

Prevalence and risk assessment of Diabetic Foot complications in a Primary Health Care unit in the Midwest of Santa Catarina, Brazil

Prevalência e avaliação do risco de complicações do Pé Diabético em uma Unidade de Atenção Primária à saúde no Meio-Oeste de Santa Catarina, Brasil

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Abstract: The worldwide high prevalence of diabetes mellitus raises significant concern regarding foot complications in these individuals. **Objective:** To analyze the prevalence and risk of developing diabetic foot in patients with type 1 and 2 diabetes mellitus in a municipality in the midwestern region of Santa Catarina. **Methods:** This is a cross-sectional, observational, quantitative study conducted through the application of the Feet Examination Manual from the Santa Casa University of Belo Horizonte. The study population consists of 61 individuals from the community of Caçador who are users of the Nossa Senhora da Salette Primary Health Care Unit, selected based on indicators regarding the proportion of individuals with diabetes who have appointments and present hemoglobin A1c levels above 6.5%. **Results:** After evaluating the total score on the Feet Examination Manual, which indicates the risk of developing diabetic foot, we observed that out of the 61 participants, 39.34% showed no predictive signs of neuropathy, 37.70% with neuropathic pain, 18.03% with painful diabetic polyneuropathy, and 4.91% at risk of ulceration, totaling 60.66% with polyneuropathic alterations. **Conclusions:** This study identified a high prevalence of sensory alterations in the feet, highlighting the importance of annual foot examinations in primary health care for patients with diabetes mellitus.

Keywords: Diabetes Mellitus, Complications, Peripheral Neuropathy, Diabetic Foot, Quality of Life.

Resumo: A elevada prevalência do diabetes mellitus no mundo suscita grande preocupação quanto às complicações nos pés desses indivíduos. **Objetivo:** Analisar a prevalência e o risco de desenvolvimento de pé diabético em pacientes com diabetes mellitus tipo 1 e 2 em um município do meio-oeste de Santa Catarina. **Métodos:** Trata-se de um estudo transversal, observacional, de abordagem quantitativa, realizado por meio da aplicação do Manual de Exame dos Pés da Santa Casa de Belo Horizonte. A amostra foi composta por 61 indivíduos usuários de uma Unidade Básica de Saúde, selecionados com base em indicadores de acompanhamento e níveis de hemoglobina glicada acima de 6,5%. **Resultados:** Após a avaliação do escore total do protocolo, observou-se que 39,34% dos participantes não apresentaram alterações neuropáticas preditivas, 37,70% apresentaram dor neuropática, 18,03% polineuropatia diabética dolorosa e 4,91% risco de ulceração, totalizando 60,66% com alterações polineuropáticas. **Conclusão:** Identificou-se elevada prevalência de alterações sensitivas nos pés, reforçando a importância da avaliação anual dos pés na Atenção Primária à Saúde para indivíduos com diabetes mellitus. **Palavras-chave:** Diabetes Mellitus, Pé Diabético, Neuropatia Periférica, Atenção Primária à Saúde, Complicações.

INTRODUCTION

Diabetes mellitus (DM) is a highly prevalent chronic condition worldwide, increasingly becoming a public health concern due to its rising incidence. It is recognized as a metabolic disorder characterized by persistent hyperglycemia, which can arise from either pancreatic deficiency in insulin synthesis or improper insulin utilization by the metabolism (Muzy et al., 2021; SBD, 2019).

According to the International Diabetes Federation (IDF) Diabetes Atlas, it is estimated that in Brazil, 16.8 million people aged 20 to 79 years old have this condition, and IDF's projection for 2030 is approximately 21.5 million individuals. Such a situation is concerning, considering the burden placed on public health services and the high rates of disabling complications that diabetes can cause in affected patients (Baltazar da Silva et al., 2024; IDF, 2021; Muzy et al., 2021; SBD, 2019).

It is known that several factors contribute to the reduction on quality of life in patients with diabetes: difficulty accepting the diagnosis, maintaining pharmacological adherence over time, complications inherent to inadequate treatment, lifestyle modifications and even, the combination of diabetes with other pre-existing comorbidities (Ribeiro et al., 2020).

