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Prevalence of sensorineural hearing loss among patients of diabetes mellitus in Southern Punjab, Pakistan

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[1] *Data collection, analysis, interpretation and manuscript writing*
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[2] *Interpretation and discussion, manuscript writing and critical revision of article*

A B S T R A C T

Background: Diabetes Mellitus (DM) is a common metabolic disorder with a prevalence of 11.77%. Studies report that DM can result in Sensorineural hearing loss (SNHL). A high prevalence of Hearing loss (HL) (43.6%) in diabetics was noted in an Indian study. In absence of local studies and a high expected prevalence, with no screening recommendations, this study was carried out to determine the prevalence of Sensorineural Hearing Loss (SNHL) in Diabetes Mellitus DM in Southern Punjab.

Methodology: In this cross-sectional study, a sample of 310 diabetics, hailing from southern Punjab and fulfilling selection criteria were recruited. Samples were collected using probability sampling technique from September 2016 to December 2016. Following detailed history and examination, cases were subjected to pure tone audiometry (PTA) at 0.5 to 6 KHz to obtain hearing thresholds to determine the prevalence. Data was analyzed by SPSS 20.

Results: Sample included N=310 diabetics with Mean age of 35.00 ± 6.93 years with 58.39% males and 41.61% females. The prevalence of HL was 46.1%. Gender wise of the male population with HL, 27.97% and 28.67% had mild and moderate HL respectively with severe HL in 8.39% cases, while moderate HL was prevalent in females 20.98%, followed by mild HL in 9.97% and severe HL in 4.20%. There was significant correlation between Diabetes and SNHL with p-value < 0.05.

Conclusion: There is a high prevalence of sensorineural hearing loss in Diabetes mellitus.

Keywords: *Diabetes Mellitus, Hearing Impairment, Prevalence, Sensorineural Hearing Loss*

Introduction

Diabetes Mellitus (DM) is a metabolic disorder characterized by chronic hyperglycemia, resulting from impaired secretion of insulin from the pancreas or faulty utilization/ action, to regulate blood sugar [1]. It is a common problem with prevalence of as 11.77% and a gender prevalence of 11.20% in males followed by 9.19 % in females, in a local study [2]. DM is classified as Type 1 DM predominantly characterized by destruction of beta cells of pancreas, Type 2 DM showing resistance to insulin and gestational variety with glucose intolerance [3]. Hyperglycemia may cause micro vascular changes resulting in ophthalmic, renal and neuronal complications as its consequence [4]. Sensorineural hearing loss (SNHL), is one of the critical complications [5], and Bainbridge & Hoffman found DM to be an independent risk factor for development of hearing impairment (HI) with around 35% to 60 % diabetics facing hearing deficiency [6], however this is unrelated to peripheral neuropathy [5].

Although precautionary measures for prevention of DM associated HL, have not been fully determined, however, numerous studies have reported that DM can be among others a reason of SNHL. According to Bener et al. high blood sugar level in diabetics can result in damage to the capillaries and nerves in the inner ear

resulting in HL, and concluded that high blood sugar and blood pressure, nephropathy, retinopathy, and neuropathy are the risk factors involved [7]. Rathmann and Giani noted great diversity in prevalence and risk factors of DM in Europe [8]. A high prevalence of DM (11.77%) has been noted in a local study by Meo et al. [2] and a prevalence of HL (43.6%) in diabetics was noted in an Indian study [5].

With a high expected prevalence of HL in diabetics and with no screening recommendations for HL in DM, this study was carried out to determine the prevalence of SNHL in Diabetes Mellitus DM in Southern Punjab, Pakistan. This research work provides base line knowledge hence significant since there is scarcity of local literature on prevalence of HL in diabetes from Pakistan and because knowing the prevalence could be helpful in planning screening recommendations for preventive and mitigation measures.

Methodology

In this Cross-sectional study, a sample of n=310 patients, calculated using statistical formula Sample size (n) = $Z^2P(1-P)/d^2$. Cases suffering from diabetes mellitus (DM) were recruited, using non-probability sampling. These were cases who presented in Medical and Otolryngology outpatients of Bahawal Victoria and Bahawalpur General Hospital, Bahawalpur over a period of 4 months from September 2016 to December 2016. Sample included cases diagnosed with Diabetes Mellitus (DM), of both genders, aged 18-40 years, hailing from southern Punjab who consented for inclusion in the study. Cases with external or middle ear diseases, ototoxicity, noise induced hearing loss, tuberculosis, hypertension, other metabolic disorders, and gestational diabetes were excluded from the study.

