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THE RELATIONSHIP BETWEEN BLOOD PRESSURE LEVELS AND THE INCIDENCE OF DIABETIC NEUROPATHY IN TYPE-2 DIABETES MELLITUS PATIENTS.

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ABSTRACT

Diabetic neuropathy (DN) is microvascular complications in people with type 2 diabetes that can significantly affect patients' quality of life. Higher levels of blood pressure are known to be associated with an increased occurrence of diabetic neuropathy in type 2 diabetes patients. This study aimed to determine the risk factors for blood pressure levels with the incidence of diabetic neuropathy. This approach used purposive sampling with a cross-sectional methodology. SPSS version 26 with the chi square test was used to analyze the data. This study involved 68 patient. Patient with diabetic neuropathy mostly female (23.8%), aged of 51-60 years (16.2%), have had diabetes for > 5 years (22.1%), consumed insulin or anti-diabetic medications orally (35.5%), have a history of hypertension (20.6%), and do not take antihypertensive drugs (20.6%). According to the findings of the ci-squre analysis, there was a significant correlation between the incidence of diabetic neuropathy and the level of blood pressure (p < 0.04). Patients who suffer from neuropathy diabetic had the most hypertension grade 1. Meanwhile, patients who do not had diabetic neuropathy mostly have optimal, normal and normal-high blood pressure. In conclusion, there is a correlation between the incidence of blood pressure levels and diabetic neuropathy.

KEYWORDS:

Type 2 Diabetes Mellitus, Diabetic Neuropathy, Hypertension, Blood Pressure Level.

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INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by hyperglycemia due to impaired insulin secretion, insulin action, or both. The global prevalence of diabetes shows a sharp increasing trend in the last 5 years. According to the 10th edition of the IDF Diabetes Atlas, in 2021, there were approximately 537 million adults (aged 20–79 years) living with diabetes, with a global prevalence of 10.5%. This number has significantly increased compared to previous years and is projected to continue rising. The IDF projects that the number of people with diabetes will increase to 643 million by 2030 and reach 783 million by 2045 if effective interventions are not implemented. Additionally, the 2021 IDF also noted that nearly 1 in 2 adults living with diabetes (about 44%) are not aware that they have the condition, which means

there is a large but hidden disease burden [1]

One of the microvascular consequences of diabetes mellitus type 2 is diabetic neuropathy (DN). This complication affects the sensory nerves in the extremities and is manifested as a tingling sensation in the areas of the legs that is irreversible [2]. Lower extremity amputation is a serious and common complication arising from diabetic neuropathy, especially in patients with type 2 diabetes who have chronic foot wounds or ulcers[3]. Between 22-46.5% of people with diabetes have diabetic neuropathy. Prevalence of diabetic neuropathy occur in Low-to middle-income developing countries[4]. A study shows that patients with diabetic peripheral neuropathy (DPN) experience a significant decline in quality of life scores and anxiety/depression scores. The addition of neuropathic pain symptoms worsens both the quality of life and the mental condition of the patients [5].

High Blood pressure is one of the main predictors of peripheral neuropathy and is significantly associated with diabetic neuropathy. Additionally, the study revealed that type 2 diabetes patients with hypertension had a greater risk of developing DN compared to those without hypertension [4]. A systematic review from Current Problems in Cardiology concluded that hypertension is a major modifiable risk factor for diabetic neuropathy, particularly distal symmetrical polyneuropathy, which is evidenced by nerve conduction abnormalities and increased vibration perception threshold [6]. There will be a novelty factor in this study because the blood pressure level is not listed. However, However, a study showed that hypertension does not have a statistically significant relationship with the occurrence of diabetic neuropathy [7].

Based on the context above, this study aims to determine relationship between the blood pressure levels and the incidence of diabetic neuropathy in patients with type 2 diabetes mellitus patients.

METHODS

This study used a cross sectional research design with purposive sampling techniques. Using the ordinal-nominal correlative R5 sample formula, 68 participants acquired [8]. The inclusion criteria in this study were patients with type 2 diabetes mellitus, those who were willing to participate in the study, and those who were ≥ 20 years old. Patients with DM type 2 who smoke, had DM for ≥ 20 years, have a BMI ≥ 40, suffered kidney illness, had pregnancy-related hypertension, or have neurological conditions that cause sensory abnormalities including leprosy, CTS, or TTS are excluded.

