

Prevalence of Hearing Loss Associated with Diabetes Mellitus and Hypercholesterolemia

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ABSTRACT

Background: The relationship between hearing loss and metabolic disorders, particularly diabetes mellitus and hypercholesterolemia, has emerged as a critical research focus. The intricate interplay between these systemic conditions and auditory health poses significant implications for global public health, warranting comprehensive exploration and intervention strategies. **Objective:** To determine the prevalence of hearing loss associated with diabetes mellitus and hypercholesterolemia. **Study Design:** Cross sectional study. **Settings:** Department of ENT, CMH, Multan Pakistan. **Duration:** From November 2022 to April 2023. **Methods:** Total 153 adult patients aged 18 years and above of either gender with known history of diabetes mellitus and hypercholesterolemia although without a history of pre-existing auditory disorders, congenital hearing impairment, or any other systemic conditions known to affect hearing were included. Patients with a history of known auditory disorders, pre-existing hearing impairment, or other systemic conditions such as autoimmune diseases or neurodegenerative disorders affecting hearing were excluded. Written informed consent was obtained from all patients before their inclusion in the study. Fasting blood samples were collected for the assessment of metabolic parameters. Statistical analysis was performed using SPSS version 22. **Results:** The mean age of the patients was 45.2 ± 8.7 years. Gender distribution revealed that 78 patients (51%) were male, while 75(49%) were female. Of the total patients, 27 (18%) had hearing loss, while the majority, 126(82%), had normal hearing. Mild hearing loss was identified in 15(10%), moderate hearing loss in 8(5%), and severe hearing loss in 4(3%) patients. Regarding the type of hearing loss, sensorineural impairment was the most common, affecting 20(13%), followed by conductive hearing loss in 5(3%), and mixed hearing loss in 2(1%) patients. **Conclusion:** The prevalence of hearing loss associated with diabetes mellitus and hypercholesterolemia underscores the multifaceted nature of health conditions and their impact on sensory functions.

Keywords: Prevalence, Hearing Loss, Diabetes Mellitus, Hypercholesterolemia, Metabolic Disorders, Auditory Function.

INTRODUCTION

Hearing loss, a multifaceted and prevalent health concern, has been associated with various systemic disorders, among which diabetes mellitus and hypercholesterolemia have emerged as significant contributors.^{1,2} This intricate relationship between metabolic disorders and auditory impairment has garnered attention in recent years, prompting extensive research to elucidate the global prevalence, regional

disparities, etiology, and underlying pathophysiological mechanisms.³

Hearing loss is a global health issue affecting millions of individuals, with diverse etiologies ranging from genetic factors and environmental exposures to systemic diseases. The World Health Organization (WHO) estimates that over 5% of the world's population, equivalent to 466 million people, experiences disabling hearing loss, emphasizing the magnitude of this health

concern on a global scale.⁴ The association between diabetes mellitus, hypercholesterolemia, and hearing loss has gained recognition, adding another layer to the complexity of this pervasive condition.⁵

The etiology of hearing loss associated with diabetes mellitus and hypercholesterolemia is multifactorial, involving a complex interplay of vascular, inflammatory, and metabolic pathways. In diabetes mellitus, chronic hyperglycemia contributes to microvascular complications, affecting the delicate blood supply to the cochlea. This vascular compromise, coupled with oxidative stress and inflammation, may result in damage to the auditory structures, leading to sensorineural hearing loss.⁶ Hypercholesterolemia, characterized by elevated levels of cholesterol in the bloodstream, has been implicated in atherosclerosis and vascular dysfunction. The intricate network of blood vessels supplying the inner ear is susceptible to the deleterious effects of hypercholesterolemia, compromising the perfusion of vital structures responsible for hearing. Additionally, the deposition of cholesterol plaques in the vascular system may exacerbate oxidative stress and inflammatory responses, further contributing to auditory impairment.^{7,8}

The pathophysiology of hearing loss in the context of diabetes mellitus and hypercholesterolemia involves intricate cellular and molecular mechanisms. In diabetes, high levels of glucose can lead to the formation of advanced glycation end products (AGEs), contributing to oxidative stress and inflammation in the auditory system. Microangiopathy, a hallmark of diabetes, may result in impaired blood flow to the cochlea, leading to ischemia and subsequent damage to sensory cells.⁹ Hypercholesterolemia, on the other hand, promotes atherosclerosis and endothelial dysfunction, compromising the integrity of blood vessels supplying the inner ear. The accumulation of cholesterol in these vessels further exacerbates oxidative stress, creating a pro-inflammatory environment that adversely affects auditory function. The combined impact of these pathophysiological processes underscores the intricate relationship between metabolic disorders and hearing loss.¹⁰

