MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.59218/makrjms.2024.3.25.28

Association of HbA1c Levels with Sensorineural Hearing Impairment in Individuals with Diabetes Mellitus: A Cross-sectional Study

[1]Shashank Tyagi, [2]Preeti Nigotia, [3]Hansraj Maurya and [4]Ajay Soni

[1]Department of Biochemistry, SRVS Government Medical College, Shivpuri, Madhya Pradesh, India
[2]Department of Medicine, SRVS Government Medical College, Shivpuri, Madhya Pradesh, India
[3]Department of Otorhinolaryngology, Dr. Sone Lal Patel Autonomous State Medical College, Pratapgarh, Uttar Pradesh, India
[4]Department of Physiology, MGM Medical College, Indore, Madhya Pradesh, India

ABSTRACT

The precise patho-physiology underpinning hearing loss in the context of diabetes remains incompletely elucidated. Typically, a gradual onset of bilateral sensorineural hearing loss, particularly at higher frequencies, is noted in individuals with diabetes mellitus. The primary objective of our study was to discern the prevalence of SNHL in diabetes mellitus and its potential correlation with glycated hemoglobin (HbA1c) levels. The study encompassed a cohort of 345 subjects, comprising 173 well-matched healthy individuals serving as controls and 172 patients diagnosed with type 2 diabetes aged between 10 and 50 years. For the investigation, fasting blood sugar levels and HbA1c concentrations were measured in all subjects. Subsequently, pure tone audiometry (PTA) was conducted to assess hearing thresholds. The data analysis involved scrutinizing the degree, type, and association of hearing loss with HbA1c levels. The findings revealed that 28% of diabetic patients experienced SNHL, while 72% exhibited a normal hearing threshold. Within the diabetic group, out of 42 patients, 23 had mild, 9 had moderate, 9 had moderately severe, and 1 had severe degrees of hearing loss. Notably, the occurrence of hearing loss was more prominent at higher frequencies. Although an association between hearing loss and HbA1c was observed the highest correlation was identified in the 10-13.9% HbA1c range. However, it is imperative to note that this correlation did not attain statistical significance in our study. Despite the absence of a significant correlation with HbA1c, our findings support a robust association between type 2 diabetes mellitus and hearing loss. This underscores the importance of further exploration into the intricate interplay between metabolic disorders and auditory function.

OPEN ACCESS

Key Words
Diabetes mellitus, HbA1C, SNHL, pure tone audiometry

Corresponding Author
Ajay Soni,
Department of Physiology, MGM Medical College, Indore, Madhya Pradesh, India

Author Designation
[1]Professor
[2]Associate Professor
[3,4]Assistant Professor

Received: 19 November 2023
Accepted: 25 December 2023
Published: 27 December 2023

Citation: Shashank Tyagi, Preeti Nigotia, Hansraj Maurya and Ajay Soni, 2024. Association of HbA1c Levels with Sensorineural Hearing Impairment in Individuals with Diabetes Mellitus: A Cross-sectional Study. Res. J. Med. Sci., 18: 25-28, doi: 10.59218/makrjms.2024.3.25.28

INTRODUCTION

Hearing impairment stands as a significant complication of diabetes, exerting a considerable impact on both social and personal dimensions of an individual's quality of life. Diabetes mellitus, a prevalent non-communicable endocrine disorder, contributes to widespread impairments across the body. The global prevalence of diabetes is on the rise, with a documented overall population prevalence of up to 7%. Notably, India bears a heightened burden, being acknowledged as the "Diabetic capital of the world" with approximately 40.9 million diabetic patients, a figure projected to escalate to 69.92 million by 2025[1,2].

