

Original Research Article

Type 2 diabetes mellitus and hearing impairment as seen in a tertiary hospital in Port Harcourt

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ABSTRACT

Background: Diabetes mellitus prevalence has been on the increase especially the type 2. This study therefore is to determine the pattern, type and severity of hearing impairment and correlating it with the duration, presence of peripheral neuropathy, glycaemic control of the type 2 diabetes mellitus seen in university of Port Harcourt teaching hospital (UPTH).

Methods: It is a descriptive cross sectional study of adult diabetic patients seen at the endocrinology clinic of University of Port Harcourt teaching hospital. Consecutive patients with confirmed diagnosis of diabetes mellitus that gave their informed consent were recruited. A semi structured questionnaire aimed at obtaining the biodata, duration of diabetes and level of control, presence of neuropathy was administered to these patients. They had otoscopy done in addition to audiometric evaluation using pure tone audiometry.

Results: The study involved 108 subjects with confirmed diagnosis of type 2 diabetes mellitus. Males; 42 and females; 66. Age ranged from 20 -81years. Hearing impairment was present in 68.52% of the subjects. Audiometric pattern showed 54.6% with SNHL while 31.5% had normal hearing. Majority of the subjects had mild degree hearing loss (50%). Bilateral SNHL was the commonly seen type of hearing loss in 55.93%.

Conclusions: There is a high prevalence of hearing loss in patients with type 2 diabetes mellitus. The commonest type of hearing loss in these subjects was bilateral mild sensorineural hearing loss. There is therefore a need to incorporate regular audiologic assessment in the management protocol of the adult diabetic patients.

Keywords: Type2 diabetes mellitus, Pure tone audiometry, Hearing loss, HBA1c

INTRODUCTION

Diabetes mellitus is a systemic disease of metabolism in which there is a relative or an absolute deficiency of the hormone; insulin. This results in elevated blood glucose with resultant long term vascular and sometimes neural damage. As a systemic disease, it is known to affect multiple organs with resultant serious complications. The ears with its auditory function are not spared with resultant hearing loss worsening the quality of life of these patients.

The prevalence of diabetes mellitus has been on the increase. Presently, the population of diabetics in the world as at 2011 was about 366million and this is expected to increase to 552 million by the year 2030.¹ The WHO report gave the world- wide value as 422 million in 2016.² There appear to be a world- wide pandemic of diabetes mellitus.³

In diabetes mellitus, there could be an associated multiple system complication and multiple end organ damage especially when there is poor control of the hyperglycemia. The auditory system with its end organ is

also vulnerable to the effects of the high blood sugar. The nature of the long term complications may be macrovascular and or microvascular.⁴ The microvascular changes resulting from diabetes can affect the auditory pathway from the cochlear to the cortex.⁵ It is known that diabetes mellitus tend to predispose to hearing loss since the odds of having hearing loss is found to be higher in diabetics more than their non- diabetic counterparts.⁶ The pathology of this hearing loss is thought to be due to the combined effect of microangiopathy and neuropathy found in diabetes mellitus. These causes change in the stria vascularis, basilar membrane as well as in the cochlear hair cells.⁷ The result of all this is hearing impairment in these patients. The relationship between hearing loss and diabetes was first reported in 1857 by Jordao.⁸ However, the epidemiological evidence of this association are not consistent among researchers. While some postulate on the presence of a mild subclinical sensorineural hearing impairment in diabetes mellitus, others found no such association.^{9,10} Although the presence of microangiopathy and neuropathy in type 2 diabetes mellitus is associated with hearing loss, some researchers has found early auditory dysfunction in some patients even in the absence of microvascular and neurologic complications.¹¹ Majority of researchers in characterizing the hearing impairment found that it is mainly sensorineural and affects the high frequencies more than the low frequencies.^{9,12} But a few reported low frequency affectation more than the high frequencies.¹³ In diabetes mellitus ,other end organs such as the kidneys, the eyes and even the extremities are often affected by these microvascular, macrovascular and neurologic complications.it is postulated that these vascular and neuropathic changes affecting these areas could also affect the cochlear inducing hearing loss.^{5,14,15} The glycaemic control can also be a means of assessing disease progression and development of complications including diabetic sensorimotor polyneuropathy(DSPN). This is the most common chronic complication associated with diabetes mellitus. Its prevalence is directly related to the diabetic duration, age of the patient and the glycaemic control.¹⁶ There is also a positive relation between glycosylated haemoglobin (HbA1c) levels and severity of hearing loss. It also correlates with diabetic complication risks.¹⁷ Increased Hba1c levels is a known indicator of poor glycaemic control, hence levels > 8% give higher levels of hearing loss.¹⁸ Therefore good control of sugar levels in diabetes mellitus reduces the incidence of hearing loss.^{19,20}