Detailed history was obtained using patient history sheet especially related to DM like complications, duration, treatment, family history; and history of HL, smoking, use of ototoxic drugs, noise exposure, and other associated diseases. This was followed by otoscopy done in all cases, which helped excluded cases with outer and middle ear pathologies. Following this, the recruited cases which fulfilled selection criteria were subjected to pure tone audiometry PTA using pure tone audiometer (Interacoustic Model AD226 Denmark). Both ears were tested at 0.5, 1, 2, 4 and 6 kHz frequencies. The hearing measurements were performed in a sound proof room by one audiologist using ascending method followed by descending to 1 and 0.5 kHz, as per the S 3.1-1991 specifications of American National Standards Institute (ANSI). Cases were classified according to degree of hearing loss using WHO classification. All cases were examined by a medical specialist and blood glucose estimation was done by glucose oxidase method. Cases were diagnosed as DM, depending on recommendation of National diabetes data group of National Institute of Health (Foster 1983), with a postprandial blood glucose (RBS) of 110–140 mg% and fasting blood glucose (FBS) of 70–110 mg% were considered as cases with controlled DM, while cases with FBS above 120 mg% were considered to have uncontrolled DM. Pathologies like neuropathy, nephropathy, retinopathy and vascular diseases were also noted and where required other relevant specialties were consulted.

Initially all the observations were recorded in the patient's history sheet, following which data was organized in MS Excel Worksheet and SPSS 20.0 was used for data analysis and statistical evaluation. For the variables like age and duration, the mean and standard deviation was calculated while frequency was used for the rest of the variables. The main variable in the study was hearing loss, and primary exposure variable was DM. Chi-Square Test was used to determine relationship between DM and SNHL and p value of < 0.05 was considered significant. Multiple regression analysis was also performed. Results obtained were compared with literature and deductions made were discussed.

Results

Our study population comprised of n=310 of diabetics (Both Type I and type II DM), with mean age of 35 ± 6.93 years with 58.39% (n=181) males and 41.61 % (n=129) females (Table 1).

Of the N = 310 enrolled diabetics fulfilling selection criteria the prevalence of HL was 46.1% (n=143) (Table 2). As regards age distribution of respondents 25.81% (n=80) were 16-25 years old, 31.61% (n=98) were 26-34 years old, with maximum prevalence of DM being 42.58% (n=132) at age of 35-40 years.

Table 1: Clinical profile and demographics of the population (N=310).

Variables	Mean ± SD or n (%)
Age (mean in years ± SD)	35 ± 6.93
Gender- Male, Female	181 (58.39%), 129 (41.61%)
Duration of Diabetes (years)	5.83 ± 1.92
Associated Diseases (yes)	86 (28%)
Complication of Diabetes (U, C)	97 (31.3%), 213 (68.7%)
Family History of Diabetes (no)	221 (71.4%)
Control of Diabetes (C, U)	226 (72.6%), 84 (27.4%)
Medication Dose (28 units x BD)	80 (25.8%)
Medicine-taking duration (years)	5.79 ± 1.18
Hearing loss duration (years)	2.95 ± 1.73
Associated Symptoms (no)	170 (54.8%)
Kind of Hearing Loss (unilateral)	131 (42.3%)
Ear Pain History (no)	234 (75.5%)
Ear Discharge (no)	223 (71.9%)
Nasal Allergies (no)	224 (72.3%)
Head Trauma (no)	235 (75.8%)
Smoking History (no)	227 (73.2%)
Chronic Illness (no)	234 (75.5%)
Family History of Hearing Loss (no)	231 (74.5%)
Exposure with Loud Noises (no)	230 (74.2%)

(Key: C: Controlled, U: Uncontrolled, No: Negative history)

Table 2: Prevalence of severity of HL* Gender. Cross tabulation (n=143).

Hearing Level	Gender				Total		
	Male		Female				
	No	%	No	%	No	%	
Mild HL	40	27.9	14	9.7	54	37.7	37.7
Moderate HL	41	28.6	30	20.9	71	49.6	87.4
Severe HL	12	8.3	6	4.2	18	12.5	100
Profound HL	0	0	0	0	0	0	
Total	93	65.0	50	34.9	143	100	

As regards the severity of HL, it varies gender wise (Table 2). In the male population, 27.97 % (n=40) and 28.67 % (n=41) were having mild and moderate HL respectively with only 8.39% (n=12) having severe HL, while in the females, moderate HL was prevalent with 20.98% (n=30), followed by mild HL 9.79% (n=14) and severe HL 4.2% (n=6) cases.

Overall n=93 (65.03%) males and n=50 (34.97%) females presented with Hl with a male to female ratio of 1.86:1. Correlation analysis with patients divided into two groups i.e. Diabetics with SNHL and Diabetics without SNHL (Table 3), shows that HL had significant relation to variables including age, complication of diabetes, medication dosage, duration of medication and family history of HL, with p-value is less than 0.05.

Table 3: Relationship between demographics and clinical traits of the selected patients (N=310).