Diabetes engenders a spectrum of chronic complications, encompassing retinopathy, neuropathy, nephropathy and vascular and cutaneous damage, collectively diminishing the quality of life and substantially increasing morbidity and mortality[3,4]. Despite extensive research and pathological insights into the inner ear, a comprehensive review of the literature reveals a persistently contentious relationship between diabetes and hearing loss. While certain studies indicate an elevated risk of hearing loss in diabetic individuals, others fail to establish a conclusive association between diabetes mellitus and hearing impairment[5-13]. The prevalence of otological hearing loss in conjunction with diabetes remains an under-explored area in existing literature, prompting the focus of our study on delineating hearing loss patterns in diabetic cases. The objectives of our study were to evaluate sensorineural hearing loss (SNHL) in individuals with diabetes mellitus and to investigate the association between SNHL and glycated hemoglobin (HbA1c) levels in the diabetic population.

MATERIALS AND METHODS

Our investigation was carried out on a total cohort comprising 345 participants. The exclusion criteria for both groups encompassed individuals with hearing impairment attributable to any other ailment, a familial background of diabetes, a history of noise exposure, ototoxic drug intake, non-cooperative subjects and those incapable of effective communication. We meticulously recorded the Fasting Blood Sugar (FBS) and HbA1c levels for all participants. The age range considered for inclusion was 10-50 yrs, with a stringent upper age limit of 50 yrs to mitigate the impact of presbyacusis. Thorough Ear, Nose and Throat (ENT) examinations were conducted to rule out any alternative causes of audiovestibular involvement leading to hearing loss.

Audiological investigations involved Tuning Fork Tests and Pure Tone Audiometry (PTA). The audiometric thresholds at 500, 1000 and 2000 Hz were averaged to derive the PTA for both air and bone conduction. The resulting PTA values were categorized into different degrees of hearing loss (mild, moderate, moderately severe and severe) following the World Health Organization (WHO) guidelines. Each diabetic and control participant underwent a comprehensive hearing assessment using a pure tone audiometer, covering frequencies ranging from 250-8000 Hz. Additionally, we gathered data on FBS, HbA1c, duration of diabetes, age, sex, family history and other relevant parameters. Statistical analysis for quantitative data involved the calculation of mean and standard deviation while proportions and percentages were utilized for qualitative data. The Chi-square test was employed for statistical analysis. $p<0.05$ was considered significant.

RESULTS

In the current investigation, individuals with diabetes exhibited a heightened prevalence of hearing impairment in comparison to their non-diabetic counterparts. The data presented in Table 1 delineates a comparison of the mean Pure-Tone Average (PTA) between the diabetic and control groups, revealing a statistically significant p-value. These findings substantiate a robust association between diabetes and the occurrence of hearing impairment.

Table 2 illustrates the distribution of subjects based on the degree of hearing loss within both the diabetic and non-diabetic groups. The application of the Chi-square test for intergroup comparison yielded a statistically significant result, indicating a substantial correlation between varying degrees of hearing loss and diabetes.

Furthermore, Table 3 outlines the measurement of HbA1c, reflective of diabetes control. Notably, the maximum prevalence of hearing loss was observed in the 10-13.9% HbA1c group. However, our study did not reveal any discernible correlation between HbA1c levels and the degree of Sensorineural Hearing Loss (SNHL) in individuals with diabetes mellitus.

DISCUSSIONS

Our research outcomes align with those reported by Somogyi *et al*.[14], Sharma *et al*.[15], Saini *et al*.[16] and Sachdeva *et al*.[17]. However, our findings were notably lower when compared to Taylor and Irwin [18], Friedman *et al*.[19] and Chamyale *et al*.[20]. Furthermore, our results were considerably lower than those observed by Rajendran *et al*.[21]. Conversely, Kakarlapudi *et al*.[22] reported lower results compared to our study.

