

ORIGINAL ARTICLE

Evaluation of Correlation between Diabetic Retinopathy and Hearing Impairment in Type 2 Diabetes MellitusMashhood uz Zafar Farooq^{1*}, Syed Inamullah², Shama Mashhood³**ABSTRACT**

Objective: Diabetic retinopathy is one of the leading causes of blindness that occurs secondary to diabetes mellitus. Besides having serious effects on the retina, diabetes has also been found to affect the hearing sense. The aim of our study was to identify any correlation of hearing impairment with diabetic retinopathy in patients suffering from Type 2 diabetes mellitus.

Study Design: A Retrospective study.

Place and Duration of Study: The study was carried out at the outpatient Otorhinolaryngology and Ophthalmology clinics of Mohsin Family Health Clinic, Federal B Area of Karachi, Pakistan, from July 2016 to June 2019.

Materials and Methods: Retrospective data analysis was performed using non-probability purposive sampling. The demographic data, diabetic retinopathy and Hearing status were collected and analyzed using SPSS 20.0 in patients suffering from type 2 diabetes mellitus.

Results: The mean age of patients was 60.65±7.35 and the duration of diabetes was 6.76±3.52. Diabetic retinopathy was evident in 235 patients (52.2%), and hearing impairment was found in 108(24%) patients. Age ($p=0.024$), duration of diabetes ($p<0.001$), and diabetic retinopathy ($p<0.001$) were significantly correlated with hearing impairment in type 2 DM patients.

Conclusion: Hearing impairment is correlated with diabetic retinopathy in patients with type 2 diabetes mellitus. Monitoring of auditory function is advised in patients with retinopathy and vice versa, as timely management of the condition can prevent further disability.

Keywords: Complications, Diabetic Retinopathy, Hearing Impairment, Type 2 Diabetes Mellitus.

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Introduction

Diabetes has now become a global health issue. It is projected that the disease magnitude will be doubled to nearly fourteen million by the year 2030.¹ Working population is commonly affected by the

disease.² Diabetic complications are on the rise due to the increased prevalence of diabetes.³ Retinopathy, neuropathy and nephropathy are the most common complications of type 2 diabetes mellitus (T2DM) which are attributed to raised blood glucose levels.⁴ Diabetic retinopathy (DR) is found to be one of the leading causes of visual loss and blindness worldwide.⁵ Registry report of the disease has revealed that nearly 12% of new cases of blindness each year are secondary to DR.⁶ Systemic hypertension, obesity, poor glycemic control, hyperglycemia, hyperlipidaemia, duration of diabetes, and family history of diabetes are important risk factors for the development of DR.^{7,8} Effects of diabetes are also demonstrated in the form of hearing loss in patients of T2DM. This has been reflected in the result of different studies which have

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identified hearing impairment (HI) in patients with T2DM.⁹⁻¹¹ Studies conducted by Ooley C. et al. and Kurt E. et al. demonstrated a relationship between DR and HI in patients suffering from T2DM.^{12,13} Whereas some researchers have found controversial results showing no relationship between DR and HI.^{14,15} These results developed a curiosity to design and conduct a study to determine the frequency of hearing impairment among T2DM patients and its correlation with DR in our out-patient population.

Materials and Methods

The retrospective non-probability purposive sampling study was conducted from July 2016 to June 2019 at the outpatient Otorhinolaryngology and Ophthalmology clinics of Mohsin Family Health Clinic, Block 16, Federal B Area, Karachi, Pakistan. A total of 450 patients aged 40-70 years who were suffering from T2DM as per the criteria of the American Diabetic Association were included in the study.

Patient suffering from any systemic disorder other than T2DM and the patients who were found to have any ocular disorder other than DR or have undergone any ocular surgery were not included in the study. Also, excluded were patients suffering from any middle and external ear pathology; those who had undergone ENT surgery and had a history of ocular or ENT trauma.

Records of patients were traced from July 2016 to June 2019. After considering the inclusion and exclusion criteria, clinical data of the patients with respect to age, gender, duration of diabetes, retinopathy and hearing status were analysed. The patient records were coded and de-identified. A sample of 450 eligible subjects was analysed. The sample size was calculated through OpenEpi, Version 3.0. Taking 18.5%¹⁵ hearing impairment in type 2 diabetic retinopathy patients, 5% Confidence limits and 99% confidence level. Total calculated sample size was 400. After adding 10% for non-response, 450 type 2 DM patients were enrolled in this study. Prior approval of the study was taken from the Ethical Review Committee of Ziauddin University, Karachi, Pakistan, and the study was conducted as per principles of the Helsinki Declaration of 1975 as revised in 2000. Record of the patient included visual acuity assessment with Snellen's Chart, refraction, detailed ocular examination with slit lamp

