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Neurological Deafness Prevalence Based on Diabetes Mellitus and Gender

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Abstract

Neurological deafness or sensorineural hearing loss is a hearing loss caused by damage to the cochlea, vestibulocochlear nerve (N.VIII), or the nerve pathways that connect the ear to the brain. Indonesia is part of 4 countries in Asia that have a high prevalence of sensorineural hearing loss, namely 4.6%. Neurological deafness is caused by several factors, including age, genetic factors, and environmental factors. Some studies also show that hypertension, diabetes, and hypercholesterolemia can predispose to neural deafness. One of the complications caused by diabetes mellitus is hearing loss caused by microangiopathy. Gender has also been linked as a risk factor that causes neural deafness. This study aims to determine the relationship between diabetes mellitus and gender with the incidence of neurological deafness in adult patients in the city of Surakarta. This study used secondary data from adult neurologically deaf patients aged >18 years who had diabetes mellitus. This research design uses cross sectional. The total sample size was 67 respondents. The data obtained were analyzed using the chi-square test and logistic regression test. The results of this study stated that there was a relationship between diabetes mellitus and the incidence of neural deafness (p=0.000), there was a relationship between gender and the incidence of neural deafness, namely male gender (p=0.025). A significant relationship was found between diabetes mellitus and gender and the incidence of neurological deafness in adult patients in the city of Surakarta.

Introduction

Neurological deafness is a hearing loss caused by damage to the cochlea, vestibulocochlear nerve or nerve pathways that connect the ear to the brain (Rahayuningrum et al., 2016). World Health Organization (WHO) states that global hearing loss sufferers worldwide reach 222 million people in adulthood. More than 35 million Americans aged 18 years and over have sensorineural hearing loss and it gets worse with age (Marisdayana et al., 2016). Based on Basic Health Research Data (Riskesdas) in 2013, the rate of hearing loss increases with increasing age (Santosa et al., 2022). Sensorineural hearing loss begins at higher frequencies (3000 Hz to 6000 Hz) and gradually worsens with prolonged exposure to excessive noise levels (Marlina et al., 2016). Neurological deafness or SNHL is caused by several factors, including age factors because damage to the hearing nerve occurs naturally with age, genetic factors can trigger neural deafness or SNHL, environmental factors such as frequent exposure to noise can

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also cause neural deafness, alcohol consumption and use of ototoxic drugs such as streptomycin which can damage the vascular stria, thereby triggering neural deafness (Triola et al., 2023). Some studies also show that hypertension, diabetes, and hypercholesterolemia can predispose to neural deafness. This is because diseases such as hypertension, diabetes and hypercholesterolemia directly affect blood flow in the cochlea, resulting in reduced nutrient transport, and indirectly causing secondary degeneration of the auditory nerve (Marlina et al., 2016). One of the complications caused by diabetes mellitus is hearing loss caused by microangiopathy. Hearing loss in diabetes mellitus patients is bilaterally progressive and is a type of cochlear type sensorineural hearing loss (Sonia, 2019). This research is proven by research conducted by Alnuman & Ghnimat (2019) which stated that 76.3% of respondents had hearing loss and 23.7% were normal. Gender has also been linked as a risk factor that causes neural deafness. A study in Korea found that women have weaker hearing, namely above 2 Hz, compared to men (Santosa et al., 2022). Research by Wang et al. (2021), states that the prevalence of men is higher than women (Wang et al., 2021). The lifestyle of men who smoke more often is also a risk factor for hearing loss (Aminudin, 2022).

Men also tend to pay less attention to themselves and are less concerned about seeking treatment if hearing loss occurs. This will ultimately worsen hearing loss (Marlina et al., 2016). One of the health problems commonly experienced with increasing age is hearing loss (Shukla et al., 2020). Hearing loss in adult patients (18 years and over) is an effect of aging (Cunningham & Tucci, 2017). This research is proven by research conducted by Goderie et al. (2021) which states that adult patients have experienced hearing loss, starting from the age of 18-30 as many as 54 people, aged 31-40 years as many as 83 people, 41-50 as many as 152 people, 164 people aged 51-60 years, and 49 people aged 61-70 years, this proves that neural deafness increases with age. Several studies have been conducted that discuss diabetes mellitus and hearing loss, but there are no studies that specifically discuss the relationship between diabetes mellitus and gender with neurological deafness in adult patients.

