The Relationship Between Body Mass Index and Diabetic Neuropathy in Patients With Diabetes Mellitus at the Regional General Hospital dr.Soehadi Prijonegoro Sragen District

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Abstract

Diabetic neuropathy is a prevalent consequence of diabetes mellitus, affecting around 50% of individuals with the condition. There exists a strong correlation between the onset of diabetic neuropathy and body mass index. There is a positive correlation between body mass index and the risk of neuropathy. The objective of this study is to investigate the correlation between body mass index and diabetic neuropathy among individuals diagnosed with diabetes mellitus within the context of dr. Soehadi Prijonegoro Sragen Regional General Hospital. The present study employed quantitative methodologies with a cross-sectional design. The present investigation was carried out under the operational jurisdiction of the Regional General Hospital dr. Soehadi Prijonegoro Sragen. The study's implementation commenced in September 2023 and concluded in February 2024. A total of 782 patients diagnosed with diabetes mellitus were included in the study population at dr. Soehadi Prijonegoro Sragen Regional General Hospital. A purposive sampling strategy was used to choose a sample of 89 people with diabetes mellitus for this investigation. The study examined the relationship between the independent variable, Body Mass Index, and the dependent variable, diabetic neuropathy. The study employed a research instrument in the form of a questionnaire administered through direct interviews. Data collection was carried out using weight scales using Speeds brand digital weight scales and Stature Meter to measure height. Diabetic neuropathy measurement instrument using diabetes neuropathy symptom score (DNS). Data analysis using bivariate analysis with chi-square test, data processing with SPSS software version 20. The results showed that there was a significant relationship between body mass index and the incidence of diabetic neuropathy in patients with diabetes mellitus at dr. Soehadi Prijonegoro Sragen Regional General Hospital (p-value=0.032).

Keyword: Body Mass Index, Diabetic Neuropathy, Diabetes Mellitus

INTRODUCTION

Diabetes mellitus is a metabolic disorder marked by elevated blood sugar levels caused by irregularities in the production or effectiveness of insulin. Currently, diabetes cannot be cured, but it can be managed (Lispin et al., 2021). Diabetes mellitus, sometimes known as diabetes, encompasses a diverse range of illnesses that are distinguished by elevated amounts of glucose in the bloodstream, commonly referred to as hyperglycemia (Nurlaela et al., 2020).

Uncontrolled diabetes causes long-term disease (Zhou et al., 2024), and can become serious and lead to dangerous chronic conditions if left untreated (Yulian, 2019). Diabetes is considered a cause of premature death worldwide (Ariani et al., 2022).

Worldwide, the population of people with diabetes mellitus was nearly 537 million in 2021 (Berlin et al., 2024). And by 2045, the number of people with diabetes is expected to increase by 68% (Vu et al., 2023). Indonesia ranks third in Asia with a diabetes prevalence of 11.3% (IDF, 2021). In 2018, Central Java Province experienced an increase in DM problems, reaching 496,181 and there was an increase of 652,822 in 2019 (Central Java Provincial Statistics Agency, 2020).

So, from year to year diabetes mellitus sufferers will increase (Mujabi et al., 2018). Based on the results of the Medical Record Report of the Regional General Hospital dr. Soehadi Prijonegoro Sragen, in January to December 2022 there were 1.165 visits of patients with diabetes mellitus with neuropathy who underwent outpatient care and in January to November 2023, the number of outpatient visits with diabetes mellitus with neuropathy increased to 1.565 patients (RSUD dr. Soehadi Prijonegoro Sragen, 2023).

Based on research conducted by Rachmantoko et al., (2021), one of the problems caused by diabetes mellitus is neuropathy. Diabetic neuropathy is a nerve disorder and loss of sensory function starting from the distal parts of the lower extremities as a result of high blood glucose in sufferers (Hasyim et al., 2023). Diabetic neuropathy is one of the most common complications in diabetes mellitus, there are 50% of diabetes mellitus sufferers who experience diabetic neuropathy (Graciella et al., 2020)

The clinical manifestations of sensory neuropathy encompass paresthesia and dyesthesia, hyperalgesia, a sensation of burning, acute pain, as well as impairments in pain perception and temperature perception (Mawaddah et al., 2022; Yudiantara et al., 2023). The results of research conducted by Putri et al., (2020), regarding the factors that influence the severity of neuropathy in diabetes mellitus patients, one of which is high blood sugar levels and being overweight by determining the Body Mass Index value. The development of diabetic neuropathy is closely related to body mass index the greater the body mass index, the greater the risk of neuropathy.

The Body Mass Index (BMI) serves as a straightforward instrument for assessing the nutritional health of individuals, particularly in relation to underweight and overweight conditions (Khanna et al., 2022). One simple method that is commonly used to determine being underweight or overweight is by measuring the body mass index, which is a way to assess body composition and is a parameter for determining a person's nutritional status (Sovina et al., 2022).

