Original Article

Factors associated with the occurrence of diabetic peripheral neuropathy in individuals with type 2 diabetes mellitus

Fatores associados à ocorrência da neuropatia periférica diabética em pessoas com diabetes mellitus tipo 2

Debora Ellen Sousa Costa[1]
Lívia Maia Pascoal[1]
Marcelino Santos Neto[1]
Jairo Domingos de Morais[2]
Yan Torres Andrade[1]
Ana Clara Laundos Oliveira[1]
Barbara dos Santos Limeira[1]

[1]Universidade Federal do Maranhão.
Imperatriz, MA, Brazil.
[2]Universidade da Integração Internacional da Lusofonia Afro-Brasileira. Redenção, CE, Brazil.

Corresponding author:
Debora Ellen Sousa Costa
Universidade Federal do Maranhão, Av. da Universidade, S/N, Dom Afonso Felipe Gregory, CEP: 65915-240.
Imperatriz, MA, Brazil.
E-mail: debora.sousa@ufma.br

Conflict of interest: the authors have declared that there is no conflict of interest.

EDITOR IN CHIEF: Ana Fatima Carvalho Fernandes
ASSOCIATE EDITOR: Jéssica de Castro Santos

ABSTRACT

Objective: to identify factors associated with diabetic peripheral neuropathy in individuals with type 2 diabetes mellitus. **Methods:** cross-sectional study conducted with 123 users followed up in a Primary Health Care Unit. Multiple Poisson regression with robust variance and Spearman correlation were used to analyze associated factors. **Results:** the prevalence of diabetic peripheral neuropathy was 44.7%. The occurrence of this complication showed a statistically significant association with marital status—married/stable union (p=0.048) and widowed (p=0.015), incomplete secondary education (p=0.030), presence of neuropathic pain (p=0.001) or indeterminate pain (p=0.001), duration of diabetes diagnosis between five and 10 years (p=0.031), and longer than 10 years (p=0.001). **Conclusion:** sociodemographic and clinical factors directly influenced the occurrence of diabetic peripheral neuropathy. **Contributions to practice:** these findings reinforce the relevance of Primary Health Care in screening and managing neuropathy, highlighting the nurse's role in prevention, health education, clinical surveillance, and continuous follow-up.
Descriptors: Diabetic Neuropathies; Primary Health Care; Diabetes Mellitus, Type 2; Risk Factors.

RESUMO

Objetivo: identificar fatores associados à ocorrência da neuropatia periférica diabética em pessoas com diabetes mellitus tipo 2. **Métodos:** estudo transversal realizado com 123 usuários acompanhados em uma Unidade Básica de Saúde. Para análise dos fatores associados, aplicou-se regressão múltipla de Poisson com variância robusta e coeficiente de Spearman para correlação. **Resultados:** a prevalência de neuropatia periférica diabética foi de 44,7%. A ocorrência da complicação apresentou associação estatisticamente significativa com o estado civil casado/união estável (p=0,048) e viúvo (p=0,015), ensino médio incompleto (p=0,030), presença de dor neuropática (p=0,001) ou dor indeterminada (p=0,001), tempo de diagnóstico do diabetes entre cinco e 10 anos (p=0,031) e superior a 10 anos (p=0,001). **Conclusão:** fatores sociodemográficos e clínicos influenciaram diretamente a ocorrência da neuropatia periférica diabética. **Contribuições para a prática:** esses achados reforçam a relevância da Atenção Primária no rastreamento e manejo da neuropatia, destacando a atuação do enfermeiro na prevenção, educação em saúde, vigilância clínica e acompanhamento contínuo.
Descritores: Neuropatias Diabéticas; Atenção Primária à Saúde; Diabetes Mellitus Tipo 2; Fatores de Risco.

Introduction

Diabetic peripheral neuropathy is a chronic complication related to diabetes mellitus (DM), defined by progressive impairment of nerve fibers, mainly in the distal regions of the lower limbs, showing a symmetric and bilateral pattern[1]. Nearly half of the cases remain asymptomatic for long periods, leading to late diagnosis and a higher incidence of plantar ulcers and non-traumatic amputations among individuals with the disease[2]. Its manifestations range from mild symptoms such as numbness, tingling, and fatigue to severe ones, including burning pain, hyperalgesia, allodynia, paresthesia, and nocturnal sensory disturbances. Neurological assessment is therefore recommended from the diagnosis of type 2 diabetes mellitus (DM2) and at annual intervals[3].

