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Research Article

Association of Body Mass Index and Paresthesia Symptoms with the Duration of Type 2 Diabetes Mellitus at Ardhito Medika Clinic, Bandar Lampung, 2025

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Abstract

Diabetic peripheral neuropathy is one of the most common chronic complications of type 2 diabetes mellitus (T2DM), with prolonged hyperglycemia and obesity recognized as major contributing factors. However, evidence regarding the relationship between body mass index (BMI), paresthesia, and diabetes duration among Indonesian patients remains limited. This study aimed to determine the association between BMI, paresthesia symptoms, and the duration of T2DM at Ardhito Medika Clinic, Bandar Lampung. A retrospective cross-sectional study was conducted using secondary data from electronic medical records of 62 patients with T2DM, including 31 patients with paresthesia and 31 without paresthesia. BMI was categorized as normal or overweight according to the WHO Asian classification, while diabetes duration was classified as ≤6 months or >6 months. Associations were analyzed using the Pearson chi-square test with odds ratios (ORs) and 95% confidence intervals (CIs). Paresthesia was significantly associated with diabetes duration ($p < 0.001$; OR = 4.145; 95% CI: 2.322–7.400). BMI was also significantly associated with diabetes duration ($p = 0.020$; OR = 3.500; 95% CI: 1.190–10.293). Longer diabetes duration was associated with paresthesia, whereas overweight BMI was associated with prolonged diabetes duration, highlighting the importance of early weight management and routine neuropathy screening.

Keywords: type 2 diabetes mellitus; body mass index; paresthesia; diabetic peripheral neuropathy; diabetes duration.

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1 Introduction

Diabetes mellitus (DM) continues to represent one of the most pressing global health challenges because of its rapidly increasing prevalence and its substantial contribution to premature mortality, disability, and healthcare expenditure worldwide [1]. Recent estimates from the Global Burden of Disease Study indicate that approximately 529 million people were living with diabetes in 2021, of whom nearly 96% were diagnosed with type 2 diabetes mellitus (T2DM). This burden is expected to increase dramatically, reaching more than 1.3 billion individuals by 2050 [1]. The expanding prevalence of T2DM has intensified concern not only because of its metabolic consequences but also because of the wide range of chronic complications that progressively impair quality of life and increase demands on healthcare systems [2]. Among the major modifiable determinants of T2DM, excess body weight remains one of the strongest contributors, accounting for a substantial proportion of diabetes-related disability and mortality worldwide [1], [3], [4]. The pathophysiological effects of obesity extend beyond abnormal glucose metabolism and include insulin resistance, chronic low-grade inflammation, endothelial dysfunction, and multiple metabolic disturbances that accelerate disease progression [5].

Diabetic peripheral neuropathy (DPN) is one of the most prevalent long-term complications of T2DM and represents a major source of morbidity among affected individuals [6], [7]. Previous evidence suggests that nearly half of all patients with diabetes may eventually develop peripheral neuropathy, although prevalence varies according to disease duration, glycemic control, and patient characteristics [7], [8]. Neuropathy may already be detectable during the early stages of T2DM, while its frequency increases considerably after several years of persistent hyperglycemia [7]. A nationwide study involving more than 14,000 Chinese patients reported that DPN affected approximately two-thirds of individuals with T2DM and was particularly common among older adults, women, and patients with longer disease duration [9]. Clinically, DPN manifests as numbness, tingling sensations, pain, and sensory impairment that may progress to foot ulceration, lower-extremity amputation, impaired mobility, recurrent falls, and substantial reductions in health-related quality of life [7], [10].