Diabetes is responsible for high rates of overall morbidity and mortality, totaling, in the year 2021, according to the IDF, 214 thousand deaths in Brazil and 6.7 million deaths worldwide. Additionally, it is crucial to emphasize that if not treated properly, it can lead to various complications, both in microvascular and macrovascular aspects, including peripheral neuropathy, one of the most common, which is the focus of this study (IDF, 2021; SBD, 2019).

In this context, the prevention and treatment of changes occurring in diabetic feet are a priority in the care and follow-up of affected patients. There are factors that chronically contribute to the emergence of plantar ulcers, infectious processes, osteomyelitis, and amputations in the feet, namely: peripheral neuropathy (PN), peripheral arterial disease (PAD), and diabetic sensory-motor polyneuropathy (Ferreira, 2020).

The semi-quantitative test for neurological assessment using the Semmes-Weinstein 10g monofilament is the most widely used and validated for screening feet with a higher propensity for developing ulcerative neuropathy, given its high sensitivity (IDF, 2021; Lima & Mota, 2019). The test can identify vibratory, painful, and protective sensitivity and is usually used in conjunction with other tests such as the 128 Hz tuning fork, pinprick perception, and Achilles reflex (Brito et al., 2020; Boulton, 2020).

The present study was based on the material "Diabetes Mellitus: Feet Examination Manual," developed by the Santa Casa de Belo Horizonte group. Considering the need for follow-up and management of diabetic patients, the examination was created to clarify the step-by-step process of applying the aforementioned examination. According to the manual, the examination should be performed at least once annually. The objective is to aid in the screening of diabetes-related complications and enhance the knowledge of the primary health care team (Reis et al., 2016).

MATERIALS AND METHODS

The present study is an exploratory, cross-sectional, quantitative research involving the collection and analysis of health data through the application of the Feet Examination Manual from the Santa Casa University of Belo Horizonte, in a municipality in the midwestern region of Santa Catarina. For the implementation of this project, in accordance with opinion 6.270.355 from Plataforma Brasil, CAAE 718841230.0000.0259, each participant received an invitation to sign the informed consent form after receiving a detailed explanation about the research objectives. Access to the data was restricted only to the researchers directly involved in the interviews, and these researchers formalized their commitment to maintain the confidentiality and secrecy of all information by signing an appropriate agreement.

The Primary Health Care Unit (UBS) constitutes the first level of care offered by the Unified Health System (SUS), providing qualified, person-centered clinical care, with referrals to higher levels of care when necessary. The research participants are users of the UBS in the Nossa Senhora Salete neighborhood, included in the indicators of the proportion of

individuals with diabetes, with completed appointments and glycosylated hemoglobin levels above 6.5%. Among the inclusion criteria were signing the Informed Consent Form (ICF) and being at least 18 years old (Assumpção et al., 2018).

Exclusion criteria included pathological conditions that could interfere with the assessment protocol, such as leprosy, chronic venous disease, peripheral arterial obstruction, and individuals with partial or total limb amputations. Based on epidemiological data from the e-SUS system, there are 122 individuals with this condition in the aforementioned neighborhood. A total of 93 participants was selected through sample size calculation, with a tolerable sampling error margin of 5%. Participant withdrawal reduced the final sample size to 61, which may have limited the power of statistical comparisons (Assumpção et al., 2018).

Data collection occurred in two stages: the first involved the administration of the informed consent form followed by an interview aimed at understanding the background of the current disease of each participant; the second stage involved the application of the foot assessment protocol, which includes medication currently use, evaluation of deformities and alterations on inspection, assessment of muscle strength and proprioception, signs and symptoms of polyneuropathy, intensity of neuropathic symptoms, examination for ulcer risk – using the 10g monofilament, and circulatory assessment. No diagnosis or treatment was provided based on the foot assessment protocol, as this study was observational in nature and focused on data collection related to diabetes mellitus and foot assessment.