biomicroscope for anterior segment, intraocular pressure measurement and with 90 D lens and indirect ophthalmoscope for posterior segment. Status of retinopathy was recorded. The presence of microaneurysms, one or more dot and blot haemorrhages, hard exudates, soft exudates, intraretinal microvascular abnormalities, venous bleeding, and new retinal vessels formations were identified to define the severity of retinopathy status of the patients as having No Retinopathy, Non-proliferative DR (NPDR) and Proliferative DR (PDR) according to the classification by Early Treatment Diabetic Retinopathy Study (EDTRS).¹⁶ For evaluating the presence of any external and middle ear abnormality, an ENT examination record was evaluated. Results of hearing threshold using pure tone audiometry were documented. Hearing is described according to WHO guidelines as normal with ≤ 25 dB and from 26-40 dB as mild, 41-60 dB moderate, 61-80 dB severe, and >81 dB as profound loss.¹⁷ In our study, the range of hearing loss was dichotomized and was considered mild to moderate loss from 26-60 dB and > 61 dB as severe hearing loss. The mean value was recorded for both ears. Findings of the physical examination were also analysed to find any disorder other than diabetes.

Data was entered in excel and converted in SPSS version 20.0 for data analysis. Mean and SD were estimated for continuous variables and frequency, and percentage were calculated for categorical data. Chi-square test was used to check the correlation of hearing impairment with age, gender, duration of diabetes, and diabetic retinopathy status as qualitative variables. *P* value <0.05 was considered as significant.

Results

A total of 450 patient record sheets were finalized for analysis. The mean age of participants was 60.65 ± 7.35 years with more males in the study population figure 1.

Diabetic retinopathy status was analyzed, and retinopathy was found in 235 (52.2%) patients. Impaired hearing was observed in 108 (24%) patients. Demographic and clinical characteristics of the patients are presented in Table 1.

Diabetic retinopathy was significantly associated with hearing impairment in T2DM patients with a *p*-value <0.001 . (Table 2)

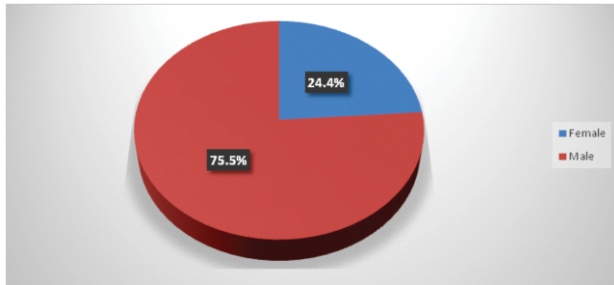


Fig 1: Gender Distribution

Characteristics	n	(%)
Age (year)	60.65±7.35	
40-50	44	9.8
51-60	136	30.2
61-70	270	60.0
Gender		
Female	110	24.4
Male	340	75.6
Duration of Diabetes (years)	6.76±3.52	
3-5	204	45.3
6-10	190	42.2
>10	56	12.4
Diabetic Retinopathy Status		
Normal	215	47.8
NPDR	185	41.1
PDR	50	11.1
Hearing impairment		
Normal	342	76.0
Moderate	75	16.7
Severe	33	7.3

Hearing impairment was different in age groups,

Characteristics	Hearing impairment						Chi-Square Tests	
	Normal		Mild-Moderate		Severe		statistic	p-value
	N	(%)	n	(%)	n	(%)		
Diabetic Retinopathy Status	185	54.1	23	30.7	7	21.2	68.88	<0.001
NPDR	137	40.1	38	50.7	10	30.3		
PDR	20	5.8	14	18.7	16	48.5		

NPDR: Non-Proliferative Diabetic Retinopathy
PDR: Proliferative Diabetic Retinopathy

5(15.2%) in <50 age group 11(33.3%) in 51 -60 years age group and 17(51.5%) in >60 years age group ($p=0.024$). Increasing age was significantly associated with the presence of hearing impairment. Similarly, the duration of diabetes was also found to be significantly associated with HI ($p<0.001$). Gender distribution is similar in hearing impairment. Age ($p=0.024$), duration of diabetes ($p<0.001$), and diabetic retinopathy ($p<0.001$) were significantly associated with hearing impairment. (Table 3).