Methods

This research is a quantitative study with an observational analytical design using a cross-sectional approach. The location of this research was carried out at RSU PKU Muhammadiyah Surakarta. The research was conducted from October 2023 to November 2023 by taking secondary data. The population in this study contains objects that provide certain characteristics. This study took the population from medical record data of adult patients aged 18 years who experienced neurological deafness accompanied by DM at RSU PKU Muhammadiyah Surakarta for the period 2020-2023. The samples taken in this study were all medical record data from adult patients aged ≈ 18 years who experienced neurological deafness accompanied by DM at RSU PKU Muhammadiyah Surakarta from 2020-2023. Sampling was carried out using a non-probability sampling technique in the form of purposive sampling. The inclusion criteria for this study were all medical record data from neurologically deaf patients aged more than 18 years who had diabetes mellitus and who did not have diabetes mellitus. The exclusion criteria are neurologically deaf patients aged more than 18 years who have hypertension, hypercholesterolemia, a history of ear infections, and work history as a laborer. In this study, the sample size was determined using the Lemeshow formula and the results obtained were 67 respondents. Diabetes mellitus was categorized as DM and Non-DM, then gender was categorized as male and female, and neurological deafness was categorized as neurological deafness and non-neurological deafness. The independent variables in this study were diabetes mellitus and gender and the dependent variable in this study was the incidence of neurological deafness. The research instrument used in this study was medical record data obtained from adult patients diagnosed with neurological deafness accompanied by DM. Researchers used univariate analysis techniques, bivariate analysis using the chi-square test, and multivariate analysis using the logistic regression test. This research has been declared

ethically sound by the Health Research Ethics Commision of PKU Muhammadiyah Hospital Surakarta No. 02/KEPK/RS.PKU/XI/2023.

Result and Discussion

Table 1. Characteristics of Respondents with Neurological Deafness

Variable	Frequency (n)	Percentage (%)
Gender		
Male	40	59,7
Female	27	40,3
Age		
Teenager	3	4,5
Adult	17	25,4
Elderly	39	58,2
Seniors	8	11,9
Incidence of DM		
DM	54	80,6
Non-DM	13	10,4
Incidence of Deaf		
Neurological Deafness	43	64,2
Non-Neurological Deafness	24	35,8

Source: Secondary Data, 2023

From table 1, it is known that the characteristics of respondents are based on gender, the majority of patients are male, namely 40 respondents (59.7%). Based on the age category, the majority of respondents were aged 46-65 years, namely 39 respondents (58.2%). Based on the DM incident category, it is known that of the 67 respondents, the majority of respondents in the study experienced DM, namely 54 respondents (80.6%). Based on the categories of deafness incidents from the table above, it can be seen that of the 67 respondents, 43 respondents (64.2%) experienced neurological deafness.

Table 2. The Relationship between Diabetes Mellitus with the Incidence Neurological Deafnes

Incidence of DM	Neurological Deafness		Non-Neurological Deafness		Total		P. Value
	N	%	N	%	N	%	
DM	42	62,7	12	17,9	54	80,6	0,000
Non-DM	1	1,5	12	17,9	13	19,4	

Source: Secondary Data, 2023

From table 2, the results of bivariate analysis regarding the relationship between diabetes mellitus and the incidence of neurological deafness which was tested using the chi-square test were 62.7% and the P value was 0.000 (P < 0.05). So in this study, it can be concluded that there is a relationship between diabetes mellitus and the incidence of neurological deafness. In DM and non-DM patients, the percentage of neural deafness and non-neural deafness was comparable, namely 17.9%.

Table 3. The Relationship between Gender with the Incidence Neurological Deafness

Gender	Neurological Deafness		Non-Neurological Deafness		Total		P. Value
	N	%	N	%	N	%	
Male	30	44,8	10	14,9	40	59,7	0,025
Female	13	19,4	14	20,9	27	40,3	

Source: Secondary Data, 2023

From table 3, Most neurological deafness sufferers were male, 44.8% with a P value of 0.025 (P < 0.05). In female patients who did not experience nerve deafness, it was 20.9%. So in this study, it was concluded that there was a relationship between gender, namely male gender, and the incidence of neurological deafness.