The data were organized using Microsoft Excel for Mac, version 16.101.1 (25092124), and subjected to descriptive statistical analysis (absolute and relative frequencies, n and %). To assess the association between categorical variables and the participants' sex, Pearson's chi-square test (χ^2) was performed, adopting a significance level of 5% ($p < 0.05$).

RESULTS

A total of 61 diabetic foot assessment protocols were conducted among individuals diagnosed with diabetes mellitus. Although the initial sample size was calculated to be

93 (with 5% margin of error), only 61 individuals completed the protocol due to low adherence, which may have limited the power of statistical comparisons. Only two participants were diagnosed with type 1 diabetes mellitus, while the remaining had type 2 diabetes mellitus. The mean age of the participants was 59.85 ± 13.97 years, with a predominance of 57.37% being female.

Regarding the therapeutic plan, as presented in Table 1, it was observed that the majority of participants, namely 60.65%, were using oral antidiabetic agents, with metformin being the most prescribed. Additionally, 29.50% of participants were using a combination of oral antidiabetic agents and insulin, while 9.83% were using insulin alone. With respect to the different percentages in the therapeutic plan between men and women, no statistically significant difference was observed between the groups.

Table 1
Medications in use

Medications in use	Male n (%)	Female n (%)	p
Oral antidiabetics	13 (35.13)	24 (68.30)	
Insulin	3 (50)	3 (50)	
Antidiabetics + insulin	10 (55.56)	8 (44.45)	
			0.33

Analysis of the therapeutic plan according to gender ($p < 0.05$).

Regarding the evaluation of changes observed during the inspection of the feet, 91.80% of the participants had a normal temperature, with only 8.19% of the sample having a cold temperature. Regarding color, 96.72% exhibited a normal coloration, while only 3.27% were cyanotic.

Regarding hygiene, 54.09% of the participants were considered adequate, while 45.90% were considered inadequate. Regarding footwear use in diabetic participants, 59.01% of the sample used appropriate footwear, whereas 40.98% used inappropriate footwear.

In the assessment of muscle strength and proprioception, as presented in Table 2, 80.32% of the sample demonstrated normal strength, meaning they were able to overcome resistance. On the other hand, 19.67% exhibited alterations, including mild to moderate weakness. Regarding the different percentages of muscle strength between men and women, no statistically significant difference observed between the groups.

Table 2
Muscle strength assesment, Applied according to the Lysholm Functional Scale

Muscle strength	Male n (%)	Female n (%)	p
Overcome resistance	23 (46.93)	26 (53.06)	
Showed alterations	3 (25)	9 (75)	
			0.38

Muscle Strength assesment According to Gender (p<0.05).

After summing the scores of neuropathic symptoms according to the protocol, it was observed that 44.26% of the participants presented severe neuropathic symptoms, 39.34% presented moderate symptoms, 24.59% showed no alterations, and 14.45% presented mild symptoms. Regarding the different percentages of muscle strength assesment between men and women, a statistically significant difference was observed between the groups (p < 0.05).

Regarding the scores of neuropathic signs according to the protocol, it was found that 77.04% of the participants exhibited normal signs, 18.03% showed mild signs, and 4.91% demonstrated moderate signs. As for the different percentages of neuropathic signs scores between men and women, no statistically significant difference was identified between the groups.

Tabela 3
Euroopathic signs and symptoms score

Neuropathic symptoms score	Male n (%)	Female n (%)	P
Normal	5 (33.34)	10 (66.67)	
Mild	5 (55.56)	4 (44.45)	
Moderate	3 (12.5)	7 (29.16)	
Severe	13 (48.14)	14 (51.85)	
			*0.01

Analysis of Neuropathic Symptoms According to Gender (p<0.05).

Neurological signs score	Male n (%)	Female n (%)	P
Normal	20 (42.55)	27 (57.44)	
Mild	5 (45.46)	6 (54.55)	
Moderate	1 (33.34)	2 (66.67)	
			0.93

Analysis of Neurological Symptoms According to Gender (p<0.05).