Current evidence indicates that the development of DPN is driven by a complex interaction of metabolic and vascular abnormalities rather than chronic hyperglycemia alone. Oxidative stress, persistent inflammation, dyslipidemia, insulin resistance, mitochondrial dysfunction, and impaired microvascular circulation collectively contribute to progressive peripheral nerve injury [7], [10]. Consequently, optimal glycemic control alone may not adequately prevent neuropathy, emphasizing the importance of identifying additional modifiable risk factors. Obesity has consistently been recognized as one such factor, with numerous studies demonstrating that individuals with elevated body mass index (BMI) have a greater likelihood of developing diabetic neuropathy than those with normal body weight [11]. Likewise, fluctuations in BMI and central adiposity have also been linked to an increased incidence of diabetic microvascular complications [12].

Despite accumulating evidence, the relationship between BMI and diabetic peripheral neuropathy remains incompletely understood. While several investigations have identified obesity as an independent predictor of neuropathy [11], [12], other studies conducted in Asian populations have reported inconsistent findings after adjustment for demographic and metabolic variables [9]. In Indonesia, Fadlilah et al. demonstrated that BMI, blood pressure, glycemic status, HbA1c, and ankle-brachial index were significantly associated with peripheral neuropathy among patients with T2DM [13]. These discrepancies suggest that ethnic background, body fat distribution, and metabolic heterogeneity may influence the association between obesity and neuropathic complications, highlighting the need for additional evidence from diverse populations [10].

Considering the increasing burden of T2DM and the clinical significance of diabetic peripheral neuropathy, identifying factors associated with paresthesia has become increasingly important for early intervention. However, studies simultaneously evaluating body mass index, paresthesia symptoms, and diabetes duration among Indonesian patients remain limited. Therefore, the present study aimed to examine the association between BMI, paresthesia symptoms, and the duration of type 2 diabetes mellitus among patients attending Ardhito Medika Clinic, Bandar Lampung. The findings are expected to provide

Doi: 10.30872/jtpc.v10i2.418

additional evidence supporting early identification of patients at increased risk of diabetic peripheral neuropathy and to contribute to strategies for preventing diabetes-related neurological complications.

2 Method

2.1 Study Design and Setting

This study employed an analytical observational approach using a retrospective cross-sectional design to evaluate the association between body mass index (BMI), duration of type 2 diabetes mellitus (T2DM), and the presence of paresthesia. The investigation was conducted at Ardhito Medika Clinic, Bandar Lampung, Indonesia, utilizing routinely collected electronic medical records of patients who received outpatient care between January and December 2025.

2.2 Study Population and Participant Selection

The source population consisted of all patients diagnosed with T2DM who attended the clinic during the study period (n = 87). Participants were recruited using purposive sampling based on predefined eligibility criteria. After screening the medical records, 62 patients fulfilled all inclusion criteria and were included in the final analysis. The study population comprised two equal groups: 31 patients diagnosed with paresthesia and 31 patients without documented paresthesia. Patients were eligible if they had a confirmed diagnosis of T2DM, an HbA1c level of at least 6.5%, had received antidiabetic therapy for a minimum of three months, possessed complete clinical records during the study period, and had documented information regarding BMI, diabetes duration, HbA1c level, and neurological status. Records were excluded when essential clinical information was incomplete or when patients had medical conditions capable of causing peripheral neuropathy independently of diabetes, including cerebrovascular disease, traumatic nerve injury, alcohol-related neuropathy, or autoimmune neurological disorders.

2.3 Variables and Operational Definitions

The primary variables included BMI, duration of T2DM, and paresthesia status. Body mass index was calculated from recorded body weight and height and categorized according to the World Health Organization recommendations for Asian populations into normal weight (18.5–22.9 kg/m²) and overweight (23.0–24.9 kg/m²). Diabetes duration was classified into two categories (≤6 months and >6 months) according to the information available in the medical records. Paresthesia status was determined from physician-documented clinical diagnoses recorded in the electronic medical record system and categorized as either present or absent.

