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Original Research Article

A Comparative Study of Hearing Impairment between Hyperglycemic and Normoglycemic Individuals

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Abstract:

Background: Since Jardao's 1857 discovery of the link between diabetes and hearing loss, numerous studies have been conducted on the subject, with both favorable and unfavorable findings. High blood sugar levels primarily affect the auditory system. Increased glucose in diabetes patients can damage the auditory system, both anatomically and physiologically. This study aims to compare the auditory acuity in hyperglycemic and normoglycemic individuals.

Methodology: This is a hospital-based case-control study. The study participants will be randomly recruited from OPD and IPD of various departments in GIMS, Kalaburagi. 200 subjects were divided as Group A with 100 normoglycemic and Group B with 100 hyperglycemic. FBS, PPBS and HbA1c values were measured. Pure tone audiometry and OAE was performed for subjects.

Results: A total of 200 individuals were randomly selected: 100 normoglycemic (Group A) and 100 hyperglycemic (Group B), aged 30-60. The age distribution was similar, with 33 in Group A and 46 in Group B aged 51-60. Both groups had equal sex distribution. Out of 39 individuals with hearing loss, 32 (82%) were in Group B. Severity was lower in Group A (6% mild, 1% moderate) compared to Group B (21% mild, 9% moderate, 2% moderately severe.) 30 patients in Group B had mild to moderate hearing loss, compared to 7 in Group A. Higher HbA1c levels correlated with increased severity of hearing loss.

Conclusion: Hyperglycemic individuals showed higher prevalence and severity of hearing loss compared to normoglycemic controls, suggesting a link between glycemic control and auditory health.

Keywords: Ear, Diabetes mellitus, Hearing loss, deafness, Sensorineural hearing loss, Diabetes, Audiometry.

Introduction

Hearing loss caused by DM can be referred to as diabetes-related hearing loss (DRHL), a term first proposed by Axelsson et al. (1978)[1].

The auditory pathway has high metabolic activity, so it is the target organ for the pathogenesis of hyperglycemia and diabetes. High blood sugar leads to a number of metabolic disorders impairing the auditory system physiologically and anatomically[2].

Several mechanisms have been suggested for the development of hearing loss in diabetic patients, including microangiopathy, neuropathy, and oxidative stress damage[3]. Diabetes can cause some changes to the stria vascularis, the basement membrane, and the cochlear hair cells. The cochlea has a large number of small blood vessels exposed to microangiopathy during hyperglycemia[4]. Besides, hyperglycemia leads to oxidative stress (OS) and the production of free radicals, thereby leading to neuronal damage and microglial activation[5]. These changes lead to the degeneration of the small blood vessels feeding the atrial-cochlear nerve responsible for hearing and balance[6].

Despite multiple studies demonstrating a relationship between the two clinical disorders, people with diabetes and healthcare providers are oblivious of hearing loss as a possible comorbid condition linked with type 2 diabetes. More than

43% of diabetics are expected to have some form of hearing impairment, whether related or unrelated to chronic hyperglycemia[7]. Additional research is needed to investigate the link between diabetes and hearing problems. Hearing impairments in diabetics may be linked to hyperglycemia or other connected disorders such as impaired immunity, which may predispose one to ear infections of the external, middle, or internal ear.

The present study is conducted to determine if there exists a relation between hyperglcemia and hearing impairment in the northern district of Karnataka. Also, create awareness regarding early identification and intervention.

Materials and Methods

A hospital-based case-control study was conducted by department of ENT in GIMS Kalaburagi. 200 individuals of 30-60years age group, were randomly selected and divided into group A with 100 normoglycemic individuals and group B with 100 hyperglycemic individuals both known diabetics and recently diagnosed hyperglycemia.

Subjects with history of chronic noise exposure, with history of ear discharge, perforated tympanic membrane or any other chronic ear disease, with the history of intake of ototoxic drugs in the past 2 months, with family history of hearing loss, on central nervous system sedatives and subjects with trauma to the ear were excluded from the present study.