Table 4. Logistic Regression Table between Diabetes Mellitus and Gender with the Neurological Deafness

Variable	B	p-value	Exp(B)	95% CI for EXP(B)	
				Lower	Upper
Gender	1.951	0,008	7,037	1.664	29.756
DM	4.355	0,000	77,836	7.539	803.651

Source: Secondary Data, 2023

In table 4, the results of multivariate analysis using the logistic regression test showed that the most significant or related P value was the DM (diabetes mellitus) variable with a P value = 0.000, exp (B) = 77.836 and 95% CI for EXP (B) = 7.539-803.651. The gender variable obtained a value of P = 0.008, exp (B) = 7.037 and 95% CI for EXP (B) = 1.664-29.756. So it can be concluded that there is a relationship between the diabetes mellitus variable and the incidence of neurological deafness in adult patients in Surakarta City with an OR value (Exp B) of 77.836. These results indicate that patients with diabetes mellitus have a 77,836 risk of experiencing neurological deafness. Based on the results of the multivariate analysis, the research hypothesis was accepted. The data obtained shows that there is a relationship between diabetes mellitus and gender and the incidence of neurological deafness.

In this study, most patients had DM and neurological deafness with and some were male. Diabetes mellitus is a complication of sensorineural deafness. This is caused by microangiopathic abnormalities that occur in the capillaries of the striae vascularis, which can then occur in the internal auditory artery, modiolus, vasa nervosum spiral ganglion and demyelination of the auditory nerve. Hyperglycemia plays an important role in this process, chronic hyperglycemia causes non-enzymatic tissue protein glycosylation processes. Microangiopathy then causes atrophy of the organ of Corti and a reduction in hair cells. Neuropathy occurs due to microangiopathy in the vasa nervosum N.VIII and vasa spiral ligament which results in atrophy of the spiral ganglion and demyelination of the VIII nerve fibers (Sonia, 2019). The gender difference in high-frequency hearing thresholds is because men are usually more exposed to workplace noise than women. Gender differences in neural deafness are not entirely due to changes in the cochlea, in women, the shape of the earlobes is smaller and the ear canal is smaller (Dewi, 2016). Men have a greater risk of developing neurological deafness because men are more often exposed to noise than women. Men also more often have hobbies in outdoor activities such as hunting, driving, carpentering, off-roading and others. Over time exposure to noise from machine tools or firearms can result in neurological deafness. Noise exposure causes sensitive hair cells in the inner ear and causes hair cells to be damaged by repeated and extreme noise exposure (Marlina et al., 2016). Based on the results in Table 1, it is known that the characteristics of respondents are based on gender, the majority of patients are male, namely 40 respondents (59.7%). Based on the age category, the majority of respondents were aged 46-65 years, namely 39 respondents (58.2%). Based on the DM incident category, it is known that of the 67 respondents, the majority of respondents in the study experienced DM, namely 54 respondents (80.6%). Based on the categories of deafness incidents from the table above, it can be seen that of the 67 respondents, 43 respondents (64.2%) experienced neurological deafness.

Based on the results in Table 2, the results of bivariate analysis regarding the relationship between diabetes mellitus and the incidence of neurological deafness which was tested using the chi-square test were 62.7% and the P value was 0.000 (P < 0.05). So in this study, it can be

concluded that there is a relationship between diabetes mellitus and the incidence of neurological deafness. In DM and non-DM patients, the percentage of neural deafness and non-neural deafness was comparable, namely 17.9%. The National Institute of Diabetes and Digestive and Kidney Disease (NIDDK) conducted research that is in line with the research results. Patients who have diabetes tend to experience bilateral sensorineural hearing loss compared to normal people (Sachdeva & Azim., 2018). The results of this study are also by research conducted by Hisaki Fukushima (2006) which stated that there was cochlear microangiopathy and degeneration of vascular striae in people with diabetes mellitus (Fukushima et al., 2006; Pathak et al., 2017).