2.4 Data Collection

Patient information was extracted from electronic medical records using a standardized data extraction sheet to ensure consistency during data collection. Demographic characteristics, anthropometric measurements, laboratory findings, duration of diabetes, and neurological status were reviewed and recorded. Before statistical analysis, all datasets underwent verification, coding, data entry, and cleaning procedures to identify missing values and minimize potential recording errors.

2.5 Statistical Analysis

Data analysis was performed using IBM SPSS Statistics version 26 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize participant characteristics, with categorical variables presented as frequencies and percentages. Associations between categorical variables were evaluated using Pearson's chi-square test. Crude odds ratios (ORs) together with 95% confidence intervals (95% CIs) were calculated to quantify the strength of the observed associations. Statistical significance was defined as a two-tailed p-value of less than 0.05.

3 Result and Discussion

A total of 62 patients with type 2 diabetes mellitus met the study inclusion criteria, consisting of 31 patients with paresthesia symptoms and 31 patients without paresthesia symptoms. Respondent characteristics based on age, sex, body mass index (BMI), and duration of diabetes mellitus are presented in Table 1. Based on age, the majority of respondents were in the 40–65 years age group, comprising 47

Doi: 10.30872/jtpc.v10i2.418

patients (75.8%), while 13 patients (21.0%) were older than 65 years and only 2 patients (3.2%) were younger than 40 years. Among patients with paresthesia, 21 (67.7%) were aged 40–65 years, whereas 26 patients (83.9%) without paresthesia were in the same age group. All respondents younger than 40 years experienced paresthesia; however, the number was too small to represent the overall population trend.

Regarding sex, female respondents slightly outnumbered males, accounting for 34 patients (54.8%) and 28 patients (45.2%), respectively. Among patients with paresthesia, 18 (58.1%) were female and 13 (41.9%) were male, whereas the distribution of males and females was relatively balanced in the non-paresthesia group.

The BMI distribution showed that the overweight category was the most prevalent, including 36 patients (58.1%), while 26 patients (41.9%) had a normal BMI. Among respondents aged 40–65 years, 28 were classified as overweight and 19 had a normal BMI.

Based on the duration of diabetes mellitus, most respondents had been living with diabetes for more than six months (39 patients; 62.9%), whereas 23 patients (37.1%) had a disease duration of six months or less. The 40–65 years age group predominated in both duration categories.

Table 1 Characteristics of respondents according to age, sex, paresthesia status, body mass index, and duration of diabetes mellitus (n = 62)

Variable	Category	Paresthesia Yes, n	Paresthesia No, n	Normal BMI, n	Overweight BMI, n	DM Duration ≤6 months, n	DM Duration >6 months, n
Age (years)	<40	2	0	1	1	1	1
	40–65	21	26	19	28	14	33
	>65	8	5	6	7	8	5
	Total	31	31	26	36	23	39
Sex	Male	13	15	10	18	6	22
	Female	18	16	16	18	17	17
	Total	31	31	26	36	23	39

The present study found that most respondents were aged 40–65 years (75.8%). This age group predominated in both the paresthesia and non-paresthesia groups, indicating that type 2 diabetes mellitus in this study primarily affected middle-aged and older adults. This finding is consistent with Mao et al., who reported that age is an independent risk factor for diabetic peripheral neuropathy (DPN), with the risk increasing as a result of age-related degenerative changes and prolonged exposure to chronic hyperglycemia [14]. Similarly, Popescu et al. found that patients with diabetic neuropathy were generally older than those without neuropathy [15].

Studies conducted in Indonesia have reported similar findings. Mawaddah et al. observed that most patients with diabetic neuropathy were aged 46–55 years [16], while Nistiandani et al. and Irwansyah et al. reported that middle-aged and early elderly adults constituted the largest proportion of patients with diabetic neuropathy [17], [18]. Therefore, the age distribution observed in this study is consistent with previous evidence indicating that increasing age is associated with a higher risk of neuropathic complications due to microvascular alterations, oxidative stress, and reduced peripheral nerve regenerative capacity [19].