Individuals with a higher body mass index are at a heightened risk of developing diabetes mellitus compared to other disorders The results of research conducted by Kadri et al.,

(2021), The vast majority of participants had been afflicted with diabetes mellitus for a duration beyond 5 years (83.7%), were classified as overweight (69.1%), and exhibited poor symptoms of neuropathy (57.3%). A notable correlation exists between the duration of distress and Body Mass Index in individuals with diabetes mellitus, and the manifestation of neuropathy symptoms.

This study seeks to establish a method for early identification by consistently monitoring Body Mass Index (BMI) and evaluating the prevalence of diabetic neuropathy among individuals with Diabetes Mellitus. The researchers examined, conducted research, and established the correlation between body mass index and diabetic neuropathy in individuals with diabetes mellitus at dr. Soehadi Prijonegoro Hospital in Sragen, based on the provided background information.

METHODS

The type of research used in this research is quantitative research with a cross sectional approach, a research where the independent variable and dependent variable are studied simultaneously, namely a research method to see the relationship between body mass index and diabetic neuropathy in diabetes mellitus sufferers.

This research was conducted at the Regional General Hospital dr. Soehadi Prijonegoro, Sragen Regency from September 2023 to February 2024. The population in this study were diabetes mellitus sufferers with neuropathy who underwent outpatient treatment in the work area of the Regional General Hospital dr. Soehadi Prijonegoro, Sragen Regency from January to November 2023, there were 1565 patients. Assuming the proportion of Diabetes Mellitus patients with neuropathy is 50%, the total population is 782 patients.

The sampling technique used in this research is purposive sampling, purposive sampling technique is a technique by determining certain criteria for the sample. The inclusion criteria in this study were Diabetes Mellitus patients undergoing outpatient treatment at the Regional General Hospital dr. Soehadi Prijonegoro Sragen Regency, can communicate, read and write well, lives in the Working Area of the Regional General Hospital dr. Soehadi Prijonegoro, Sragen Regency, patient over 17 years old and willing to be used as a sample in the research. Meanwhile, the exclusion criteria for the research sample were patients who experienced impaired consciousness and patients who had amputations of their legs. The sample in this study was 89 people.

The independent variable in this study is Body Mass Index and the dependent variable in this study is diabetic neuropathy. Data collection in this study was obtained through observation sheets in the form of scales and height measuring instruments as well as Diabetic Neuropathy Symptom (DNS) questionnaires.

The Body Mass Index instrument used is a body weight scale, which is a tool used to measure body weight. This research instrument uses a Speeds brand digital weight scale and a Stature Meter, a tool used to measure body height. In this research instrument, the Onemed brand Wireless Body Height Meter was used. Diabetic neuropathy instrument This study used Neuropathy Symptom (DNS) measurements.

Diabetic Neuropathy Symptom (DNS) is a 4-point symptom score with high predictive value for screening polyneuropathy in diabetes. Symptoms of unstable gait, neuropathic pain, paresthesia or thick feeling. One symptom is assessed as a score of 1, the maximum score is 4. A score of 1 or more is translated as positive for diabetic polyneuropathy. Diabetic Neuropathy Symptom (DNS) score provisions where if the question is answered "yes", then the value is 1 if the symptoms occur several times in 1 week for at least the last 2 weeks; The question was answered "no" if there were no symptoms; Total score is 4; A score of 0 indicates no diabetic neuropathy; and a score of 1 - 4 indicates the presence of diabetic neuropathy.

Testing the validity and reliability of this questionnaire was carried out by Badrujamaludin et al., (2021) at the Cimahi Community Health Center entitled The relationship between physical activity and the incidence of diaberic neuropathy in Type 2 diabetes mellitus sufferers, the sensitivity value of the DNS was 79% and the specificity was 78% and the test found that the reliability of the DNS was 0.64. Questionnaires with a reliability value > 0.6 are said to be reliable.

Data analysis in this study used univariate tests and bivariate tests using the Chi-square test. Data processing was carried out using SPSS version 20 software. This research has received approval from the Research Ethics Committee with Research Ethical Clearance number 127/Etik-Crssp/XII/2023.