Data were collected from administered-gfrom, questionnaire, and physical examination. This study was conducted on 25 on October 2024 at Siti Khodijah Muhammadiyah Hospital, sidoarjo, indonesia. Data of age, gender, duration of diabetes,

consume anti-diabetic drugs, history of other diseases were and diabetic neurophaty screening obtained by questionnaire. ABN Spectrum Stethoscope and Spectrum Sphygmomanometer were used to take the patient's blood pressure. The measures were taken 3 times with a one- minute pause. The average of the last 2 readings was then calculated. Hypertension is indicated when blood pressure is 2-3 times ≥ 140 / ≥ 90 mmHg at a clinic visit [9]. The classification of Hypertension used European Society of Cardiology (ESC) [10]

The Michigan Neuropathy Screening Instrument (MNSI) consists of 2 parts. Part A is a subjective assessment with 15 yes or no questions. A patient is diagnosed with clinical neuropathy if the MNSI Part A score ≥ 7. Part B is an objective assessment based on a physical examination which includes foot inspection to evaluate for deformities, dry skin, calluses, infections, and ulceration; assessment of vibration sensation at the great toe using a 128-Hz tuning fork; ankle reflexes; and monofilament testing using a 10-g monofilament. If the MNSI Part B score is ≥ 2.5, the patient is diagnosed with diabetic neuropathy; if the score is < 2.5, the patient is not diagnosed with diabetic neuropathy. Due to its subjectivity, MNSI Part A is not employed to determine the participants' detection results. The individuals' detection results (diabetic neuropathy or not) are based on their MNSI Part B score[11]

Data analysis used spss version 26 with chi-square test. Every participants has received written and verbal information. Before they registered as participant, their informed consent was acquired. This research was approved by Health Research Ethics Committee, Siti Khodijah Muhammadiyah Hospital, sidoarjo, Indonesia with No. 23/ KET-KEPK/8-2024)

RESULT AND DISCUSSION

Tabel 1. Characteristics of type 2 diabetes patients

Variabel	N	%
Gender		
Man	13	19,1 %
Women	55	80,9 %
Total	68	100 %
Age		
≤ 50 years	12	17,6 %
51–60 years	30	44,1 %
61–70 years	24	35,5 %
≥ 71 years	2	2,9 %
Total	68	100 %
DM duration		
≤ 5 years	33	48,5 %
> 5 years	35	51,5 %
Total	68	100 %
Consume anti-diabetic drugs		
Yes	65	95,6 %
No	3	4,4 %
Total	68	100 %
History of hypertension		
Yes	34	50 %
No	34	50 %
Total	68	100 %
Consume anti-hypertensive drugs		
Yes	31	45,4 %
No	37	54,6 %
Total	68	100 %
Blood pressure levels		
Optimal	13	19,1 %
Normal	16	23,5 %
High-Normal	18	26,5 %
Hypertension grade 1	17	25 %
Hypertension grade 2	3	4,4 %
Hypertension grade 3	1	1,5 %
Total	68	100 %
Diabetic neuropathy		
DN +	43	63,2 %
DN -	25	36,8 %
Total	**68**	**100 %**

Among the 68 type 2 diabetes patients in this study, the patients were mostly female (80.9%). Women are particularly susceptible to type 2

diabetes, which is impacted by metabolic and hormonal variables. Multiple research findings suggest that estrogen-related alterations that impact insulin sensitivity and body fat distribution increase the risk of diabetes in women, particularly after menopause[12]. The findings of this study are consistent with those of Rosita's (2022) study, which discovered that women have a 2.15-fold higher risk of type 2 diabetes than men [13]. Majority of DM type 2 patients were between the ages of 51-60, with 30 patients (44.1%) and 24 patients (35.5%) into the 61–70 age range. Physiological in humans decrease rapidly after the age of 45 years. A reduction functions, including the endocrine metabolic system, is one of the symptoms and indicators of aging [14]. These findings are supported by Fibra (2021) that diabetes mellitus often occurs after someone reaches the vulnerable age range, which is after the age of 45[15].