In Primary Health Care, continuous monitoring of individuals with DM2 promotes the screening of diabetic peripheral neuropathy and its associated factors, as well as timely adoption of preventive and therapeutic interventions[4]. Factors including inadequate glycemic control, dyslipidemias, arterial hypertension, overweight, smoking, duration of DM, and presence of other complications such as diabetic retinopathy and nephropathy[3], have been linked to the occurrence and progression of this condition.

Identifying modifiable factors is essential, considering that this complication contributes to increased morbidity through outcomes such as higher pain intensity, sleep disorders, and altered plantar sensitivity, which affect mental health and vitality among those affected[5]. Within this context, educational interventions conducted by nurses have proven effective, improving patients' understanding regarding DM, its complications, and foot care, resulting in better adherence to self-care practices and behavioral change[6].

Despite the clinical and epidemiological relevance of diabetic peripheral neuropathy, scientific production remains limited regarding investigations conducted within Primary Health Care settings in Northeastern Brazilian states, a region historically marked by socioeconomic inequalities and structural challenges in organizing care for individuals with DM[7]. Moreover, few recent Brazilian studies have analyzed in an integrated manner sociodemographic, clinical, and behavioral factors related to diabetic peripheral neuropathy in this level of care[8].

The scarcity of evidence becomes even more evident given the lack of analytical approaches that jointly consider social determinants of health, clinical conditions, and care-related behaviors, especially among vulnerable populations. As a result, gaps persist in identifying groups at higher risk for developing this condition and in guiding more accurate and context-specific care practices.

Thus, given that diabetic peripheral neuropathy is associated with increased risk for ulcers and non-traumatic amputations, decreased functionality, intensification of chronic pain, impaired quality of life, and greater psychosocial vulnerability among individuals with DM2, identifying factors associated with its occurrence becomes relevant. Such identification may guide nursing practice, facilitate early recognition of individuals at higher risk, and inform the planning of educational actions. Furthermore, it contributes to organizing care, improving clinical protocols, and preventing adverse outcomes related to disease progression. Within this framework, this study aimed to identify factors associated with diabetic peripheral neuropathy in individuals with type 2 diabetes mellitus.

Methods

Research design

Cross-sectional study conducted in a Primary Health Care Unit located in the city of Imperatriz, Maranhão. The study followed recommendations from the Strengthening the Reporting in Observational Studies in Epidemiology (STROBE) statement for observational research reports.

Population, sample and eligibility criteria

The sample included individuals with a medical diagnosis of type 2 DM, aged 18 years or older, under clinical follow-up in the Primary Health Care Unit where the study was performed. Participants with cognitive impairment were excluded, assessed through the Mini-Mental State Examination (MMSE), with scores adjusted for schooling level[9].

Based on data from e-SUS – Sistema Único de Saúde, there were 10,590 individuals with a diagnosis of DM2 registered and under follow-up in the municipality[10]. This number was adopted as the finite population (N) for sample size calculation. Considering a 95% confidence interval (CI) (Z=1.96), expected proportion for the phenomenon of 75%[11] (p=0.75; q=0.25), and a sampling error of 7.61% (d=0.0761), sample size was estimated at 123 participants.

Sample recruitment

With support from nurses and Community Health Workers in the Primary Health Care Unit, active telephone outreach was conducted among 661 individuals with DM2 linked to four Family Health Strategy teams, together with in-person invitations in the waiting room for nursing and medical appointments. However, due to operational limitations, such as unsuccessful calls and incorrect telephone records, initial contact was possible with 419 individuals. After this first contact and presentation of study objectives, 242 individuals were invited to take part and were instructed to attend the Primary Health Care Unit at a previously scheduled date and time. Among them, 57 refused participation, mainly due to lack of available time, personal reasons, and lack of interest in the research. Thus, 185 individuals were scheduled, but 62 did not attend any meetings, even after subsequent rescheduling attempts. In the end, 123 individuals attended the Primary Health Care Unit and formed the final sample for the study.