The present study demonstrated that 58.1% of respondents were classified as overweight, exceeding the proportion of respondents with normal BMI (41.9%). Furthermore, among respondents aged 40–65 years, overweight individuals outnumbered those with normal BMI. These findings indicate that excess body weight remains a predominant characteristic of patients with type 2 diabetes mellitus attending the study clinic.

These findings are consistent with Astuti et al., who reported that nearly half of patients with type 2 diabetes mellitus were overweight and that BMI was significantly associated with diabetic peripheral neuropathy [20]. Aktifah et al. also found that most patients with diabetic neuropathy were classified as

Doi: 10.30872/jtpc.v10i2.418

overweight and that higher BMI was associated with increased diabetic neuropathy scores [21]. This relationship is further supported by Johnson et al., who suggested that obesity contributes to insulin resistance, chronic inflammation, microvascular dysfunction, and impaired perfusion of the *vasa nervorum*, thereby accelerating peripheral nerve damage in patients with diabetes [19]. Therefore, the predominance of overweight individuals in the present study highlights the importance of body weight management as part of strategies to prevent neuropathic complications.

Most respondents in the present study had been diagnosed with diabetes mellitus for more than six months (62.9%). This finding indicates that the majority of patients had experienced prolonged exposure to hyperglycemia before the assessment of paresthesia symptoms.

The present findings are in agreement with Munandar, who reported that a longer duration of diabetes is associated with an increased risk of diabetic neuropathy [22]. Likewise, Irwansyah et al. demonstrated a significant association between diabetes duration and the occurrence of peripheral neuropathy [18], while Astuti et al. identified diabetes duration as one of the significant factors associated with diabetic neuropathy [20]. However, Sabari et al. did not observe a statistically significant relationship between diabetes duration and peripheral neuropathy, although neuropathy remained more prevalent among patients with longer disease duration [23]. These discrepancies may be attributable to differences in sample characteristics, sample size, and the duration thresholds used across studies. Overall, the respondents in this study were predominantly characterized by an age of 40–65 years, overweight BMI, and a diabetes duration exceeding six months, reflecting the profile of patients with type 2 diabetes mellitus who may be at increased risk of developing peripheral neuropathic complications.

Table 2 Association between paresthesia and duration of diabetes mellitus

Paresthesia	≤6 Months, n (%)	>6 Months, n (%)	Total n (%)	*p*-value	OR (95% CI)
Yes	1 (3.2)	30 (96.8)	31 (100.0)	<0.001	4.145 (2.322–7.400)
No	22 (70.9)	9 (29.1)	31 (100.0)		
Total	23	39	62		

The present study demonstrated that paresthesia was predominantly observed among patients with a diabetes duration exceeding 6 months, whereas most patients without paresthesia had been diagnosed with diabetes for 6 months or less. These findings indicate that prolonged disease duration is significantly associated with the occurrence of paresthesia in patients with T2DM. The observed association suggests that longer exposure to chronic hyperglycemia may progressively increase the risk of peripheral nerve dysfunction.

These findings are consistent with those reported by Aghniya, who found that the prevalence of diabetic peripheral neuropathy (DPN) increased significantly with longer diabetes duration among patients with T2DM [24]. Similarly, Karki et al. reported a significant increase in peripheral neuropathy among patients with a longer duration of diabetes, particularly in those with disease duration exceeding five years [25]. Akter et al. also identified prolonged diabetes duration as one of the major risk factors for peripheral neuropathy in patients with T2DM [26].

The present findings are further supported by the retrospective cohort study conducted by Chew et al., which identified diabetes duration as an independent predictor of incident DPN after adjustment for demographic, lifestyle, and clinical factors [27]. Likewise, Zhong et al. demonstrated that patients with a longer duration of diabetes experienced poorer neurological outcomes, indicating that prolonged diabetes not only increases the likelihood of neuropathy but also adversely affects disease progression [28]. Furthermore, Mazhar et al. reported a positive association between diabetes duration and peripheral neuropathy among patients with T2DM [29].