Neuropathy in these patients was screened using the Diabetic neuropathy symptom score. (DNSS) This is a 4 item validated symptom score. It has a high predictive value for screening for PNP in diabetics.²¹ It has a maximum score of 4 and a value of 1 or more is considered positive for PNP.

In normal aging process, there are changes in oxidative stress and vascular damage in the cochlear and this is worsened by diabetes. Therefore combination of diabetes and aging causes acceleration in microvascular damage

and cochlear ischaemia.¹³ This worsens the hearing impairment in this group of diabetics. This study therefore is to find the pattern and the type of hearing impairment and correlate this with glycaemic control, duration of diabetes mellitus and presence of peripheral neuropathy among the patients seen in the outpatient endocrinology clinic.

METHODS

It is a descriptive cross sectional study of adult diabetic patients seen at the endocrinology clinic of University of Port Harcourt teaching hospital, Port Harcourt within a period of 6 months; June to November 2020. Consecutive patients with confirmed diagnosis of diabetes mellitus that gave their informed consent were recruited. A semi structured questionnaire aimed at obtaining the biodata, duration of diabetes and level of control, presence of neuropathy was administered to these patients. They had otoscopy done in addition to audiometric evaluation using pure tone audiometry. They were also assessed to determine their latest FBG, HbA1C and screened for diabetic neuropathy. The screening was done using the Diabetic neuropathy symptom score. (DNSS)This is a 4 item validated symptom score. It has a maximum score of 4 and a value of 1 or more is considered positive for Peripheral neuropathy (PNP).

Adult diabetics with any known neoplasia in any part of the ear or any form of ear problems prior to the diagnosis of diabetes were excluded. Also were excluded those with comorbidities such as tuberculosis and human immune deficiency virus.

Data collected were analysed using IBM Statistical package for social sciences (SPSS) version 20 and results shown with statistical tables and figures. Frequencies and proportions were used to summarize categorical variables while numerical variables employed mean± standard deviation, and median/ranges. Differences in proportions were compared using Chi square test. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The study involved a total number of one hundred and eight subjects with confirmed diagnosis of type diabetes mellitus. They were 42 males and 66 females with a male: female ratio of 1:1.6 the age ranged from 20 -81years. The age range 40 to 59 comprised majority of the study population (57.4%). Most were married with tertiary level of education. The HBA1c level in majority of the subjects was above 7% (57.4%) table1. The newly diagnosed subjects in the study comprised 17.6% while most has been diabetic for more than 10years (33.3%). Table 2. Hearing impairment was present in 68.52% of the subjects. Figure 1. Audiometric pattern showed 54.6% had SNHL while only 3.7% had mixed hearing loss and 31.5% had normal hearing. Majority of the subjects had mild degree hearing loss (50%) followed by moderate degree. Table 3.

Table 1: Demographic distribution (n=108).

Variable	Frequency	Percentage
Age-group (in years)		
20-29	4	3.7
30-39	21	19.4
40-49	31	28.7
50-59	31	28.7
60-69	18	16.7
70-79	2	1.9
80 and above	1	0.9
Sex		
Male	42	38.9
Female	66	61.1
Marital status		
Married	89	82.4
Separated/divorced	5	4.6
Single	11	10.2
Widow	3	2.8
Education		
Primary	24	22.2
Secondary	25	23.1
Tertiary	59	54.6
HBA1c Range		
1-6%	46	42.6
>7%	62	57.4
FBS		
Mean	7.76	
Minimum	4.3	
Maximum	20.0	
Standard Deviation	2.24	

Table 2: Duration of DM.