Fasting blood sugar, post-prandial blood sugar and HbA1c values are determined and those with <126 FBS, <200 PPBS and <6.5 HbA1c values are grouped into group A. Others with higher values and individuals with diabetes mellitus are grouped into group B.

Further these individuals underwent PTA evaluation using Hughson and Westlake method; and OAE is recorded using Maico OAE screener. Degree of Hearing Loss was categorized as mild hearing loss (26 dB HL to 40 dB HL), moderate hearing loss (41 dB HL to 55 dB HL), moderately severe hearing loss (56 dB HLto 70 dBHL), severe hearing loss (71 dB HL to 90 dB HL) and profound hearing loss(>91 dB HL).

Data collected is entered in excel sheet and analysis done using SPSS software version 22. The results are extrapolated using graphs and suitable statistical test applied. The p value of <0.05 is considered as statistically significant.

Results

A total of 200 individuals were included in the study by random selection. 100 normoglycemic in Group A and 100 hyperglycemic in Group B. Individuals between 30-60 years of age were included in the study. We found almost equal distribution among the age range of 51-60 years, 33 in Group A and 46 in Group B.(Chart 1)

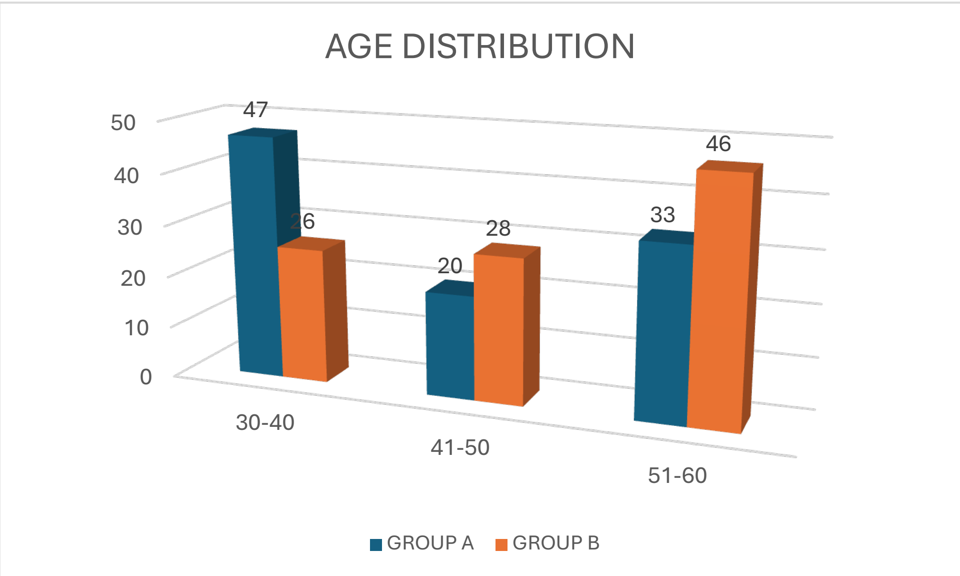

Chart 1: Age-wise distribution

Among Group A and Group B, there was an equal distribution. (Chart 2).