Significant factors that increased the risk of hearing

Table 3. Correlation of Age, Gender, Duration of Diabetes, and Retinopathy Status with Hearing Status

Hearing impairment Characteristics	Normal		Mild-Moderate		Severe		Chi-Square Tests	
	N	(%)	n	(%)	n	(%)	statistic	p-value
Age (year)							11.25	0.024
40-50	33	9.6	6	8.0	5	15.2		
51-60	113	33.0	12	16.0	11	33.3		
61-70	196	57.3	57	76.0	17	51.5		
Gender							1.947	0.378
Female	79	23.1	20	26.7	11	33.3		
Male	263	76.9	55	73.3	22	66.7		
Duration of Diabetes (years)							35.66	<0.001
3-5	181	52.9	18	24.0	5	15.2		
6-10	128	37.4	42	56.0	20	60.6		
>10	33	9.6	15	20.0	8	24.2		
Diabetic Retinopathy Status							68.88	<0.001
Normal	185	54.1	23	30.7	7	21.2		
NPDR	137	40.1	38	50.7	10	30.3		
PDR	20	5.8	14	18.7	16	48.5		

impairment were age, duration of diabetes, and retinopathy status. The gender was not found to be associated with HI.

Discussion

The results of our study revealed a correlation between DR and HI in patients with T2DM. Ooley C et al. studied the relationship of DR and HI according to the severity and, after adjusting the controlling factors for diabetes, demonstrated significant correlation between them.¹²

Martin DK. et. al. and Bener A. et al. have also demonstrated a similar correlation between DR and HI.^{18,19} In the study of Ashkezari SJ et al., a significant association was found between high frequency threshold hearing loss and severity of retinopathy.²⁰ Our study demonstrated a dissimilar prevalence of DR in Normal and HI groups while in the study of Kim JM et al.¹⁵ Hearing impairment was not associated with increased risk of DR as shown by the similar weighted prevalence of DR in Hearing Impaired and Normal Hearing Group with P value of 0.740. However, in the same study, age was found to be a risk factor for DR and HI and showed a 6.574-fold (95% PI, 5.254–8.226) increased risk per decade (ORs, 3.033). In our study, age ($p=0.024$), was also found to be contributing to HI. Some other studies have also shown similar results.^{21,22} Gender influence was not demonstrated in our study ($P=0.378$). Report of meta-analysis reflected in the study of Ashkezari SJ et al. has also shown no gender preference for HI in

people with diabetes.²⁰ Duration of diabetes adversely affected the hearing in diabetic patients as reflected in our study ($p < 0.001$) as also reported in the studies of Bener A et al. and Gupta S et al.^{10,23}

The increasing prevalence of diabetes and its complications have become a focus for researchers. DR is a known complication of diabetes, and it is considered to be related to duration of diabetes. In our study we have a large number of patients having retinopathy with short duration ($n=204$). A large number of studies report finding retinopathy at the time of first diagnosis or development of retinopathy with short duration.²⁴⁻³³ Finding retinopathy early in the disease might be related to late diagnosis, poor control of diabetes, and the presence of risk factors or a combination of these and other factors.

Studies have revealed hearing loss as a complication of diabetes and a relationship between diabetes mellitus and HI.³⁴⁻³⁶ Mechanism of complication in retinopathy is microangiopathy.¹⁵ Similar pathology is considered to be the mechanism in the inner ear that leads to sensorineural hearing loss. Hearing impairment in diabetes is believed to be due to vascular and neural changes in the cochlea.³⁷ Visual loss severely affects the normal working of an individual. When it is coupled to HI, the effects become more devastating and have significant negative effects on quality of life.³⁸ The impact of visual and hearing loss is not only physical and psychological but also has serious socio-economic effects that are not limited to the individual but also involve family and society. Monitoring auditory function and ophthalmic examination appear to be beneficial for managing diabetic patients, especially those with risk factors.

Limitations of our study include a limited number of patients, which limits the power of study. Many risk factors contributing to the development of diabetic complications like fasting plasma glucose, HbA1C, obesity, cigarette smoking, socio-economic status, hyperlipidemia and level of creatinine, have not been evaluated. Control of the disease is not evaluated, which may create a bias in severity of disease. Patients having HI were not investigated for the age of onset. There may be subjects with HI well before the development of diabetes. Similarly, noise exposure has also not been investigated, which may affect hearing. Loud noise is reported to damage

cells and membranes in the cochlea. Exposure to loud noise cause progressive hearing loss that may even continue after cessation of exposure.³⁹ Fundus examination was limited to a single examiner assessment of retinopathy which may cause a bias.

Conclusion

The present study found a correlation between retinopathy and hearing impairment in patients suffering from type 2 diabetes mellitus.

Recommendations

1. Auditory evaluation is desired in every patient having DR. Similarly, patients having impaired hearing with T2DM, need to be screened for DR.
2. The screening program should be organized with the use of a fundus camera for fundus photography.
3. Patient education regarding awareness of diabetes and its complication with dietary and lifestyle modification is desirable to prevent complications.
4. Support programs for timely management should be instituted for the poor population.
5. Further study to confirm this correlation is desired.

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