Up to 35 type 2 diabetes patients were identified suffering for more than 5 years. This result is correlates with research conducted by Sarah (2023), who said that diabetes is a chronic metabolic disorder that requires long-term care and directly impacts the decline in quality of life[16]. Most patients in this study were consumed oral or insulin antidiabetic medications (95,6%). By enhancing insulin receptor sensitivity, medication therapy decreases blood sugar levels and promotes the pancreas production of insulin[17]. The findings of this study are consistent with Nurul's research, which discovered that most patients with type 2 diabetes (72.5%) in Central Javan hospitals adhere to their prescription regimens [18].

The study included 34 patients (50%) with a history of hypertension and 34 patients (50%) without a history of hypertension. Sedentary lifestyle, high calorie intake, insulin resistance, renal dysfunction, the renin-angiotensin-aldosterone system (RAAS), and socioeconomic and environmental variables are all contributed to hypertension in type 2 diabetes [19]. Diabetic mellitus patients who has high normal blood pressure were obtained as 18 patients (26.5%) and 17 patients (25%) with grade 1 hypertension. Blood vessel resistance and an increase in the volume of fluid within blood vessels can both contribute to the pathophysiology of hypertension. Vascular resistance was obtained due to tension caused by RAAS activation, increased sympathetic nerve activation, vascular recapitalization experienced by patients with diabetes mellitus. Insulin resistance is more likely to emerge when blood pressure rises because it can exacerbate inflammation in β cell function and insulin signaling pathways. Insulin resistance caused hyperglycemia. The amount of circulatory fluid increases as a result of hyperglycemia's effects on plasma osmolarity and cell water release into blood vessels[20]. This outcome supports the findings of Sethi (2023) which found

hypertension is thought to be the primary modifiable risk factor for the development of diabetic neuropathy, particularly distal symmetrical polyneuropathy, which results in aberrant nerve conduction characteristics and an elevated vibration perception threshold in patients with diabetes mellitus[6].

The incidence of diabetic neuropathy in the study was 25 patients (33.2%). Mechanism of their body was overactivated the polyol pathways, hexamine, the protein kinase C pathway (PKC), and the production of advanced glycation end-product (AGE) in response to hyperglycemia. Oxidative damage brought on by this overactive process results in inflammation, vascular malfunction, and deficiencies in nerve transmission. This will eventually lead to the development of diabetic neuropathy [21]. Diabetic neuropathy cased to factors such delayed diagnosis, a lack of resources for screening and diagnosis, poor blood glucose control, growing health care expenses, and inadequate diabetes care services, and more common in developing nations. The absence of diabetic neuropathy in patients with diabetes mellitus is probably caused by newly diagnosed individuals, lifestyle changes such a low-sugar diet, balanced physical activity, and the management of modifiable risk factors. The findings of this study support Sharie's findings (2023) that between 22 - 46.5% of patients with diabetes mellitus had diabetic neuropathy [4].

Tabel 2. Characteristic of diabetic neuropathy patients.

Characteristic	**DN +**		**DN -**	
	(N)	**(%)**	**(N)**	**(%)**
Gender				
Man	2	2,9 %	11	16,2 %
Woman	23	33,8 %	32	47,1 %
Total	25	36,8 %	43	63,2 %
Age				
≤ 50 years	4	5,9 %	8	11,8 %
51–60 years	11	16,2 %	19	27,9 %
61–70 years	8	11,8 %	16	23,6 %
≥ 71 years	2	2,9 %	0	0,0 %
Total	25	36,8 %	43	63,2 %
DM duration				
≤ 5 years	10	14,7 %	23	33,8 %
> 5 years	15	22,1 %	20	29,4 %
Total	25	36,8 %	43	63,2 %
Consume anti-diabetic drugs				
Yes	24	35,3 %	41	60,3 %
No	1	1,5 %	2	2,9 %
Total	25	36,8 %	43	63,2 %
History of hypertension				
Yes	14	20,6 %	20	29,4 %
No	11	16,2 %	23	33,8 %
Total	25	36,8 %	43	63,2 %
Consume anti-hypertensive drugs				
Yes	11	16,2 %	20	29,4 %
No	14	20,6 %	23	33,8 %
Total	**25**	**36,8 %**	**43**	**63,2 %**