From a pathophysiological perspective, prolonged exposure to hyperglycemia promotes activation of the polyol pathway, excessive formation of advanced glycation end products (AGEs), oxidative stress,

Doi: 10.30872/jtpc.v10i2.418

chronic inflammation, and microvascular dysfunction affecting the vasa nervorum. These mechanisms progressively damage peripheral nerve fibers, ultimately leading to sensory disturbances such as paresthesia [19]. Therefore, the significant association observed in the present study highlights the importance of early neuropathy screening and routine neurological assessment in patients with increasing diabetes duration to facilitate timely intervention and prevent further diabetic neuropathic complications.

Table 3 Association between body mass index and duration of diabetes mellitus

Body Mass Index	≤6 Months, n (%)	>6 Months, n (%)	Total, n (%)	*p*-value	OR (95% CI)
Normal	14 (53.8)	12 (46.2)	26 (100.0)	0.020	3.500 (1.190–10.293)
Overweight	9 (25.0)	27 (75.0)	36 (100.0)		
Total	23	39	62		

Table 3 shows that among the 26 patients with a normal body mass index (BMI), 14 patients (53.8%) had a duration of diabetes mellitus (DM) of ≤6 months, whereas 12 patients (46.2%) had a disease duration of >6 months. In contrast, among the 36 patients classified as overweight, the majority (27 patients; 75.0%) had a diabetes duration of >6 months, while only 9 patients (25.0%) had been diagnosed with DM for ≤6 months. The Chi-square test demonstrated a statistically significant association between BMI and the duration of diabetes mellitus ($p = 0.020$). The odds ratio (OR = 3.500; 95% CI: 1.190–10.293) indicates that patients with an overweight BMI were approximately 3.5 times more likely to have had diabetes mellitus for more than six months than those with a normal BMI.

The present findings are consistent with those reported by Tomić et al., who demonstrated that increasing BMI was associated with worsening metabolic parameters, including higher HbA1c levels, elevated blood pressure, and increased low-density lipoprotein (LDL) cholesterol, as well as a higher prevalence of microvascular complications, particularly diabetic neuropathy [30]. These findings suggest that obesity not only contributes to the development of type 2 diabetes mellitus but also accelerates disease progression, thereby increasing the likelihood of chronic complications among patients with longer disease duration.

This finding is further supported by Ubaid et al., who reported that BMI and diabetes duration are closely related risk factors for the development of microvascular complications. Their multivariable analysis identified BMI, HbA1c, and diabetes duration as independent predictors of diabetic complications, indicating that overweight individuals are more likely to experience a prolonged disease course accompanied by a greater risk of diabetes-related complications [31].

In the Indonesian population, the present findings are consistent with the study by Nurhaliza et al., which reported that most patients with type 2 diabetes mellitus and diabetic polyneuropathy sought medical care after prolonged exposure to metabolic disturbances. Similarly, Ong reported that the majority of Indonesian patients with type 2 diabetes mellitus had lived with the disease for five years or longer, with most exhibiting poor glycemic control, while diabetic neuropathy was the most frequently reported microvascular complication [32], [33]. Together, these findings suggest that longer diabetes duration is commonly accompanied by excess body weight and persistent metabolic abnormalities that contribute to disease progression.

From a biological perspective, the association between overweight BMI and prolonged diabetes duration may be explained by increased insulin resistance, which promotes persistent hyperglycemia. Excess adipose tissue releases pro-inflammatory cytokines, enhances oxidative stress, and aggravates endothelial dysfunction, making long-term glycemic control increasingly difficult as the disease progresses. Studies by Jaya et al., Baxi et al., and Rai et al. have consistently demonstrated that elevated BMI, poor glycemic control, and longer diabetes duration interact to increase the risk of diabetic peripheral neuropathy [34]–[36].