The exploration of the prevalence of hearing loss associated with diabetes mellitus and hypercholesterolemia is imperative due to the escalating global burden of both metabolic disorders and hearing impairment. Understanding the prevalence provides valuable insights into the scale of this health intersection, aiding healthcare professionals in prioritizing preventive measures and interventions. Moreover, it facilitates the identification of at-risk populations, enabling targeted screening and early detection strategies. This research also contributes to the broader understanding of the intricate connections between systemic health conditions

and their impact on sensory functions, fostering a holistic approach to healthcare management.

METHODS

After approval from the hospital's ethical review board (ERB), this cross-sectional study was conducted at Department of ENT CMH, Multan from November 2022 to April 2023. The sample size of 153 patients was calculated using a prevalence estimation formula, considering an anticipated prevalence of hearing loss associated with diabetes mellitus to be 36.6% based on previous literature.¹³ A confidence level of 95% and a margin of error of 5% were used in the calculation to ensure the precision of the findings.

Adults aged 18 years and above of either gender with known history of diabetes mellitus and hypercholesterolemia although without a history of pre-existing auditory disorders, congenital hearing impairment, or any other systemic conditions known to affect hearing were included. Patients with a history of known auditory disorders, pre-existing hearing impairment, or other systemic conditions such as autoimmune diseases or neurodegenerative disorders affecting hearing were excluded. Written informed consent was obtained from all patients before their inclusion in the study.

Patients underwent a structured interview to obtain detailed medical histories, including the presence of diabetes mellitus and hypercholesterolemia. Demographic information such as age, gender, occupation, and socioeconomic status was also recorded. Audiometric evaluations were conducted to assess hearing status. Pure-tone audiometry measured hearing thresholds at different frequencies, while speech audiometry assessed speech discrimination abilities. Patients were categorized into groups based on the severity and type of hearing loss. Fasting blood samples were collected for the assessment of metabolic parameters. Blood glucose levels were measured to identify individuals with diabetes mellitus, and lipid profiles were obtained to identify hypercholesterolemia.

Statistical analysis was performed using SPSS version 22. Descriptive statistics for demographic characteristics and prevalence rates were calculated. Chi-square tests and logistic regression analyses were applied to assess the association between hearing loss and the presence of diabetes mellitus and hypercholesterolemia, controlling for potential confounding variables.

RESULTS

The mean age of the patients was 45.2 ± 8.7 years. Age distribution revealed that 20% were in the 18-30 years

range, 30% in the 31-45 years range, 33% in the 46-60 years range, and 17% were 61 years and above. Gender distribution revealed that 78 patients (51%) were male, while 75 patients (49%) were female. In terms of residence, the majority (60%) were from urban areas, with 92 patients, while 40% resided in rural areas, constituting 61 patients as given in table 1.

Table 2 displays the prevalence of the outcome variable, hearing loss, within the study population. Of the total patients, 27 (18%) had hearing loss, while the majority, 126 patients (82%), had normal hearing.

Table 3 showed severity and type of hearing loss observed in the study patients. Mild hearing loss was identified in 15 patients (10%), moderate hearing loss in 8 patients (5%), and severe hearing loss in 4 patients (3%). Regarding the type of hearing loss, sensorineural impairment was the most common, affecting 20 patients (13%), followed by conductive hearing loss in 5 patients (3%), and mixed hearing loss in 2 patients (1%).

Table 1: Distribution of demographics of included patients

Variable	Category	Number of Patients (%)
Age	Mean \pm SD	45.2 \pm 8.7 years
	18-30 years	31 (20%)
	31-45 years	46 (30%)
	46-60 years	50 (33%)
	61 years and above	26 (17%)
Gender	Male	78 (51%)
	Female	75 (49%)
Residence	Urban	92 (60%)
	Rural	61 (40%)

Table 2: Prevalence of outcome variable

Variables	Category	Number of Patients (%)
Hearing Loss	Present	27 (18%)
	Absent	126 (82%)

Table 3: Severity and type of hearing loss

Variables	Category	Number of Patients (%)
Severity of Hearing Loss	Mild	15 (10%)
	Moderate	8 (5%)
	Severe	4 (3%)
Type of Hearing Loss	Sensorineural	20 (13%)
	Conductive	5 (3%)
	Mixed	2 (1%)

DISCUSSION

Hearing loss linked to diabetes mellitus and hypercholesterolemia underscores the intricate interplay between metabolic health and auditory function. Individuals with diabetes may experience microvascular complications affecting the delicate blood supply to the cochlea, leading to sensorineural hearing loss.