RESULTS

Based on the results of the study, it is known that the characteristics of the respondents in this study are as follows:

Table 1 Characteristics of Respondents (n=89)

Characteristics	Frequency	%
Gender		
Male	22	24.7
Female	67	75.3
Age		
18-40 years	3	3.4
41-60 years	41	46.1
>60 years	45	50.6
Employment		
Civil servants	5	5.6
Self-employed	29	32.6
Not Working	9	10.1
Labor	2	2.2
Mother of the household	44	49.4
Education		
No school	6	6.7
Elementary school	23	25.8
Middle school	10	11.2
High school	47	52.8
University	3	3.4
Duration of Diabetes Mellitus		
0-5 years	18	20.2
6-10 years	58	65.2
> 10 years	13	14.6

Source: Primary data 2024

According to Table 1, the study revealed that the majority of participants were female, with 67 individuals (75.3%). The study reveals that the majority of respondents, comprising 45 individuals (50.6%), fall within the age bracket of above 60 years. According to the occupational category, the study reveals that the largest proportion of respondents, comprising 44 individuals (49.4%), are employed as Mothers of the household. According to the data pertaining to the education category, it is evident that a significant proportion of participants possess a high school education, comprising 47 respondents (52.8%). Moreover, according to the duration of Diabetes Mellitus, it is evident that the majority of participants in this study have experienced Diabetes Mellitus for a period ranging from 6 to 10 years, comprising a total of 58 individuals (65.2%).

Table 2 Description of Research Variables (n=89)

Variables	Frequency	%
Body Mass Index		
Underweight (<18.5)	3	3.4
Normal (18.5–22.9)	39	43.8
Overweight (23.0–24.9)	25	28.1
Obesity (>25.0)	22	24.7
Diabetic Neuropathy		
No Diabetic Neuropathy	10	11.2
Diabetic Neuropathy	79	88.8

Source: Primary data 2024

According to the data presented in Table 2, it can be observed that a significant proportion of participants in this study fell inside the normal body mass index category, with 39 respondents (43.8). According to the findings of this study, a significant proportion of individuals diagnosed with diabetes mellitus, specifically 79 patients (88.8%), exhibited the presence of diabetic neuropathy.

Table 3 The relationship between body mass index and the incidence of diabetic neuropathy in patients with diabetes mellitus at dr. Soehadi Prijonegoro Regional General Hospital, Sragen Regency

Body Mass Index	Diabetic Neuropathy				*P-value*
	No Diabetic Neuropathy		Diabetic Neuropathy		
	f	(%)	f	(%)	
Underweight	1	1.1	2	2.2	
Normal	3	3.4	36	40.4	
Overweight	6	6.7	19	21.3	0.032
Obesity	0	0.0	22	24.7	
Total	10	11.2	79	88.2	

Source: Primary data 2024

The study reveals that the P-value obtained from the chi-square test is 0.032 ($P < 0.05$). Based on the findings, it can be inferred that a correlation exists between body mass index and the prevalence of diabetic neuropathy among individuals diagnosed with diabetes mellitus at dr. Soehadi Prijonegoro Regional General Hospital, located in Sragen Regency.

DISCUSSION

The Relationship Between Body Mass Index and the Incidence of Diabetic Neuropathy in Patients With Diabetes Mellitus

Diabetic neuropathy is a complication of diabetes mellitus which occurs due to damage to blood vessels and nerves, especially the legs, either directly due to high blood sugar, or due to decreased blood flow to the nerves. Nerve damage will cause sensory disturbances, the symptoms of which can include tingling, numbness, or pain (Febrinasari et al., 2020). The findings of the research indicate that a significant proportion of individuals diagnosed with diabetes mellitus who participated in this study were of the female gender. This is in line with

research conducted by Wu et al., (2021), study revealed that the majority of individuals with diabetic neuropathy were female. The elevated prevalence of diabetic neuropathy among women can be attributed to elevated levels of estrogen, which can impede the absorption of iodine, a crucial factor in the synthesis of nerve myelin. Diabetic neuropathy can be induced by this (Amelia et al., 2019).

Based on age characteristics, it is known that the majority of respondents in this study were > 60 years old. Age is one of the factors causing the emergence of various types of diseases. With advancing age, the organs in the body experience a decline in their functioning, particularly the capacity of pancreatic β-cells to generate insulin and other organs that also engage in compensatory mechanisms during prolonged hyperglycemia (Wulandari et al., 2020).

Explained that along with the aging process, the nervous system becomes increasingly vulnerable to metabolic stress that occurs continuously and due to degenerative processes that occur physiologically (Abdissa et al., 2020). Therefore, increasing age will increase the accumulation of cellular and molecular damage that occurs over time caused by chronic hyperglycemia, such as axonal damage or nerve demyelination which can lead to increased development of sensory diabetic neuropathy (Amelia et al., 2019; Quiroz-Aldave et al., 2023; Feldman et al., 2019).

Based on the identified employment characteristics, it is evident that a significant proportion of participants in this study are employed in the role of a mother of the household. This study's findings align with the outcomes of previous studies undertaken by (Pratama et al., 2023), that stated that the majority of people with Diabetes Mellitus are housewives. The habit carried out by women, especially mother of the household, is the habit of tasting food. The habit of tasting food will affect adherence to the patient's diet program, seen from the number of calories that are not adhered to, or the meal schedule and if these habits cannot be controlled, this can affect the patient's blood glucose levels (Micarelli et al., 2021; Nanjar et al., 2023).