Data collection

Data were collected between May and June 2024 by undergraduate nursing students from a Brazilian federal university. Interviews and clinical assessments took place in a private setting, within the Primary Health Care Unit. A structured instrument developed by the researchers was used to collect sociodemographic and clinical information. Validated instruments were applied to screen diabetic peripheral neuropathy and assess neuropathic pain[12-14]. Data collectors were previously trained regarding clinical assessment for individuals with DM and accurate completion of instruments.

Measuring instruments

For sociodemographic characterization, the following information was collected: age, gender, race/skin color, and monthly income. For clinical characterization, data were obtained on duration for type 2 DM diagnosis and history of previous ulcer in lower limbs. Furthermore, lifestyle habits were investigated, including alcohol consumption and dietary patterns.

Screening for diabetic peripheral neuropathy was carried out using the Michigan Neuropathy Screening Instrument (QMNSI), one of the instruments most used to investigate and screen neuropathy in individuals with DM. The QMNSI comprises two sections, in which section A includes 15 yes/no questions regarding sensations in the feet, and section B covers aspects of foot assessment related to inspection, vibratory sensation, deep tendon reflexes, and tactile sensitivity[12]. In this study, section A of the instrument was applied, and a score equal to or higher than four suggested presence of neuropathy[13].

Neuropathic pain was assessed with the Pain-DETECT Questionnaire, which includes four domains: pain intensity, pain course pattern, main painful areas/presence of radiating pain, and sensory descriptors for pain. Total score ranges from -1 to 38, where

scores ≤12 indicate unlikely neuropathic pain, scores between 13 and 18 indicate unclear neuropathic pain, and scores ≥19 suggest probable neuropathic pain[14].

Data analysis

Data were organized and tabulated in Microsoft Office Excel spreadsheets, and statistical tests were performed with SPSS version 20.0. Initially, absolute and relative frequencies were described. Next, the Kolmogorov-Smirnov normality test with Lilliefors correction was applied, which indicated nonparametric distribution for data ($p<0.05$).

Prevalence ratio (PR) with a 95% confidence interval, using Poisson regression, was applied to quantify crude and adjusted association between diabetic peripheral neuropathy and independent variables, as a recommended approach for outcomes with high prevalence in cross-sectional studies. Spearman correlation was used to measure the relationship between study variables and diabetic peripheral neuropathy, that is, the degree to which two variables change together and the strength and direction of this relationship. A p-value ≤0.05 was considered statistically significant in all analyses.

Ethical aspects

The Research Ethics Committee at the Federal University of Maranhão approved the study, in accordance with current guidelines in Resolutions 466/2012 and 510/2016, under opinion number 6,842,223/2024 and Certificate for Ethical Assessment Submission 77837324.0.0000.5087.

Results

Diabetic peripheral neuropathy was present among study participants with a prevalence of 44.7% (95% CI = 35.8–52.8). Among individuals with neuropathy, most were women (29.3%), married or in a stable union (25.2%), had incomplete primary schooling (16.3%), were older than 60 years (25.2%), self-identified as mixed race (29.3%), and had a monthly income up to one minimum wage (25.2%).

Regarding clinical information, most participants with diabetic peripheral neuropathy had a duration for DM diagnosis longer than ten years (20.5%). In addition, among those with neuropathy, 14.6% reported history of previous ulcer in lower limbs, and 5.7% presented neuropathic pain.

As for lifestyle habits, most respondents with neuropathy reported unrestricted diet (28.5%) and no alcohol intake (34.1%). These findings are presented in Table 1.

Table 1 – Sociodemographic and clinical characteristics and lifestyle habits among users with type 2 diabetes mellitus treated in Primary Health Care (n=123). Imperatriz, MA, Brazil, 2024