Years of DM diagnosis	Frequency	Percent
<1 year	19	17.6
1-5 years	32	29.6
6-10 years	21	19.4
10 years and above	36	33.3
Total	108	100

Bilateral SNHL was the commonly seen type of hearing loss in 55.93%. This was found to be significant statistically with p value of 0.008. Table 4.

Although hearing loss was found mainly among subjects 40-59 years of age, this distribution was not statistically significant. More females had hearing loss but the difference was not significant statistically.

Distribution of hearing loss according to the duration of the disease did not have any significant statistical difference. Table 5. The patients with HBA1c levels of more than 7% had more hearing loss 55.4% with most being SNHL however the distribution was of p value 0.676 and 0.087 respectively and therefore was not statistically significant. table6. Sixty two (57.41%) of the subjects had Peripheral neuropathy (PNP) present from the DNS score while it was absent in 42.5%.

Table 3: Audiogram findings.

Audiogram	Frequency	Percentage
CHL	11	10.2
Mixed	4	3.7
SNHL	59	54.6
Normal	34	31.5
Total	108	100
Degree of loss		
Mild	54	50
Moderate	15	13.89
Moderately - severe	1	0.92
Severe	3	2.77
Profound	1	0.92
Normal	34	31.5
Total	108	100.0

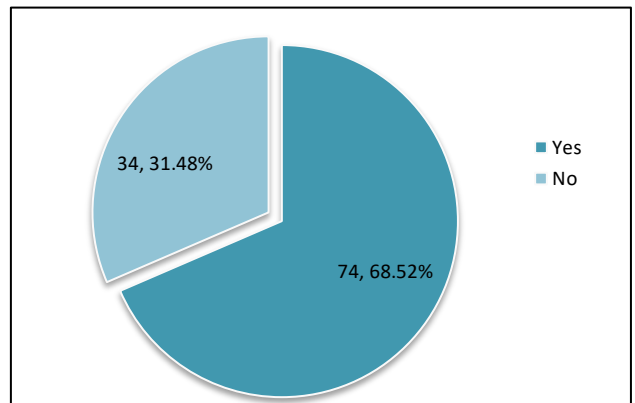


Figure 1: Distribution of impaired hearing.

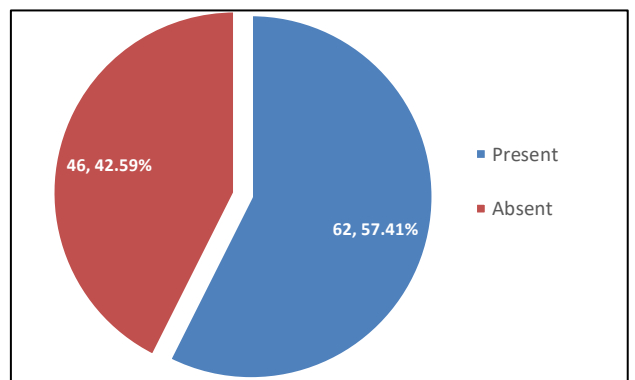


Figure 2: Distribution of DNSS.

There was no significant difference however. In terms of association with hearing loss, about 44 subjects with PNP had hearing loss while 30 that had no PNP also had hearing loss. The association with hearing loss was not statistically significant. Table 7. A mild positive correlation was found between DNSS and fasting blood sugar. Increasing fasting blood sugar was found to result in increasing DNS Score. The correlation was not however statistically significant, p value 0.727. Figure 3

Table 4: Distribution of hearing loss.