The survey findings indicate that a significant proportion of participants have a high school education, as evidenced by their educational qualities. The level of education is a significant determinant that impacts persons' utilization of health services. The utilization of health services is influenced by an individual's educational standing, as it directly impacts their awareness and knowledge regarding health. Specifically, individuals with lower levels of education and information are more susceptible to experiencing difficulties associated with certain diseases (Hakim, 2018). The results of this research are in line with research conducted

by Kumar et al., (2023) which found that the majority of type 2 DM sufferers in Kujangsari Kota Village, Bandung had a high school education level.

The findings of this study indicate that a significant proportion of participants had a duration of diabetes mellitus (DM) ranging from 6 to 10 years. There is a positive correlation between the duration of diabetes and the likelihood of experiencing problems and the occurrence of diabetic neuropathy (Mildawati et al., 2019). The longer a person experiences diabetes mellitus, the greater the risk of complications that will arise, one of which is diabetic neuropathy (Cahyono et al., 2019).

According to the body mass index classification, it is evident that a significant proportion of participants in this research exhibit a body mass index within the normal range. While a significant proportion of participants in this study have a normal body mass index, there is minimal disparity between those with excess body mass index and obesity compared to those with a normal body mass index.

Body mass index (BMI) serves as a predictor of disease susceptibility. There is a positive correlation between body mass index and the susceptibility to various diseases. Overweight and obesity are frequently linked to a range of prevalent health disorders, such as premature mortality, cardiovascular ailments, hypertension, osteoarthritis, malignancies, and diabetes (Lin et al., 2021; Powell-Wiley et al., 2021)

The findings of this study additionally revealed that a significant proportion of individuals diagnosed with diabetes mellitus who participated as respondents in this investigation exhibited symptoms of diabetic neuropathy. Diabetic neuropathy is a pathological condition characterized by the impaired transmission of neural signals between the brain and spinal cord, resulting in symptoms such as pain, sensory impairment, and impaired motor control. Symptoms of neuropathic diabetic pain include intermittent or continuous burning, prickling, tingling and numbness, hot, cold or itchy sensations. Symptoms develop in a distal to proximal distribution, generally starting from the feet (Rachmantoko et al., 2021). In addition, diabetic neuropathy is a microvascular complication due to nerve disorders caused by persistent increases in blood sugar and is experienced by 50% of type 2 diabetes mellitus patients (Khawaja et al., 2018).

Based on the results of this study, there is a significant relationship between body mass index and the incidence of diabetic neuropathy in patients with diabetes mellitus at dr. Soehadi Prijonegoro Regional General Hospital, Sragen Regency. Excess weight ≥ 20% of ideal body weight or body mass index can cause a reduction in the number of insulin receptors that work on cells in skeletal muscle and fat tissue.

Research Aprian et al., (2021), found that in the group of respondents who had an excess body mass index showed an increase in the risk of diabetic neuropathy almost 5 times higher than the thin and normal body mass index. The results of this study are in line with the results of research conducted by Kadri et al., (2021), who found that there was a significant relationship between body mass index and neuropathy symptoms in patients with diabetes mellitus (p-value=0.022).

This is due to peripheral insulin resistance which can result in atherosclerosis resulting in impaired blood circulation in the legs which can cause diabetic feet (Gau et al., 2019). The findings of this study are consistent with the outcomes of previous research endeavors by Oh et al., (2019) which found that there was a significant relationship between body mass index and neuropathy symptoms in diabetes mellitus sufferers.

Individuals diagnosed with diabetes mellitus are prone to experiencing tissue damage as a result of persistent and unregulated blood glucose levels. This phenomenon occurs due to compromised functionality and structural alterations in their blood arteries, resulting in inadequate blood perfusion to peripheral tissues. Furthermore, extended periods of increased blood glucose levels result in harm to numerous other tissues. This condition may manifest as poor cardiovascular reflexes, impaired bladder regulation, diminished sensation in the limbs, and other symptoms attributed to nerve injury (Dilworth et al., 2021).

CONCLUSIONS

The study findings indicate a statistically significant correlation between body mass index and the prevalence of diabetic neuropathy among individuals diagnosed with diabetes mellitus at dr. Soehadi Prijonegoro Regional General Hospital, located in Sragen Regency.

It is expected that patients have the awareness to maintain health by routinely implementing a healthier lifestyle and more regularly checking blood sugar levels periodically to reduce the risk of diabetic neuropathy complications. and it is expected that health practitioners will socialize to the public, especially people with diabetes mellitus, about the importance of checking blood sugar levels regularly so that the risk of diabetic neuropathy complications can decrease.

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