In the circulatory assesment, 60.65% of the sample presented present pulses, while 39.34% presented diminished or absent pulses. Regarding the different percentages of present or diminished/absent pulses between

men and women, no statistically significant differences were found between the groups.

After performing the statistics regarding the 10g monofilament assesment, it was established through the chi-square test that the alteration of sensitivity reached a percentage of 41.66% in males and 58.33% in females, indicating a greater peripheral neuropathic involvement among women.

Table 4
Circulatory assesment score and sensitivity assesment.

Circulatory assesment	Male n (%)	Female n (%)	P
Present	16 (43.24)	21 (56.75)	
Diminished or absent	10 (41.66)	14 (58.33)	
			0.90

Analysis of circulatory assesment according to gender (p<0.05).

10g Monofilament	Male n (%)	Female n (%)	P
Sensitivity alteration	20 (41.66)	28 (58.33)	
No sensitivity alteration	6 (46.15)	7 (53.84)	
			0.77

Analysis of sensitivity according to gender (p<0.05).

After evaluating the total scores in the Feet Examination Manual, which indicate the risk of developing diabetic foot, the results demonstrate that 39.34% of the participants were classified with no predictive neuropathy alterations, 37.70% with neuropathic pain, 18.03% with painful diabetic polyneuropathic and 4.9% with ulceration risk, totaling 60.66% with polyneuropathic alterations.

DISCUSSIONS

Given the results obtained, it is pertinent to discuss the changes observed among participants diagnosed with diabetes mellitus. The planned sample of 93 participants could not be reached due to low adherence to the study. A reduced number of participants with type 1 diabetes was observed, as most were underage and required a companion, hindering their inclusion. Furthermore, although many agreed to schedule the foot assesment protocol, a large proportion did not attend the Primary Health Care Unit (UBS) on the appointed date.

Another relevant limitation was the difficulty in accurately establishing the time of diagnosis and treatment, as most participants were unaware of therapy onset or disease progression. This limitation was directly related to the low education level and high social vulnerability within the community where the protocol was applied. Nevertheless, the 61 participants who underwent assessment reported great satisfaction noting that in most cases, they had never received such a specific and comprehensive foot evaluation and were often unaware of its existence.

The average age of the participants was 59.8 years, consistent with previous studies demonstrating a direct association between age and the onset of Non-Communicable Chronic Diseases (NCDs). Additionally, a predominance of female participants was observed (57.37%), which may be related to greater health awareness and more frequent healthcare-seeking behavior among women (Santos et al., 2017).

Regarding treatment, oral antidiabetic drugs were the most widely used accounting for 60.65% of participants. Their use varies according to treatment guidelines, clinical practice and medication availability. However, oral antidiabetic drugs are often recommended as the first-line treatment option for individuals with type 2 diabetes mellitus, due to their high efficacy, safety profile and relatively low cost (Assumpção et al. 2018). In cases where therapeutic goals for glycemic control are not achieved, it becomes necessary to combine them with other oral antidiabetic drugs. Moreover, in individuals with a glycated hemoglobin > 9.0%, the combination of oral antidiabetic drugs with insulin is recommended, comprising 29.50% of the sample (SBD, 2019).

Almost all participants presented foot deformities and inspection alterations. This can be explained by a chronic disease process that leads to impaired long-term glycemic control, creating conditions conducive to foot lesions and resulting in neurological, vascular and immunodeficiency complications. The most frequent deformities were calluses, hyperkeratosis, claw toes and interdigital mycoses. Peripheral nerve involvement led to reduced muscle strength assessment in 19.67% of participants, characterized by loss of balance and inability to overcome resistance applied during dorsiflexion and plantar flexion of the feet. These

changes mainly occur due to weakness of the intrinsic foot musculature, which can also lead to significant structural changes that increase autonomic deficit and gait abnormalities (Ferreira, 2020; Lima & Mota, 2019).