| Variables | Diabetic peripheral neuropathy | | |
	Present n (%)	Absent n (%)	Total n (%)
Gender			
Male	19 (15.4)	27 (22.0)	46 (37.4)
Female	36 (29.3)	41 (33.3)	77 (62.6)
Marital status			
Single	2 (1.6)	10 (8.1)	12 (9.8)
Married/Stable union	31 (25.2)	35 (28.5)	66 (53.7)
Widowed	11 (8.9)	11 (8.9)	22 (17.9)
Divorced/Separated	11 (8.9)	12 (9.8)	23 (18.7)
Schooling			
Illiterate	5 (4.1)	9 (7.3)	14 (11.4)
Incomplete Elementary School	20 (16.3)	23 (18.7)	43 (35.0)
Complete Elementary School	8 (6.5)	8 (6.5)	16 (13.0)
Incomplete High School	4 (3.3)	2 (1.6)	6 (4.9)
Complete High School	10 (8.1)	23 (18.7)	33 (26.8)
Incomplete Higher Education	1 (0.8)	1 (0.8)	2 (1.6)
Complete Higher Education	7 (5.7)	2 (1.6)	9 (7.3)
Age group (years old)			
≤ 60	24 (19.5)	31 (25.2)	55 (44.7)
> 60	31 (25.2)	37 (30.1)	68 (55.3)
Race/Skin color			
White	8 (6.5)	17 (13.8)	25 (20.3)
Black	7 (5.7)	10 (8.1)	17 (13.8)
Brown	36 (29.3)	38 (30.9)	74 (60.2)
Asian	4 (3.3)	3 (2.4)	7 (5.7)
Income (minimum wages)			
No	5 (4.1)	4 (3.3)	9 (7.3)
Up to 1	31 (25.2)	26 (21.1)	57 (46.3)
>1 - 2	11 (8.9)	17 (13.8)	28 (22.8)
>2 - 3	6 (4.9)	13 (10.6)	19 (15.4)
>4	2 (1.6)	7 (5.7)	9 (7.3)
Prefers not to answer	0 (0.0)	1 (0.8)	1 (0.8)
Previous ulcer in lower limbs			
Absent	37 (30.1)	58 (47.2)	95 (77.2)
Present	18 (14.6)	10 (8.1)	28 (22.8)
Neuropathic pain			
Absent	42 (34.1)	66 (53.7)	108 (87.8)
Present	7 (5.7)	0 (0.0)	7 (5.7)
Undetermined	6 (4.9)	2 (1.6)	8 (6.5)
Duration for diabetes diagnosis (years)			
< 5	11 (9.0)	32 (26.2)	43 (35.2)
5 - 10	18 (14.8)	21 (17.2)	39 (32.0)
> 10	25 (20.5)	15 (12.3)	40 (32.8)
Alcoholism			
Current drinker	3 (2.4)	10 (8.1)	13 (10.6)
Former drinker	10 (8.1)	21 (17.1)	31 (25.2)
Never drank	42 (34.1)	37 (30.1)	79 (64.2)
Unrestricted diet			
No	20 (16.3)	33 (26.8)	53 (43.1)
Yes	35 (28.5)	35 (28.5)	70 (56.9)

*Minimum wage in 2024: R$ 1,412.00

In Table 2, results from multiple analysis for study variables regarding occurrence of diabetic peripheral neuropathy in individuals with type 2 diabetes mellitus treated in Primary Health Care are presented. The prevalence ratio (PR) shows how much higher the frequency for diabetic peripheral neuropathy is in relation to the reference group within each variable. In relation to marital status, higher occurrence for this complication was found among those married or in a stable union and widowed, with significantly higher prevalence ratios than single participants as the reference group. Specifically, married/stable union participants showed a prevalence 3.3 times higher, and widowed ones showed a prevalence 4.8 times higher.

For schooling, a heterogeneous distribution across categories was observed. However, individuals with incomplete secondary education showed a prevalence nearly three times higher for this complication when compared with illiterate individuals (reference group), representing a marked association in this category.

For neuropathic pain, all cases with pain were concentrated exclusively among participants with diabetic peripheral neuropathy. PR, compared with the group without neuropathic pain (reference), indicated that presence of neuropathic pain was associated with a 78% higher prevalence for diabetic peripheral neuropathy. Furthermore, individuals with undetermined neuropathic pain had a prevalence 2.7 times higher than the reference group.

In relation to DM2 diagnosis duration, proportional increase was observed in occurrence for diabetic peripheral neuropathy along with longer disease duration. Taking individuals with less than five years since diagnosis as the reference group, participants with five to ten years of diagnosis presented a prevalence 1.9 times higher, and those with more than ten years presented a prevalence 2.7 times higher for this complication.