Variables	Diabetes		p value
	With SNHL (n=143)	Without SNHL (n=168)	
Age (mean in years ± SD)	37 ± 5.83	33 ± 7.92	0.043
Gender- Male	83 (58%)	98 (58.3%)	0.632
Duration of Diabetes (years)	5.75 ± 1.98	5.03 ± 1.53	0.578
Associated Diseases (yes)	35.2 (41%)	79 (47%)	0.796
Complication of Diabetes (Uncontrolled)	45 (31.5%)	97 (57.7%)	0.049
Control of Diabetes (Uncontrolled)	39 (27.3%)	45 (26.8%)	0.037
Medication Dose (28 units x BD)	37 (25.8%)	43 (25.6%)	0.048
Medication duration (years)	6.77 ± 1.99	5.19 ± 1.85	0.041
Smoking History (no)	105 (73.4%)	122 (72.6%)	0.67
Family History of HL (no)	107 (74.8%)	124 (73.8%)	0.03

Multiple regression analysis performed, assuming that linear variable (DM) has a relationship with predictor variable (HL), and the results proved that only age, DM duration and retinopathy varied in both groups with p-

value of 0.039, 0.013 and 0.049 respectively, which indicates that HL are associated with these factors in which DM duration and retinopathy points towards the relationship between hearing loss and diabetes.

Discussion

Of the n=310 diabetics enrolled in this study to determine the prevalence of SNHL in DM, a high prevalence of 46.1% (n=143) was noted. Similarly, a comparable prevalence of 43.6% has been reported by Pemmaiah & Srinivas [5], 45% by Mozaffari M et al. in an Iranian study [9], and 45.31% by Gutierrez J et al. [10] A much higher prevalence of 67.5% has been reported by Ren H et al. [11] and 51.3% by Rajamani S et al. [12] Horikawa et al. [13], and Meena R et al. [14] also reported a higher prevalence of HL in DM. A very low prevalence of 14.3% was reported by Trevi˜no-González et al. [15] Kim et al. reported in a cohort study that the incidence rate of HL in sample population with normal glucose levels and those with DM were 1.8 and 9.2 per 1000 person-years, respectively [16].

In current study prevalence of HL in males was 65.03% while in females it was 34.97% with a male to female ratio of 1.86:1, while Gutierrez J et al. found no significant in SNHL gender wise with 48.94% males and 43.21% females [10]. The higher prevalence in males in this study could be due to the fact that only a small minority of female go out for work, compared to males resulting in lesser stress and HTN in females.

In the present study gender wise, in the male population, 27.97 % (n=40) and 28.67 % (n=41) were having mild and moderate HL respectively with only 8.39% (n=12) having severe HL, while in the females, moderate HL was prevalent with 20.98% (n=30), followed by mild HL 9.79% (n=14) and severe HL 4.2% (n=6) cases. With slight variation, Pemmaiah and Srinivas, found severe HL in 7 (6.36%) patients, moderately severe HL in 16 (14.54%) patients and moderate HL in 25 (22.7%) patients [5], while Rajamani S et al. found mild to moderate HL in majority of cases [12]. Morrison CL et al. reported mild HL in 14.3%, Moderate in 62.3% and severe HL in 19.5% with profound HL in 3.9% [17], while Trevi˜no-González reported mild Hl in 83.3%, moderate Hl in 16.4% cases [15].

In the current study results revealed that HL had significant relation to variables including age, complication of diabetes, medication dosage, duration of medication and family history of hearing loss, with p-value is less than 0.05. Similarly, a number of studies reported that age of onset [9,10,18], duration of DM [5,9,15], female gender [12], higher HbA1C level [12], diabetes control by insulin [18], DM with complications [18,19,20], disease severity [21], diabetic neuropathy [11], were associated with SNHL. Pemmaiah and Srinivas, found that in cases who had diabetes for more than 10 years, 61.7% showed at least mild HL and duration of DM and sensorineural hearing loss at 2000Hz and 4000Hz showed statistically significant correlation [5]. According to Trevi˜no-González in cases with duration of DM >5 years prevalence of HL was 33%, while of the patients < 5 years had normal hearing [15]. Irshad et al. reported that association of SNHL and complicated DM, was strengthened by the presence of retinopathy, younger age group, HbA1C >7%, but no effect of high blood pressure. [19]. Also, Gutierrez J et al. reported that at age 60 years and below, retinopathy was significantly associated with SNHL [10].

DM is as common problem with a high prevalence [2] and a very high prevalence of HL of 46.1% noted in the present study, which highlights the fact that hearing assessment needs to be done as a routine procedure in diabetics. Meena R et al. also concluded in their study that audiological investigations, need to be considered as a routine procedure for patients with DM [14].

With a high prevalence of HL in DM of 46.1% in the present study it is recommended that preventive measures to control diabetes and early assessment of HL in diabetics should be included in the national health policy to minimize the burden of the disease.

