.001$).

Table 5 determines that there was a statistically significant association between SNHL and type of treatment, 407% of SNHL group had oral hypoglycemic treatment following by all (100%) of cases had insulin and majority (92.3%) of SNHL cases also, had combined treatment.

Table 3. Association between case and control regarding general information and SNHL of respondents.

Variable	Categories	Groups no (%)		p-value
		Diabetic	Non-diabetic	
Gender	Male	35 (46.7)	38 (50.7)	0.624
	Female	40 (53.3)	37 (49.3)	
Educational level	Illiterate	4 (5.3)	11 (14.7)	0.089
	Primary	14 (18.7)	7 (9.3)	
	Secondary	25 (33.3)	20 (26.7)	
	Higher education	32 (42.7)	37 (49.3)	
Socioeconomic status	Low	20 (26.7)	17 (22.7)	0.745
	Middle	44 (58.7)	49 (65.3)	
	High	11 (14.7)	9 (12)	
SNHL	No	36 (48)	60 (80)	0.001
	Yes	39 (52)	15 (20)	
Side of SNHL	No	36 (48)	60 (80)	0.001
	Right	2 (2.7)	0 (0)	
	Left	4 (5.3)	1 (1.3)	
	Bilateral	33 (44)	14 (18.7)	
Severity of SNHL	No	36 (48)	60 (80)	0.001
	Mild	22 (29.3)	13 (17.3)	
	Moderate	10 (13.3)	2 (2.7)	
	Moderately Severe	5 (6.7)	0 (0)	
	Severe	2 (2.7)	0 (0)	
Total		75 (100)	75 (100)	

Table 4. Difference between SNHL and non-SNHL cases regarding the duration of diabetes and HbA1c.

Variable	SNHL	N	Mean	Std. Deviation	p-value	t-test
Duration of diabetes (years)	Yes	39	7.62	4.75	0.001	Significant
	No	36	1.86	1.01		
HbA1c	Yes	39	7.11	1.01	0.011	Significant
	No	36	6.60	0.64		

4. Discussion

The present study investigated the prevalence and severity of SNHL among patients with T2DM in Erbil city and compared the results with a non-diabetic control group. The findings revealed a significantly higher prevalence of SNHL among diabetic individuals (52%) compared to non-diabetics (20%), consistent with previous studies suggesting a strong association between diabetes and auditory dysfunction [9, 14]. A meta-analysis demonstrated that individuals with diabetes had approximately double the risk of hearing impairment compared to non-diabetics. Similarly, other studies have shown prevalence rates of SNHL in diabetics ranging between 30% and 70% depending on the population studied and diagnostic criteria used [9, 15].

This study also observed that bilateral hearing loss was the most common pattern among diabetic participants, present in 44% of cases. This observation corroborates earlier research suggesting symmetrical, bilateral SNHL as a hallmark in diabetic patients, likely due to systemic microvascular and neural damage [16, 17]. Chronic hyperglycemia in diabetes contributes to microangiopathy, which impairs blood supply to the cochlea, leading to progressive degeneration of the sensory epithelium and stria vascularis [18].

Furthermore, the current study found that the severity of SNHL was significantly associated with

Table 5. Association between SNHL and the type of treatment among participants.

Type of treatment	SNHL no. (%)	
	No	Yes
Oral hypoglycemic	35 (59.3)	24 (40.7)
Combined	1 (7.7)	12 (92.3)
Insulin	0 (0)	3 (100)
Total	36 (48)	39 (52)

longer diabetes duration and higher HbA1c levels. Participants with hearing loss had a mean diabetes duration of 7.62 years compared to 1.86 years in those without hearing loss. These findings reinforce the notion that poor glycemic control and prolonged disease exposure exacerbate cochlear damage [19]. Tsuda et al. documented histopathological changes in the cochlea, including thickened capillary walls and loss of outer hair cells, in diabetic individuals, linking structural damage to auditory dysfunction [20].

Treatment type also appeared to be associated with SNHL severity. The highest rate of hearing loss was observed in patients receiving combined oral hypoglycemics and insulin therapy, followed by those on insulin alone. This may reflect a more advanced disease state or greater metabolic instability, necessitating aggressive glycemic control measures [15, 21].

The lack of significant associations between SNHL and gender, educational level, or socioeconomic status is consistent with several other studies that have reported no demographic predisposition for diabetes-related hearing impairment [11] or there are non-significant association [22].

In Iraq, limited data have been available regarding the association between SNHL and diabetes. Nevertheless, studies conducted in other regions of Iraq support the findings of this research. Jassim et al. reported a positive association between diabetes and sensorineural hearing impairment among Iraqi patients [12]. This highlights the importance of early auditory screening in diabetic patients to facilitate timely intervention and improve quality of life.

This study was limited by its cross-sectional design, which restricts the ability to establish causality. In addition, although ototoxic drug use and other confounding variables were considered in the exclusion criteria, undiagnosed comorbidities or subclinical conditions may have influenced the outcomes. Longitudinal studies with larger, multi-center populations and more comprehensive metabolic profiling are recommended for future research.

5. Conclusion

This study adds to the growing body of evidence supporting the inclusion of audiological assessments in routine diabetes care. Given the silent and progressive nature of SNHL, particularly in its early stages, proactive hearing evaluation could be critical in preventing long-term communicative and cognitive consequences [10].

Ethical approval

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of College of Medicine of the Hawler Medical University in Erbil City.

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