Hypercholesterolemia, characterized by elevated cholesterol levels, contributes to vascular dysfunction, potentially compromising blood flow to the inner ear. The global prevalence of these metabolic disorders amplifies the significance of understanding their impact on hearing health.^{11,12}

In comparing our study with Manzoor *et al.*, notable differences emerge in age distribution and gender proportions among participants. Our study's participants, with a mean age of 45.2 \pm 8.7 years, were spread across various age groups: 20% in the 18-30 years range, 30% in the 31-45 years range, 33% in the 46-60 years range, and 17% aged 61 years and above. In contrast, Manzoor *et al.*'s study reported a higher concentration of patients in older age brackets, with 40.6% in the 51-60 years range and 59.4% in the 61-70 years range.¹³

In our study, we observed a prevalence of hearing loss in 18% of the total patients, with varying degrees of severity. Mild hearing loss was present in 10% of patients, moderate hearing loss in 5%, and severe hearing loss in 3%. Sensorineural impairment was the predominant type, affecting 13%, followed by conductive hearing loss in 3%, and mixed hearing loss in 1%. Contrasting our findings with Bhat *et al.* (2021), their study in Nepal identified hearing loss in 30% of subjects with diabetes mellitus, predominantly mild in nature.¹⁴ Al-Rubeaan *et al.* (2022) reported a higher prevalence, with 49% of their patients experiencing hearing loss, particularly in those with higher glycated hemoglobin levels.¹⁵ In comparison, Manzoor *et al.* (2022) found a hearing loss prevalence of 36.6%, with 30.8% exhibiting mild to severe hearing loss on high frequencies.¹³

These variations in prevalence and severity across studies may be attributed to differences in sample characteristics, geographical locations, and methodologies. Our study contributes to this discourse by providing insights into the nuanced distribution of hearing loss severity and types among patients with diabetes mellitus, enhancing the collective understanding of the intricate relationship between metabolic disorders and auditory health.

Our study aligns with the broader literature, particularly systematic reviews and meta-analyses, reinforcing the association between hearing loss and diabetes mellitus. The overall pooled odds ratio of 1.91-2.15, as reported in previous meta-analyses, underscores a significantly elevated risk of hearing impairment in individuals with diabetes compared to non-diabetic subjects.¹⁶ Our findings are consistent with prior studies conducted in India, emphasizing the robustness of this association across diverse populations. Dosemane *et al.* reported a noteworthy discrepancy between self-reported complaints of ear problems (39%) among diabetes mellitus patients and the substantially higher prevalence

(97.2%) revealed through audiological evaluation in their South Indian study.¹⁷ This underscores the potential underestimation of hearing issues based solely on self-reports, highlighting the importance of comprehensive audiological assessments. In agreement with this, Soares *et al.* observed a comparatively low prevalence of self-reported hearing loss (2.56%) in diabetes mellitus patients, emphasizing the need for objective evaluations to capture the true extent of auditory impairment in this population. These collective findings emphasize the imperative for routine audiological assessments in diabetes management to mitigate the underdiagnosis of hearing loss.¹⁸

The absence of long-term follow-up data hinders the exploration of temporal relationships and the dynamic nature of metabolic conditions and hearing impairment.

CONCLUSION

In conclusion, the prevalence of hearing loss associated with diabetes mellitus and hypercholesterolemia underscores the multifaceted nature of health conditions and their impact on sensory functions. The study prompts a paradigm shift in healthcare, emphasizing the necessity of an integrated approach to address the interconnectedness of systemic and auditory health.

LIMITATIONS

Limitations include potential confounding factors and variability in diagnostic criteria, warranting cautious interpretation of findings and emphasizing the need for standardized methodologies in future studies.

SUGGESTIONS / RECOMMENDATIONS

Further investigations are warranted to elucidate the prevalence and mechanisms underlying hearing loss associated with diabetes mellitus.

CONFLICT OF INTEREST / DISCLOSURE

None.

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