Up to 23 individuals (33.8%) with diabetic neuropathy were discovered to be female. This could occur as because of women's elevated estrogen levels interfering with iodine absorption, which is important for the development of nerve myelin. This supports Muthia's findings (2018) that women are more likely to develop diabetic neuropathy than man. Most of cases of diabetic neuropathy occur in those aged 51–60 (16.2%) and 61–70 (11.8%). The effects of aging on generative processes are significant. Nerve cells are harmed by the aging process in both major and small nerve. This study's finding relevant to Yifan (2022) that age >66 years increases the risk of DPN compared to younger age groups. Age >40 or >50 years has also been proven

to be an independent predictor of DPN, even after accounting for the duration of diabetes, HbA1c control, and other factors [22]

Diabetic neuropathy patients were found 15 patients (22.1%) suffering from more than 5 years. The prolonged exposure to high glucose is the main cause of diabetic neuropathy, through mechanisms: AGE accumulation, oxidative stress, the polyol pathway, PKC activation, as well as disturbances in Schwann cell and myelin metabolism [23]. Rahmi's research supports this finding, indicating a correlation between the occurrence of diabetic neuropathy and the duration of DMT2 symptoms [24]. Diabetic neuropathy patients mostly consumed antidiabetic medications.The incidence of diabetic neuropathy and consuming antidiabetic medications did not significantly correlate. These findings are consistent with Christian's research (2017), which found that there is no relationship between diabetic neuropathy and medication adherence in patients with type 2 diabetes[25].

Based one the history of hypertension in diabetetic neuropathy patients was Acquired 11 patients (16.2%) had no history of hypertension, while 14 patients (20.6%) with diabetic neuropathy had a history of hypertension. The difference that led to these outcomes was not very substantial. Myelin fibers are impacted by hypertension, which causes an increase in matrix metalloproteinase production in myelin and a decrease in the speed of sensory nerve conduction [26]. There were 14 patients (20.6%) with diabetic neuropathy who did not use antihypertensiv emedications. Maintaining blood pressure stability and controlling blood pressure to reduce and avoid patient problems requires adherence to antihypertensive medications. According to a Fifi study (2021), patient who take blood pressure-lowering medications have greater quality of life and less adverse health effects [27] of diabetic neuropathy in patients with diabetes mellitus is probably caused by newly diagnosed individuals, lifestyle changes such a low-sugar diet, balanced physical activity, and the management of modifiable risk factors. The findings of this study support Sharie's findings (2023) that between 22 - 46.5% of patients with diabetes mellitus had diabetic neuropathy [4]

Tabel 3. The relationship between blood pressure levels and the incidence of diabetic neuropathy In Type-2 Diabetes.

Tekanan Darah	**DN + (N)**	**DN - (N)**	***Chi-Square (p)***
Optimal	5	8	
Normal	4	12	0.04
High-Normal	3	15	
Hypertension grade 1	11	6	
Hypertension grade 2	1	2	
Hypertension grade 3	1	0	
Total	**25**	**45**	

The chi-squre statistical test obtained p value 0.04 (P < 0.05). This indicates, there is a significant relationship between the level of blood pressure and the incidence of diabetic neuropathy. Patients who suffer from neuropathy diabetic had the most hypertension grade 1. Meanwhile, patients

who do not had diabetic neuropathy mostly have optimal, normal and normal-high blood pressure. This finding supports Ozaki's research (2020) that hypertension is related to the development of diabetic neuropathy. Hypertension triggers small vascular dysfunction (microangiopathy), reduces blood flow to peripheral nerves (endoneurial perfusion), exacerbates ischemia, and causes oxidative damage and demyelination of the nerves [28]

CONCLUSION

This study concluded that there is a significant relationship between the blood pressure levels and the incidence of diabetic neuropathy in patients with type 2 diabetes mellitus. Other risk factors that were identified also affect the incidence of diabetic neuropathy are female gender, aged of 51-60 years, have diabetes for more than 5 years, have history of hypertension, and not taking medication for hypertension. Recommendation for more study is include additional variables that are thought to be most at risk for the occurrence of diabetic neuropathy.

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