Table 2 – Multiple regression analysis between study variables and occurrence of diabetic peripheral neuropathy in individuals with type 2 diabetes mellitus treated in Primary Health Care (n=123). Imperatriz, MA, Brazil, 2024

Variables	Diabetic peripheral neuropathy		PR	CI 95%*	p-value
	Present n (%)	Absent n (%)			
Marital status					
Single	2 (1.6)	10 (8.1)	1[†]	–	–
Married/Stable union	31 (25.2)	35 (28.5)	3.276	1.012 – 10.60	0.048[‡]
Widowed	11 (8.9)	11 (8.9)	4.826	1.356 – 17.17	0.015[‡]
Divorced/Separated	11 (8.9)	12 (9.8)	3.316	0.972 – 11.31	0.056
Schooling					
Illiterate	5 (4.1)	9 (7.3)	1[†]	–	–
Incomplete Elementary School	20 (16.3)	23 (18.7)	1.083	0.521 – 2.251	0.830
Complete Elementary School	8 (6.5)	8 (6.5)	1.130	0.484 – 2.637	0.777
Incomplete High School	4 (3.3)	2 (1.6)	2.985	1.113 – 8.009	0.030[‡]
Complete High School	10 (8.1)	23 (18.7)	0.937	0.415 – 2.117	0.876
Incomplete Higher Education	1 (0.8)	1 (0.8)	1.828	0.549 – 6.083	0.325
Complete Higher Education	7 (5.7)	2 (1.6)	1.650	0.735 – 3.704	0.225
Neuropathic pain					
Absent	42 (34.1)	66 (53.7)	1[†]	–	–
Present	7 (5.7)	0 (0.0)	1.780	1.300 – 2.436	0.001[‡]
Undetermined	6 (4.9)	2 (1.6)	2.687	1.681 – 4.296	0.001[‡]
Duration for diabetes diagnosis (years)					
< 5	11 (9.0)	32 (26.2)	1[†]	–	–
5 and 10	18 (14.8)	21 (17.2)	1.877	1.060 – 3.325	0.031[‡]
>10	25 (20.5)	15 (12.3)	2.687	1.681 – 4.296	0.001[‡]

*CI: Confidence interval; [†]Reference variable for Poisson regression; [‡]p < 0.05; PR: Prevalence ratio

When correlation between study variables and diabetic peripheral neuropathy was analyzed with Spearman's method, individual income showed a negative correlation with presence for this complication (r = -0.226), indicating that individuals with lower income tended to have higher occurrence of neuropathy. In contrast, alcohol intake (r = 0.233), previous ulcer in lower limbs (r = 0.214), neuropathic pain (r = 0.308), and duration for DM diagnosis (r = 0.307) showed positive correlation with diabetic peripheral neuropathy, meaning that increases in these variables were associated with higher occurrence for this complication. These findings are presented in Table 3.

Table 3 – Spearman correlation between variables and occurrence of diabetic peripheral neuropathy in individuals with type 2 diabetes mellitus treated in Primary Health Care (n=123). Imperatriz, MA, Brazil, 2024

Variables	Diabetic peripheral neuropathy
Individual income	- 0.226
Alcoholism	0.233
Previous ulcer in lower limbs	0.214
Neuropathic pain	0.308
Duration for diabetes diagnosis	0.307

Discussion

Diabetic peripheral neuropathy is one of the prevalent and debilitating complications related to DM2, with significant implications for functionality, mental health, and quality of life among affected individuals[5]. This impact is even greater when aggravated by unfavorable social conditions that hinder access to continuous care, early diagnosis, and adoption of healthy habits. Within this context, care practice must prioritize close and continuous follow-up, in which nursing plays a strategic role by integrating clinical surveillance and educational interventions.

In this study, the prevalence for diabetic peripheral neuropathy is consistent with findings reporting a prevalence of 46.5%[15]. The high percentage for neuropathy identified here may be related to characteristics of the population studied, composed of individuals with DM2, a condition often diagnosed late and associated with older age, longer duration since diagnosis, and challenges in therapeutic control, factors that increase risk for microvascular complications such as diabetic peripheral neuropathy. These findings reinforce the relevance of structured and systematized follow-up within primary care services, which enables nurses to assess risks, apply diagnostic protocols, and guide self-care practices.