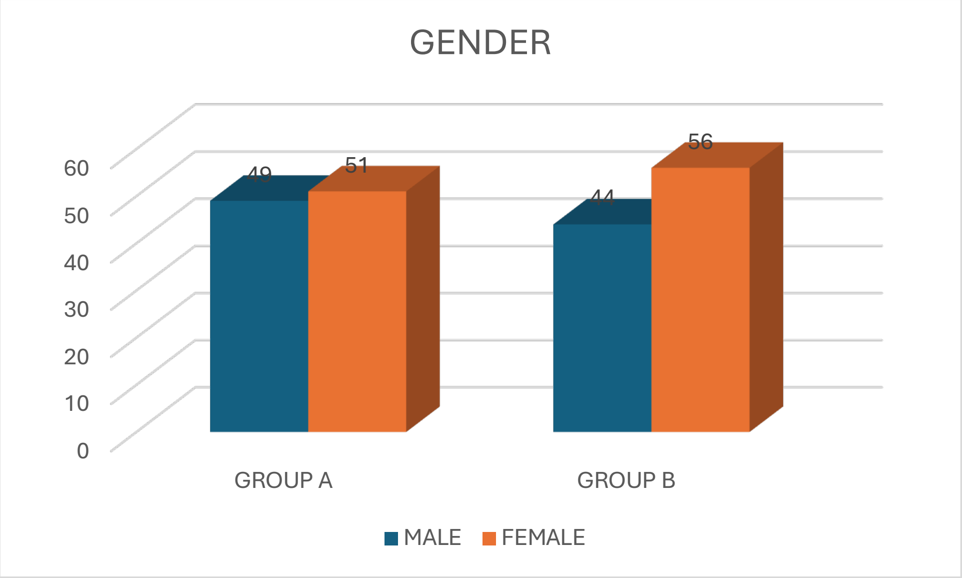

Chart 2: Sex-wise distribution

It was observed that among all the subjects of hearing loss (39), 32(82%) belonged to group B and 7(18%) belonged to group A. Also, the severity of hearing loss was found to be less in the control group (6% mild and 1% moderate HL) as compared to the hyperglycemic group (21% mild, 9% moderate and 2% moderately severe). (Chart 3)

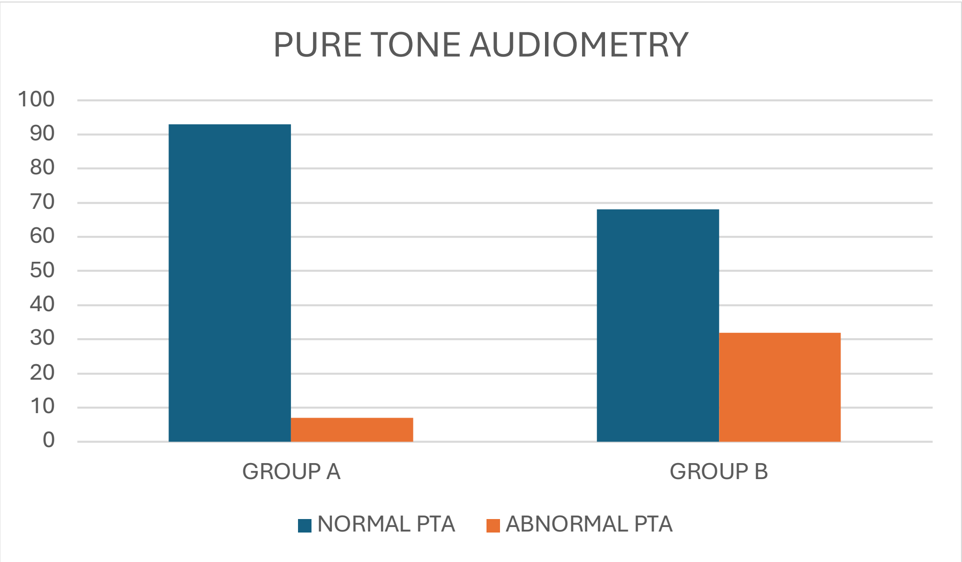

Chart 3: Hearing loss distribution among group A and group B

Out of the total subjects with hearing loss (39 individuals), 32 (82%) were from Group B (hyperglycemic), while 7 (18%) were from Group A (normoglycemic). The severity of hearing loss was notably less in the normoglycemic group, with only 6% experiencing mild and 1% moderate hearing loss, compared to the hyperglycemic group, which had 21% with mild, 9% with moderate, and 2% with moderately severe hearing loss. (Chart 4)

It was found that among the individuals with hyperglycemia, as the value of HbA1c increased- the number of people with hearing loss increased. Hence, exhibiting a significant relationship of HbA1c with hearing loss. (Chart 5)

Amongst the patients with absent OAE, 40% (40) belonged to the hyperglycemic group and 28% (28) to the normoglycemic group. Diabetes mellitus is seen to have a negative effect on outer hair cell function, study by Sachdeva et al[8]. showed significant effect.