It is imperative to acknowledge that individual study outcomes are influenced by factors such as inclusion and exclusion criteria, study duration, sample size and the heterogeneity of the specific population. Notably, certain authors, including Axelson *et al*.[23], Cullen[24], Kurien *et al*.[25] and Harner[26] did not identify any correlation between diabetes and hearing

Table 1: Comparative statistics of SNHL and PTA in study population

Parameter	Control group (n = 173)	Diabetic group (n = 172)	p-value
SNHL Present, n (%)	16 (9.24)	48 (27.90)	<0.05
PTA (Mean ± SD)	22.10 ± 6.820	28.45 ± 11.765	0.012

Table 2: Comparison of degree wise SNHL cases in study groups

Degree of SNHL	Control group (n = 173)	Diabetic group (n = 172)	p-value
None	157	125	<0.05
Mild	12	27	
Moderate	2	10	
Moderately severe	2	10	
Severe	0	1	

Table 3: Correlation between degree of SNHL and HbA1C in study groups

Degree of SNHL	HbA1C (%)			p-value
	<9.9	10-13.9	>14	
None	59	59	7	0.21
Mild	10	13	4	
Moderate	3	6	1	
Moderately severe	3	7	0	
Severe	0	1	0	

loss, refuting the existence of such a relationship. In our investigation, we categorized HbA1c levels into three groups: <9.9, 10-13.9 and >14. Notably, patients with higher HbA1c (>14), indicative of lower glycemic control, demonstrated a higher percentage of hearing loss, whereas those in the lower HbA1c category (<9.9), reflecting better glycemic control, exhibited a lower percentage of hearing loss. The intermediate HbA1c range (10-13.9) showed 32.25% of hearing loss, but no statistically significant association was identified between HbA1c levels and hearing loss. Our findings were consistent with Dalton *et al*.[27] as they also did not find a correlation between glycemic control and hearing loss.

In contrast, studies by Kurien *et al*.[25], Tay *et al*.[28], Panchu *et al*.[29] and Srinivas *et al*.[30] revealed a significant association between HbA1c levels and hearing loss. They reported that poorly controlled diabetes, indicated by higher HbA1c levels, was significantly associated with hearing impairment.

CONCLUSION

Despite the absence of a significant correlation with HbA1c, our findings support a robust association between type 2 diabetes mellitus and hearing loss. This underscores the importance of further exploration into the intricate interplay between metabolic disorders and auditory function.

REFERENCES

1. Wackym, P.,A.J.r. Linthicum and F.H., 1986. Diabetes mellitus and hearing loss: clinical and histopathologic relationships. Am. J. Otol., 7: 176-182.
2. Frisina, S.T., F. Mapes, S. Kim, D.R. Frisina and R.D. Frisina, 2006. Characterization of hearing loss in aged type ii diabetics. Hearing Res., 211: 103-113.
3. Kazmierczak, H.,G. and Doroszewska, 2006. Metabolic disorders in vertigo, tinnitus and hearing loss. Int. Tinnitus. J., 7: 54-58.
4. Ganvir, P.P. and S. Thakare, 2018. A study on maternal near miss cases in tertiary care center, chandrapur, maharashtra, India. Int. J. Reprod., Contraception, Obstet. Gynecol., 2: 1-5.
5. Mitchell, P., B. Gopinath, C.M. McMahon, E. Rochtchina, J.J. Wang, S.C. Boyages and S.R. Leeder, 2009. Relationship of type 2 diabetes to the prevalence, incidence and progression of age-related hearing loss. Diabetic Med., 26: 483-488.
6. Ren, J., P. Zhao, L. Chen, A. Xu, S.N. Brown and X. Xiao, 2009. Hearing loss in middle-aged subjects with type 2 diabetes mellitus. Arch. Med. Res., 40: 18-23.
7. Hong, O., J. Buss and E. Thomas, 2013. Type 2 diabetes and hearing loss. Disease-a-Month, 59: 139-146.
8. Hirose, K., 2008. Hearing loss and diabetes: You might not know what you're missing. Ann. Internal Med., 149: 54-55.
9. Vaughan, N., K. James, D. McDermott, S. Griest and S. Fausti, 2006. A 5-year prospective study of diabetes and hearing loss in a veteran population. Otology. Neurotology., 27: 37-43.
10. Huizinga, M.M.R.L. and Rothman, 2006. A 5-Year Prospective Study of Diabetes and Hearing Loss in a Veteran Population. Indian. J. Med. Res., 124: 481-484.
11. de León-Morales, L.V.D., K. Jáuregui-Renaud, M.E. Garay-Sevilla, J. Hernández-Prado and J.M. Malacara-Hernández, 2005. Auditory impairment in patients with type 2 diabetes mellitus. Arch. Med. Res., 36: 507-510.
12. Tadros, S.F., S.T. Frisina, F. Mapes, S. Kim, D.R. Frisina and R.D. Frisina, 2004. Loss of peripheral right-ear advantage in age-related hearing loss. Audiology. Neurotology., 10: 44-52.