A considerable proportion of participants showed poor foot hygiene and used inappropriate, particularly flip-flops, sandals and rigid soles. In this context, there is a lack of knowledge about which footwear prevents injuries, as well as a lack of financial resources to acquire appropriate footwear. Regarding the lack of hygiene, issues related to work activities and deficits in awareness of the importance of these basic care for limb health were highlighted. Therefore, there is a need for health education implementation in order to prevent and control these foot injuries (Farias et al., 2014).

The signs and symptoms of polyneuropathy are present in the majority of individuals, with pain or discomfort in the legs or feet being frequent complaints that present with different associated characteristics, in addition to the location, time of day of greatest intensity, and maneuvers capable of alleviating the pain. Polyneuropathy occurs in part due to alterations in the peripheral nervous system itself, but also due to the concomitance of diabetes with peripheral arterial disease. The predominance of severe polyneuropathy is related to the time of diabetes diagnosis, with an average of more than 10 years for the onset of these signs and symptoms, but they can also begin earlier in some individuals (Ferreira, 2020). The characteristic pain has its pathophysiological mechanism based on the loss of thin and thick nerve fibers, resulting in stabbing pain and burning sensation in the feet in the former situation, and in latter situation, presenting with numbness and reduction or loss of protective plantar sensitivity, as represented by the 10g monofilament test in which the majority of participants in this study manifested alterations (Saraiva et al., 2023).

Circulatory alterations are frequently among the complications affecting the diabetic foot and often go neglected during the physical examination of these individuals (Santos et al., 2019). The results presented show that 39.34% of the participants exhibited decreased tibial and dorsalis pedis pulses, a result that has a significant impact since a large portion of those evaluated indicated that the lack of continuous monitoring can lead to peripheral

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arterial disease. According to a study conducted by Helen de Lima, out of 35 individuals, 12 did not present circulatory alterations and 17 exhibited decreased tibial and dorsalis pedis pulses, demonstrating an alteration of 49.6%, which is consistent with the results presented in this research (Santos et al., 2019).

The loss of protective plantar sensitivity caused by peripheral neuropathy, which impairs the sensation of pressure in the feet, was the main finding of this study. Among the 61 participants, 78,7% presented alterations in the 10g monofilament test at one or more pre-established points according to the protocol. This alteration is due to peripheral nerve dysfunction, which worsens at rest and improves with physical activity. In correlation with other studies, it was noted that sensitivity alteration is the most frequent complication of diabetes mellitus. Lima and Mota (2019) reported similar findings in a study conducted in 2019, out of a sample of 26 participants, 76.92% of the individuals presented alterations in the 10g monofilament test. Compared with the results of this study, 76.68% of the participants exhibited alterations, highlighting the importance of conducting more researches in this area due to the significant increase in this complication associated with diabetes mellitus (Lima & Mota, 2019).

The 10 g monofilament test, used in the foot assessment protocol, is a tool available to all Primary Health Care Units, facilitating accessibility and reducing costs within the Brazilian Unified Health System (SUS). The finding that of 78.7% of participants presented alterations in this test demonstrates that it represents the main chronic complication affecting individuals with diabetes. This outcome is directly related to the social vulnerability of the region where the protocol was applied, the duration of the disease, and the low adherence to treatment and clinical follow-up. Training health professionals who are part of the Family Health Strategy team is essential, as theoretical and practical knowledge enable these professionals to provide appropriate disease management, thereby preventing chronic complications, particularly those that impair peripheral sensitivity, and increase the risk of ulceration and amputation.

FINAL CONSIDERATIONS

In summary, this study further reinforces that diabetes mellitus is associated with several long-term complications, among which diabetic foot stands out as one of the most prevalent and severe. The total scores obtained by participants in the Foot Examination Manual indicate a high risk for the development of such alterations. Consequently, there is a notable prevalence and risk of developing diabetic foot in individuals diagnosed with type 1 and type 2 diabetes mellitus.

Therefore, further studies on the chronic complications of diabetes are needed to validate and expand upon the findings of this evaluation. Furthermore, the development and implementation of preventive campaigns by health services, with a stronger focus on the footcare among diabetic patients, are essential. This findings highlight the need for continuous screening and professional training in primary care to prevent disabling complications associated with diabetic neuropathy.

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