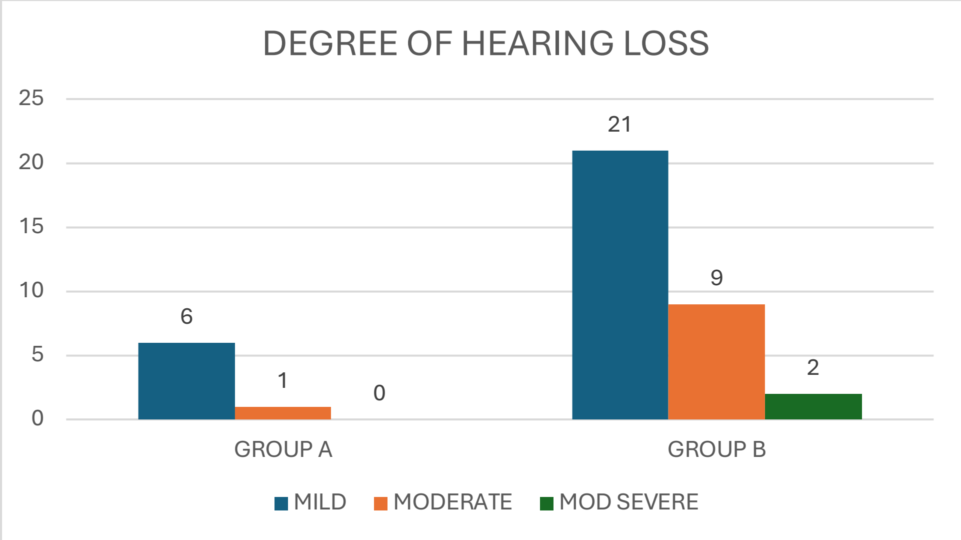

Chart 4: Degree of Hearing loss

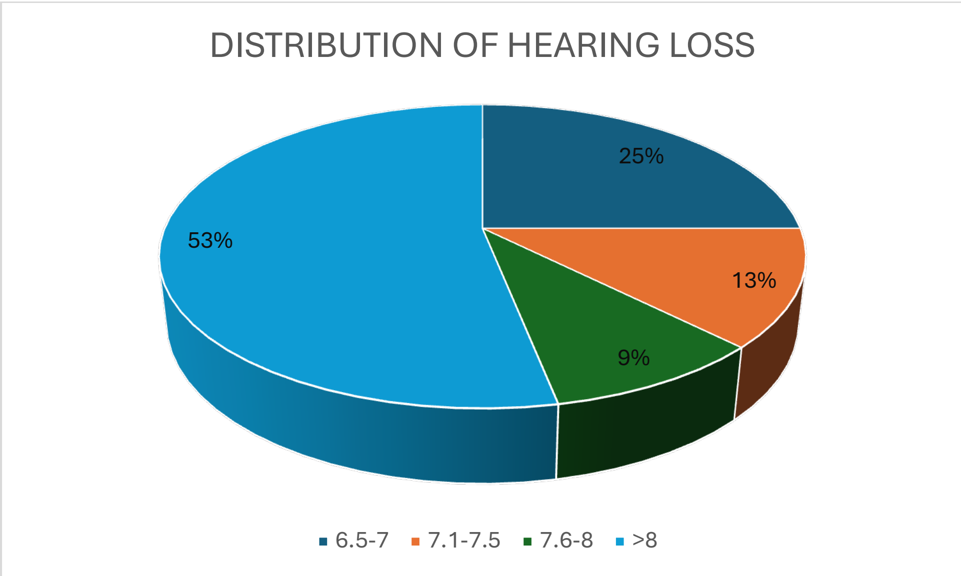

Chart 5: Distribution of hearing loss with respect to HbA1c

Discussion

Our study showed the prevalence of hearing loss in the hyperglycemic group to be 32%, significantly higher than the control group at 7%. Similarly, Nwosu et al. (2017)[9] reported that the prevalence of hearing loss was higher in diabetic adults (46.9%) than in the control group (15.6%). Samelli et al. (2016)[10] found that hearing thresholds were poorer in diabetic patients (46.3%) compared to controls (26.3%). Numerous studies confirm that diabetes increases the prevalence of sensorineural hearing loss (SNHL) in adults. In a large cross-sectional study, Oh, I. S et al. (2019)[11]demonstrated that the prevalence of hearing loss was 17.3% in diabetic patients versus 6.5% in non-diabetic individuals ($P < 0.05$).

Research by Ram Lakhan Meena et al. (2019)[12] confirmed the existence of auditory organ dysfunction in relatively young type 2 diabetic patients, indicating that age and duration of diabetes are associated with SNHL. Both cochlear and retro-cochlear auditory pathways up to the brainstem are involved.

As diabetes mellitus type 2 has become a global emergency, the number of cases detected each year continues to rise. As of 2019, an estimated 463 million people had diabetes worldwide. Pathophysiologic studies suggest that individuals with diabetes are predisposed to hearing impairment (HI) at higher frequencies. Proposed mechanisms underlying the association between diabetes and HI include the contributions of hyperglycemia and oxidative stress to cochlear microangiopathy and auditory neuropathy (Sachdeva et al., 2018)[13].

Additionally, Pemmaiah et al. (2020)[14] emphasized that the duration of diabetes and glycemic control (HbA1C) independently correlate with hearing loss, highlighting the importance of early detection and strict glycemic control to prevent HI.