This is also relevant to the results of research conducted by Limardjo et al. (2021) which stated that of 135 research samples in one of the Makassar City hospitals who experienced DM, 69.6% experienced sensorineural hearing loss. On pure tone audiometry examination, significant results were obtained. with a P value <0.05 (Limardjo et al., 2021). The results of this research are also relevant to research conducted by Fatemeh T et al (2014) which states that there is a relationship between DM and hearing loss. The results of the research showed a significant relationship, namely p=0.001 (Fatemeh et al., 2014 sit. Sonia (2019). Research conducted by Panchu (2018) suggests that the hearing threshold results in DM patients are higher than in patients without DM with a p value < 0.05 (Panchu, 2018). The results of this study are not relevant to research conducted by Krismanita et al. (2017) which states that there is no significant relationship between diabetes mellitus sufferers and sensorineural deafness with a p-value = 0.390 (Krismanita et al., 2017). Based on the results in Table 2, most neurological deafness sufferers were male, 44.8% with a P value of 0.025 (P < 0.05). In female patients who did not experience nerve deafness, it was 20.9%. So in this study, it was concluded that there was a relationship between gender, namely male gender, and the incidence of neurological deafness.

The results of this research are in line with research conducted by Pratama and Wiranadha (2019) at the ENT-KL polyclinic at Sanglah Hospital. Research conducted by Pratama & Wiranadha (2019) discussed the characteristics of sensorineural deafness sufferers and obtained consistent results that patients with neural deafness were more common in men with 174 patients (64.93%) (Pratama & Wirandha., 2019). These results are also by research conducted by Putra & Wiranadha (2023) who stated in their research on the results of pure tone audiometry in sensorineural deaf patients. The results of the research were that of the 65 sensorineural hearing loss research samples, there were more males, namely 51 respondents (78.5%) and 14 respondents (21.5%) females. The incidence of neural deafness is higher in men than in women with a ratio of 2:1 (Putra & Wiranadha., 2023). Research conducted by Dewi (2016) at the ENT-KL polyclinic at RSUP DR. Hasan Sadikin Bandung found that there were more male respondents than female respondents, namely 269 (62.7%) and 160 (37.3%) and it was proven that more men experienced neurological deafness than women (Dewi, 2016).

This result is different from research conducted by Sitompul (2023) which stated that the gender that most often experienced neurological deafness was women, namely 22 people (55%), while men were only 18 people (45%) from the research sample (Sitompul, 2023). Based on the results in Table 3, the results of multivariate analysis using the logistic regression test showed that the most significant or related P value was the DM (diabetes mellitus) variable with a P value = 0.000, exp (B) = 77.836 and 95% CI for EXP (B) = 7.539-803.651. The gender variable obtained a value of P = 0.008, exp (B) = 7.037 and 95% CI for EXP (B) = 1.664-29.756. So it can be concluded that there is a relationship between the diabetes mellitus variable and the incidence of neurological deafness in adult patients in Surakarta City with an OR value (Exp B) of 77.836. These results indicate that patients with diabetes mellitus have a 77,836 risk of experiencing neurological deafness. Based on the results of the multivariate analysis, the research hypothesis was accepted.

The data obtained shows that there is a relationship between diabetes mellitus and gender and the incidence of neurological deafness. The results of this study are relevant to research by Rajamani et al. (2018) which showed that 52 subjects were divided into 26 DM patients and 26 non-DM patients as a control group, then data analysis was carried out using chi- square and results were obtained stated that there was a relationship between DM with neural deafness with a value of P = 0.005. So it is stated that there is a relationship between diabetes mellitus and the incidence of neurological deafness with a value of P = 0.000 (Rajamani et al., 2018).

Conclusion

Based In this study, it was stated that there was a relationship between diabetes mellitus and gender and the incidence of neurological deafness in adult patients in the city of Surakarta. The diabetes mellitus variable with OR 77.836 has more influence on the incidence of neurological deafness than the gender variable with OR 7.037. Researchers hope this research can be used as a reference for additional knowledge and insight for practitioners regarding the relationship between diabetes mellitus and gender with the incidence of neurological deafness in adult patients and can be developed and further research needs to be carried out regarding other factors that cause neurological deafness.

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