Doi: 10.30872/jtpc.v10i2.418

Clinically, these findings highlight the importance of implementing weight management interventions immediately after the diagnosis of type 2 diabetes mellitus. The predominance of overweight patients among those with a diabetes duration of more than six months suggests that lifestyle modification, weight reduction, regular physical activity, and comprehensive metabolic risk management initiated during the early stage of the disease may help slow diabetes progression and reduce the subsequent risk of diabetic neuropathic complications [30], [31].

This study has several limitations that should be considered when interpreting the findings. First, this study relied on secondary data obtained from electronic medical records (EMRs). Consequently, the available information was limited to routinely documented clinical data, and no direct patient interviews or clinical examinations could be conducted to verify medical history, lifestyle factors, treatment adherence, or the characteristics and severity of paresthesia symptoms. This may have introduced information bias due to incomplete or unrecorded clinical information.

Second, the duration of type 2 diabetes mellitus was categorized according to the classification available in the electronic medical record system (≤6 months and >6 months). As a result, the actual duration of diabetes could not be determined more precisely. This categorization does not fully reflect the natural history of diabetic peripheral neuropathy, which typically develops after several years of chronic hyperglycemia, commonly after more than five to six years of disease duration. Therefore, the observed association between diabetes duration and paresthesia should be interpreted with caution, as the available classification may have underestimated the cumulative effect of long-term diabetes on peripheral nerve damage.

Finally, this study employed a cross-sectional design with a relatively small sample size from a single healthcare facility, limiting the ability to establish causal relationships and reducing the generalizability of the findings to broader populations. Future studies should consider prospective or longitudinal designs, include larger multicenter populations, and use more detailed measurements of diabetes duration (e.g., years since diagnosis) together with standardized assessments of diabetic peripheral neuropathy to provide more robust evidence.

4 Conclusion

The present study demonstrated that both the duration of type 2 diabetes mellitus and body mass index were significantly associated with clinical outcomes among patients treated at Ardhito Medika Clinic, Bandar Lampung. Individuals with a longer duration of diabetes were more likely to experience paresthesia, suggesting that prolonged exposure to metabolic abnormalities may contribute to the development of peripheral nerve dysfunction. In addition, patients classified as overweight were more frequently observed among those with a longer duration of diabetes, indicating that excess body weight remains an important metabolic characteristic in the progression of T2DM.

These findings reinforce the importance of integrating weight management, continuous metabolic monitoring, and routine neurological evaluation into the long-term management of patients with T2DM. Early identification of individuals at increased risk of diabetic peripheral neuropathy may facilitate timely preventive interventions and reduce the likelihood of chronic neurological complications.

Nevertheless, the interpretation of these findings should consider several methodological limitations, including the retrospective cross-sectional design, the relatively small sample size, the use of secondary medical record data, and the simplified categorization of diabetes duration. Future multicenter studies with larger and more diverse populations, prospective follow-up, and standardized assessments of diabetic peripheral neuropathy are recommended to validate these findings and provide stronger evidence regarding the temporal relationship between obesity, diabetes duration, and peripheral neuropathy.

5 Declarations

5.1 Acknowledgements

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5.2 Author Contributions

V.S.: Conceptualization, methodology, data collection, formal analysis, investigation, and writing original draft.
F.L.M.: Supervision, methodology, validation, and writing, review and editing.
M.H.: Supervision, methodology, validation, and writing, review and editing.
R.A.N.A.: Clinical supervision, data acquisition, validation, and writing, review and editing.
All authors have read and approved the final version of the manuscript.

5.3 Ethics

This study was approved by the Health Research Ethics Committee of Universitas Malahayati, Indonesia (Ethical Clearance No. 5321/EC-KEP-UNMAL/IV/2026).

5.4 Conflict of Interest

The people who wrote this piece say that they have no conflicts of interest with publishing it.

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