Position	CHL	Mixed	SNHL	Normal	Chi-square (p value)
Bilateral	7 (63.64)	4 (100)	33 (55.93)	32 (94.12)	17.24 (0.008)*
Left	1 (9.09)	0 (0.00)	5 (8.47)	0 (0.00)	
Right	3 (27.27)	0 (0.00)	21 (35.59)	2 (5.88)	
Total	11 (100.0)	4 (100.0)	59 (100.0)	34 (100.0)	

*distribution is statistically significant (p<0.05).

Table 5: Distribution of audiometry by demographic data.

	CHL N (%)	Mixed N (%)	SNHL N (%)	Normal N (%)	Chi-square (p value)
Age groups (years)					
20-29	2 (18.18)	1 (25)	1 (1.69)	0 (0)	21.03 (0.278)
30-39	2 (18.18)	0 (0)	11 (18.64)	8 (23.53)	
40-49	2 (18.18)	1 (25)	14 (23.73)	14 (41.18)	
50-59	3 (27.27)	1 (25)	20 (33.9)	7 (20.59)	
60-69	2 (18.18)	1 (25)	10 (16.95)	5 (14.71)	
70-79	0 (0)	0 (0)	2 (3.39)	0 (0)	
80 and above	0 (0)	0 (0)	1 (1.69)	0 (0)	
Sex					
Male	8 (72.73)	2 (50)	20 (33.9)	12 (35.29)	6.37 (0.097)
Female	3 (27.27)	2 (50)	39 (66.1)	22 (64.71)	
Duration of DM					
<1 year	0 (0)	0 (0)	13 (22.03)	6 (17.65)	10.78 (0.290)
1-5 years	4 (36.36)	1 (25)	19 (32.2)	8 (23.53)	
6-10 years	4 (36.36)	1 (25)	6 (10.17)	10 (29.41)	
10 years and above	3 (27.27)	2 (50)	21 (35.59)	10 (29.41)	

The distribution was not statistically significant (p>0.05)

Table 6: Distribution of hearing impairment with HBA1c range.

HBA1c Range	Yes	No	Chi-square (p value)
1-6%	33 (44.6)	13 (38.2)	0.38 (0.676)
>7%	41 (55.4)	21 (61.8)	
Total	74 (100.0)	34 (100.0)	

The distribution is not statistically significant (p<0.05)

HBA1c range	CHL N (%)	Mixed N (%)	SNHL N (%)	Normal N (%)	Chi-square (p value)
1-6%	7 (63.6)	2 (50)	24 (40.7)	13 (38.2)	2.43 (0.487)
>7%	4 (36.4)	2 (50)	35 (59.3)	21 (61.8)	
Total	11 (100)	4 (100)	59 (100)	34 (100)	

The distribution is not statistically significant (p<0.05)

Table 7: Association of DNSS and hearing loss.

Presence of DNSS	CHL N (%)	Mixed N (%)	SNHL N (%)	Normal N (%)	Chi-square (p value)
Yes	8(72.7)	3(75)	33(55.9)	18(52.9)	1.89 (0.595)
No	3(27.3)	1(25)	26(44.1)	16(47.1)	
Total	11 (100.0)	4 (100.0)	59 (100.0)	34 (100.0)	