In relation to gender, the higher number of women with diabetic peripheral neuropathy in this study may be associated with greater adherence among women to ambulatory and preventive health services[16], which favors early screening for complications. Similarly, an international study also showed higher prevalence for diabetic peripheral neuropathy among women[17]. This suggests that care strategies should consider gender differences, strengthening the existing bond between women and health services while expanding the reach of interventions among men, who remain historically less present in these settings.

Age group is recognized as a factor that predisposes to neurodegenerative changes associated with DM2. Pathophysiological processes such as oxidative stress, chronic inflammation, neural ischemia, and accumulation of advanced glycation end products are more frequent in older adults, increasing neurological vulnerability[18]. This pattern is consistent with the findings in this study. Primary health care should therefore incorporate specific screening protocols for older adults into routine practice, with periodic assessments conducted in a systematic manner.

In relation to race/skin color, a study conducted in the United States that assessed prevalence and factors associated with peripheral neuropathy among adults with and without DM found higher risk for neuropathy among self-identified Black individuals[19]. In the present investigation, a predominance of self-identified mixed-race individuals was observed among those with diabetic peripheral neuropathy, which may reflect the local sociodemographic profile,

given that mixed race is the majority group in Brazil and particularly in the state of Maranhão[20].

Results from multivariate analysis showed statistically significant association between diabetic peripheral neuropathy and the following factors: marital status married/stable union and widowed, incomplete secondary education, presence or undetermined status for neuropathic pain, and DM2 diagnosis duration between five and ten years and longer than ten years.

For marital status, similar findings were reported in a study in which married participants had nearly three times higher chance for developing diabetic peripheral neuropathy than those in other groups[21]. Couples tend to share behaviors related to diet, physical activity, and substance use[22], and when inadequate, these patterns may contribute to poor glycemic control and greater risk for chronic complications, including diabetic peripheral neuropathy.

In addition to findings for married individuals, widowed participants in this study presented a prevalence for diabetic peripheral neuropathy 4.8 times higher than single individuals. From a neuroendocrine perspective, widowhood may trigger prolonged stress, with cortisol elevation that increases plasma glucose levels[23]. This physiological mechanism helps explain how persistent hyperglycemia contributes to development of chronic complications such as diabetic peripheral neuropathy.

Low schooling also emerged as an associated factor, consistent with evidence showing that individuals with lower educational attainment tend to demonstrate poorer adherence to glycemic control, preventive care, and self-care practices[24]. A study conducted in China supported this association by showing that absence of secondary or higher education independently increased risk for neuropathy in individuals with DM2[25]. These findings underscore the need for Primary Health Care to recognize low educational attainment as a marker for vulnerability and to implement educational actions tailored to users' health literacy.

In relation to clinical manifestations, presence of neuropathic pain showed a significant association and positive correlation with diabetic peripheral neu-

ropathy. A study reported that individuals with diabetic peripheral neuropathy had greater likelihood of pain, more severe neuropathy, and mixed nerve fiber involvement[26]. Neuropathic pain results from lesions in peripheral nerves that alter sensory processing and compromise physiological inhibitory mechanisms. This condition affects approximately 30% to 40% of individuals with diabetic peripheral neuropathy and is believed to be associated with progressive neural damage, which leads to increased sensitization, oxidative stress, inflammatory processes, and demyelination that amplify pain responses[27].

Diabetic peripheral neuropathy may initially manifest through dysfunction in small nerve fibers and microvascular impairment that precede onset of neuropathic pain with well-defined clinical features[26]. However, there is a lack of studies that directly assess the association between indeterminate neuropathic pain results and diabetic peripheral neuropathy. In this context, indeterminate results may indicate early or subclinical phases of disease, during which pathophysiological alterations are already present but remain undetected by screening instruments.

Duration for DM diagnosis showed a positive correlation with presence of diabetic peripheral neuropathy and was associated with occurrence of this complication in the present investigation. Evidence shows that longer disease duration increases risk for diabetic peripheral neuropathy, and a mean duration of five years or more is considered a factor associated with neuropathic involvement[25]. This may be related to prolonged exposure to hyperglycemia, which promotes structural changes in peripheral nerves, including demyelination and axonal degeneration[2]. These mechanisms reinforce the importance of longitudinal follow-up and continuous surveillance within primary care, where nursing contributes to early identification of signs and improvement in treatment adherence.