Conclusion

There is high prevalence of SNHL in patients suffering from diabetes mellitus in the region and an association between DM and HI has been noted. Therefore, diabetic population should be routinely screened for HI.

R e f e r e n c e s

1. Kerner W, Brückel J. Definition, classification and diagnosis of diabetes mellitus. Exp Clin Endocrinol Diabetes. 2014; 122(7): 384-6.

2. Meo SA, Zia I, Bukhari IA, Arain SA. Type 2 diabetes mellitus in Pakistan: Current prevalence and future forecast. J Pak Med Assoc. 2016; 66(12): 1637-42.

3. American Diabetes Association. Diagnosis and Classification of Diabetes Mellitus. Diabetes Care. 2012; 35 (Suppl 1): S64-S71. Doi: 10.2337/dc12-s064.

4. Goldenberg R, Ronald Z. Definition, Classification and Diagnosis of Diabetes, Prediabetes and Metabolic Syndrome. Can J Diabetes. 2014; 37 (Suppl 1): S8 - S11.

5. Pemmaiah KD, Srinivas DR. Hearing loss in Diabetes Mellitus. Int J Collab Res Intern Med Public Health. 2011; 3(10): 725-731.

6. Bainbridge KE, Hoffman HJ, Cowie CC. Diabetes and hearing impairment in the United States: audiometric evidence from the National Health and Nutrition Examination Survey, 1999 to 2004. Ann Intern Med. 2008; 149(1): 1-10.

7. Bener A , Al-Hamaq AOAA , Abdulhadi K , Salahaldin AH , Gansan L. Interaction between diabetes mellitus and hypertension on risk of hearing loss in highly endogamous population. Diabetes Metab Syndr. 2017; 11 (Suppl 1): S45-S51.

8. Rathmann W, Giani G. Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. Diabetes Care. 2004; 27(10): 2568-69.

9. Mozaffari M, Tajik A, Ariaei N, Ali-Ehyaii F, Behnam H. Diabetes mellitus and sensorineural hearing loss among non-elderly people. East Mediterr Health J. 2010; 16(9): 947-52.

10. Gutierrez J, Jimeno C, Labra P, Grullo P, Cruz T. Prevalence of Sensorineural Hearing Loss and its Association with Glycemic Control in Filipino Patients with Diabetes at the Philippine General Hospital. J ASEAN Fed Endocr Soc. 2016; 31(2): 137.

11. Ren H, Wang Z, Mao Z, Zhang P, Wang C, Liu A. Hearing Loss in Type 2 Diabetes in Association with Diabetic Neuropathy. Arch Med Res. 2017; 48(7): 631-37.

12. Rajamani S, Senniappan S, Radhakrishnan S. Prevalence and factors influencing sensorineural hearing loss among type II diabetes mellitus patients. Int J Adv Med. 2018; 5(3): 732-37.

13. Horikawa C, Kodama S, Tanaka S, Fujihara K, Hirasawa R, Yachi Y et al. Diabetes and risk of hearing impairment in adults: a meta-analysis. J Clin Endocrinol Metab. 2013; 98(1): 51-58.

14. Meena R, Sonkhya D, Sonkhya N. Evaluation of hearing loss in patients with type 2 diabetes mellitus. Int J Res Med Sci. 2016; 4(6): 2281-87.

15. Treviˉno-Gonzáleza JL, Campuzano-Bustamantea DI, Flores-Calocab O, Santos-Lartiguea R, Villegas-González Jr MJ. Prevalence of sensorineural hearing loss in children and adolescents with diabetes mellitus. Medicina Universitaria. 2015; 17(68): 133-37.

16. Kim MB, Zhang Y, Chang Y, Ryu S, Choi Y, Kwon MJ et al. Diabetes mellitus and the incidence of hearing loss: a cohort study. Int J Epidemiol. 2017; 46(2): 717-26.

17. Morrison C, Morar P, Morrison G, Purewal T, Weston P. Hearing loss and type 2 diabetes: is there a link?. Pract Diab. 2014; 31(9): 366-69.

18. Bamante AH, Al-Noury KI. Prevalence of hearing loss among Saudi type 2 diabetic patients. Saudi Med J. 2011; 32(3): 271-274.

19. Irshad M, Ishaque M, Mahmood K, Dar UF. Association between Sensorineural Hearing Loss and Complicated Diabetes Mellitus. PJMHS. 2015; 9(4): 1384 -86.

20. Bamanie AH , Al-Noury KI. Prevalence of hearing loss among Saudi type 2 diabetic patients. Saudi Med J. 2011; 32(3): 271-74.

21. Konrad-Martin D, Reavis KM, Austin D, Reed N, Gordon J, McDermott D et al. Hearing Impairment in Relation to Severity of Diabetes in a Veteran Cohort. Ear Hear. 2015; 36(4): 381–94.