The distribution is not statistically significant

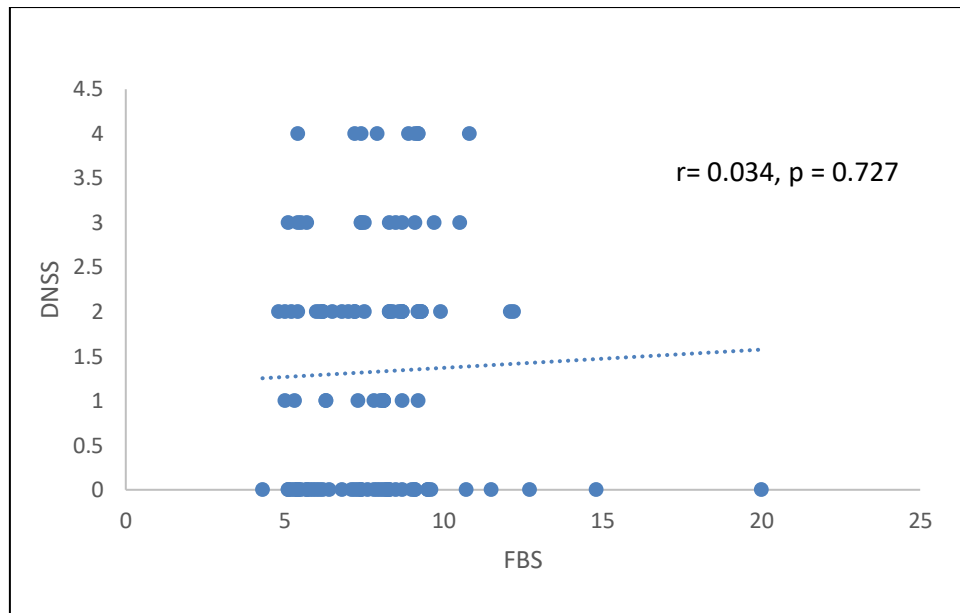


Figure 3: Correlation of DNSS and FBS in subject.

DISCUSSION

In the present study the age range studied was 20-81 years. The prevalence of hearing loss among these subjects was 68.52% agreeing with 67.5% found in a similar study.¹² In contrast an earlier study in Enugu had a prevalence of 46.9% while another in Ibadan had 17% others recorded even higher prevalence; 76% and 73%.^{18,23,24} We could not readily deduce a reason for these differences.

There was a female preponderance and more of the females had hearing loss in contrast to some researchers that had more males with hearing loss even though the difference was not significant.^{9,25} Some other researchers had equal sex distribution.^{22,26} The ages 40 to 59 were more affected in contrast to another study where ages 50 to 60 were more involved.²⁵

Majority of the subjects had bilateral SNHL which was found to be significant statistically. This was found to be similar to the findings of other researchers.^{25,27} The SNHL was mainly of mild degree which was also documented in other works.^{12,25} Profound hearing loss was not common in diabetics as also was seen in the present study= 1 (0.92%).

The duration of the disease in association to hearing loss showed those that has had the diabetes for more than 10 years had more hearing loss especially the sensorineural type but this was not significant statistically. However in contrast, some other authors postulated that duration of the disease is significantly correlated with hearing loss, that is the longer the duration of diabetes mellitus, the higher the chances of developing hearing impairment.^{18,25}

The glycosylated haemoglobin (HbA1c) level which is an indicator of glycaemic control is known to have an effect on hearing impairment. In the present study the subjects

with levels higher than 7% had more hearing loss. In order words, the higher the HbA1c level, the more the hearing loss even though this difference was not significant, it was similar to the finding of some authors.^{18,25,28} This could be why some authors from their findings, advocate that good sugar control reduces the incidence of hearing loss in diabetics.^{19,20} In contrast some other researchers did not find any correlation between HbA1c and hearing loss.²⁹

The presence of diabetic polyneuropathy as obtained using the DNSS was present in more than half of the subjects.it was also noted that most of these subjects with PNP had hearing impairment but the distribution was not significant. On the other hand, an earlier similar study also found that diabetics with peripheral neuropathy tend to record higher hearing threshold.¹⁴ A correlation of glycaemic control and DNSS using fasting blood sugar showed a weak relation between FBS and DNSS similar to the findings of other authors.³¹ It is known that the poorer the glycaemic control, the higher the incidence of development of diabetic neuropathy. This may invariably affect the hearing in these patients.

Limitations

Owing to the fact that we couldn't rule out other confounding factors such as age, noise, drugs etc it may be difficult to attribute the findings of hearing deficit to the disease alone.

CONCLUSION

There is a high prevalence of hearing loss in patients with type 2 diabetes mellitus. The commonest type of hearing loss in these subjects was bilateral mild sensorineural hearing loss. High levels of HbA1c may be associated with hearing loss. The presence of peripheral neuropathy

though not statistically significant, may be associated with hearing loss. There is therefore a need to incorporate regular audiologic assessment in the management protocol of the adult diabetic patients.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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