In our study, nearly 80 individuals belonged to the age group of 51-60 years, with 33 in group A and 46 in group B. An almost equal male-to-female ratio was observed in both groups. In group A, 6 individuals had mild hearing loss, whereas 21 individuals in group B experienced mild hearing loss. Among the hyperglycemic individuals, 2 suffered from moderately severe hearing loss, and out of 10 individuals with moderate hearing loss, 9 belonged to group B.

These findings align with existing literature, indicating that hearing loss is a common occurrence in diabetes patients, significantly affecting quality of life and potentially leading to disabilities and psychological distress.

Conclusion

The study highlights a significant association between hyperglycemia and increased prevalence and severity of hearing loss among adults aged 30 to 60. With 82% of individuals with hearing loss in the hyperglycemic group, compared to only 18% in the normoglycemic group, it is evident that diabetes mellitus type 2 may exacerbate auditory dysfunction. The severity of hearing loss was markedly higher in hyperglycemic individuals, with a greater proportion experiencing moderate and moderately severe hearing loss.

Additionally, the significant correlation between HbA1c levels and hearing loss severity underscores the impact of glycemic control on auditory health. These findings suggest that regular hearing assessments should be considered for individuals with diabetes, especially those with poor glycemic control, to facilitate early intervention and potentially mitigate the adverse effects on quality of life associated with hearing impairment. Further research is warranted to explore the underlying mechanisms and to develop preventive strategies.

Ethical approval: Taken from institutional ethical committee.

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Authors contribution: Dr Renuka S Melkundi- Study concept; writing and reviewing the paper

Dr Sapthami Satish- corresponding author, study concept and writing the paper.

Dr Siddaram Patil- writing and reviewing the paper

Ms. Sahana M.B.- compiling and analysis of data

Mr Apparaya- compiling and analysis of data

Dr Sachin Patil- writing and reviewing the paper

Shivalee. A and Rohini Kallur- with collection and reporting of blood samples.

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