13. Zandian, H. and F.D. Asl, 2020. Comparison of salivary catalase and superoxide Dismutase levels in women with gestational diabetes mellitus and Non-diabetic pregnant women. Int. J. Med. Investig., 10: 176-182
14. Somogyi, A., K. Rosta and T. Vaszi, 2013. Hearing impairment and tinnitus in patients with type 2 diabetes. Orvosi Hetilap, 154: 363-368.
15. Xing, Y., J. Chen, J. Liu and H. Ma, 2022. Associations between ggt/hdl and mafld: A cross-sectional study. Diabetes, Metab. Syndrome Obesity: Targets Ther., 383-394.
16. Saini, S., 2014. Sensorineural hearing loss in diabetic patients. Ind. J. Basic. Applied Med. Res., 3: 170-174
17. Sachdeva, K. and S. Azim, 2018. Sensorineural hearing loss and type ii diabetes mellitus. Int. J. Otorhinolaryngol. Head Neck Surg., 4: 499-507.
18. Taylor, I.G. and J. Irwin, 1978. Some audiological aspects of diabetes mellitus. J. Laryngology. Otology, 92: 99-113.
19. Friedman, S.A., 1975. Arch. In. Med., 135: 573-573.
20. Chamyal, P.C., 1997. Vestibulo-cochlear functions in diabetes mellitus. Indian J. Otolaryngology. Head Neck Surg., 49: 162-164.
21. Rajendran, V. and F. Roy, 2011. An overview of motor skill performance and balance in hearing impaired children. Ital. J. Pediatr.s, 37: 1-5.
22. Kakarlapudi, V., R. Sawyer and H. Staecker, 2003. The effect of diabetes on sensorineural hearing loss. Otology. Neurotology, 24: 382-386.
23. Shrestha, N., R. Saha and C. Karki, 1970. Near miss maternal morbidity and maternal mortality at kathmandu medical college teaching hospital. Kathmandu Uni. Med. J., 8: 222-226.
24. Cullen, J.R. and M.J. Cinnamond, 1993. Hearing loss in diabetics. J. Laryngology. Otology., 107: 179-182.
25. Kurien, M., K. Thomas and T.S. Bhanu, 1989. Hearing threshold in patients with diabetes mellitus. J. Laryngology. Otology, 103: 164-168.
26. Poovathi, P.M. and S. Sundari, 2018. A study on maternal near-miss cases in a tertiary care center. Clinical. Res. Obstet. Gynecol., 2: 1-5.
27. Dalton, D.S., K.J. Cruickshanks, R. Klein, B.E. Klein and T.L. Wiley, 1998. Association of niddm and hearing loss. Diabetes. Care., 21: 1540-1544.
28. TAY, H.L., N. RAY, R. OHRI and N.J. FROOTKO, 1995. Diabetes mellitus and hearing loss. Clin. Otolaryngology., 20: 130-134.
29. Panchu, P., 2008. Auditory acuity in type 2 diabetes mellitus. Int. J. Diabetes Dev. Ctries., 28: 114-120.
30. Srinivas, C.V., V. Shyamala and B.R.S. Kumar, 2016. Clinical study to evaluate the association between sensorineural hearing loss and diabetes mellitus in poorly controlled patients whose hba1c >8. Ind.J. Otolaryngology. Head. Neck Surg., 68: 191-195.