Within correlation analysis, variables such as alcohol intake and previous ulcer in lower limbs showed positive correlation with occurrence of diabetic peripheral neuropathy, whereas individual income showed negative correlation. For alcohol intake, ex-

cessive alcohol consumption was identified in a North American study as a factor associated with development of diabetic polyneuropathy, since alcohol disrupts neuronal metabolism, triggers axonal transport dysfunction, and impairs normal neuronal function[28].

In relation to clinical aspects, complications arising from ulcers, such as infection, may worsen microcirculation and increase tissue hypoxia, promoting degeneration in local nerve fibers and consequently contributing to diabetic peripheral neuropathy[29]. This mechanism helps explain the positive correlation between previous ulcer in lower limbs and occurrence of diabetic peripheral neuropathy. These findings also highlight the importance for foot assessment in individuals with DM, with emphasis on systematic evaluation for skin integrity, early identification of lesions, and timely ulcer management in primary care settings.

Lower income levels were associated with higher rates of diabetic peripheral neuropathy in this study, which may reflect the impact from socioeconomic barriers that restrict access to health services, medications, and healthy lifestyle habits[30]. These factors are crucial for diabetes control and prevention of complications. Consistent with these findings, a study conducted in China reported that prevalence for painful diabetic peripheral neuropathy among individuals with DM2 decreased progressively with higher income[25].

Analysis for factors associated with diabetic peripheral neuropathy emphasizes the central role of nurses in primary care. Through continuous contact with users, nurses occupy a strategic position for early screening of clinical and behavioral alterations and modifiable risk factors related to development of diabetic peripheral neuropathy, as well as for implementing educational and preventive strategies tailored to individual and community needs.

Study limitations

Among the limitations, the sample was restricted to a single municipality in Southwestern Maranhão, which limits generalization for other populations with type 2 diabetes mellitus. In addition, the cross-sectional design does not allow causal inferences between the variables investigated and diabetic peripheral neuropathy. The scarcity of recent studies on some variables also hindered comparison for the findings. Despite these constraints, the results provide support for future investigations with broader and more representative samples.

Contributions to practice

The findings from this study advance scientific knowledge by demonstrating that sociodemographic and clinical factors act as elements associated with onset of diabetic peripheral neuropathy, reinforcing the central role for Primary Health Care and nursing in surveillance, prevention, and early detection of this DM-related complication. The study also broadens understanding regarding the importance of longitudinal and continuous follow-up in disease management, aimed at identifying susceptible users and monitoring development of chronic complications, including neuropathy.

For health and nursing, the results support improvement in care practices by guiding development of protocols, educational initiatives, and evidence-based care strategies. These include use of validated instruments and interventions focused on health education, foot self-care, and treatment adherence. Furthermore, these contributions directly foster progress toward targets established in the 2030 Agenda by aligning nursing practice with the United Nations Sustainable Development Goal "Good Health and Well-being" (SDG 3), particularly regarding health promotion, prevention of complications, and reduction in health inequalities.

Conclusion

The main factors associated with occurrence of diabetic peripheral neuropathy in individuals with DM2 treated in Primary Health Care were marital status married/stable union and widowed, incomplete secondary education, neuropathic pain present or

undetermined, and duration for diabetes diagnosis between five and ten years and longer than ten years. The study enabled description and delineation of the profile for individuals with type 2 diabetes mellitus and diabetic peripheral neuropathy, as well as identification of clinical and social factors associated with development of this complication.

Acknowledgments

Authors' contributions

Conception and design or data analysis and interpretation; manuscript drafting and critical review with relevant intellectual content: **Costa DES, Pascoal LM.** Relevant critical review of intellectual content: **Santos Neto M.** Conception and design or data analysis and interpretation: **Morais JD, Andrade YT, Oliveira ACL, Limeira BS.** Final approval of the version to be published; Agreement to be responsible for all aspects of the manuscript ensuring that issues relating to the accuracy or completeness of any part of the manuscript are properly investigated and resolved: **Costa DES, Pascoal LM, Santos Neto M, Morais JD, Andrade YT, Oliveira ACL, Limeira BS.**

Data availability

The authors state that the complete dataset is fully available within the article.

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