

# **IMPROVING DIABETIC NEUROPATHY SCREENING IN PRIMARY HEALTH CARE: A PROPOSAL**

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*Marcelo Maroco Cruzeiro*

*Luciana do Nascimento Campissi*

*Fernando Colugnati*

*Rogério Baumgratz de Paula*

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**Abstract:** The early detection of diabetes mellitus (DM) and its complications are real challenges for public health. In a hierarchically organized public system such as the SUS (primary, secondary and tertiary levels), Primary Care (PHC) is the entrance to the health system. Therefore, it becomes fundamental that the screening of DM and its complications be effective, in order to avoid functional losses and early retirements. One of the most fearsome complications of DM is diabetic neuropathy (DN), a highly prevalent condition responsible for approximately 70% of cases of non-traumatic amputation. Thus, screening for DN can reduce the personal, family and social impacts of this chronic condition. Objective: to develop a simple and easy-to-apply screening test for early detection of DN by PHC nurses. Method: Cross-sectional study in which 269 medical records of diabetic patients treated at Centro Hiperdia/ Juiz de Fora - MG were evaluated. Demographic, clinical and neurological data of the population assessed from 2010 to 2014 were tabulated. Results: Sixty-two percent of diabetics were female; the mean age was 58.7 years and the mean BMI was 30.6; the mean time since DM diagnosis was 11.5 years and glycated hemoglobin (HbA1c) was equal to 9.1%. Foot burning (64.9%), paresthesia (83.8%), numbness (73%) and neuropathic pain (54.1%) were the most prevalent symptoms. Symptoms were poor predictors for the diagnosis of probable DN. On the other hand, changes in thermal and pain sensitivity and the absence of the Achilles reflex were the abnormalities most frequently related to the presence of diabetic neuropathy.

## INTRODUCTION

DM is a public health problem that affects more than 200 million people worldwide. In 1996, the global prevalence of diabetes was 120 million people and, by 2025, the

forecast is that this number will reach 380 million diabetics. These predictions are due to population aging, obesity, sedentary lifestyle and changes in dietary patterns. DM complications can occur in the macro and microcirculation. Macroangiopathies are represented by stroke and acute myocardial infarction. Microangiopathies are represented by diabetic retinopathy, nephropathy and neuropathy. This has a potential connection with the onset of diabetic foot (PD), the leading cause of lower limb amputations in Brazil.

Diabetic neuropathy (DN) is defined as the presence of symptoms and/or signs resulting from peripheral nerve dysfunction in people with diabetes mellitus (International Consensus on Diabetic Foot, 2002). Its prevalence can reach 50% depending on the group of patients evaluated (Guideline of the Brazilian Society of Diabetes, 2011). Other authors report that 60 to 90% of diabetics develop neuropathy, a condition responsible for more than 80% of cases of ulcers in diabetic individuals (Aalaae cols, 2012).

DN can cause sensory changes, mainly in temperature, touch and pain; in addition to motor and autonomic symptoms. The change in nociceptive perception favors the development of PD, which can result in amputation in most affected patients. The protocols developed for the diagnosis of DN such as Michigan are good tools, but their application in PHC by non-medical professionals is complex (Bolton, 2004). Therefore, simplified and, at the same time, sensitive evaluation methods are needed for the early diagnosis of probable DN.

The present study aims to evaluate signs and symptoms of diabetic neuropathy that may constitute an easy and quick tool for early screening of this condition by primary care nurses.

## METHODOLOGY

A cross-sectional study was carried out by selecting data from the medical records of individuals treated at the diabetic foot outpatient clinic of the HIPERDIA Center / Juiz de Fora, from January 2010 to December 2014. The individuals were evaluated by the nurse in charge, and the data were obtained in medical records. Socio-demographic data, symptoms and signs present were analyzed. The laboratory tests evaluated were HbA1c, time since DM diagnosis and body mass index (BMI).

The neuropathy signs and symptoms questionnaire (ESSN - Neuropathic Symptoms and Signs Score) was used (Moreira et al 2005), under the supervision of a neurologist. This questionnaire deals with the analysis of symptoms and signs and classifies DN, according to the score, as mild, moderate or severe. The DN classifications have proposed classifications according to their clinical presentations, in degrees, among others. Classifications tend to use clinical and electrophysiological criteria.

One of these classifications divides the DN impossible, probable and confirmed (Tesfaye et al, 2010). Possible neuropathy is defined by the presence of neuropathic symptoms or signs; probable neuropathy consists of the presence of neuropathic signs and symptoms, whereas confirmed neuropathy is diagnosed by the presence of at least one neuroconduction abnormality on electroneuromyography (ENMG) with neuropathic signs and/or symptoms. In the present study, ENMG was not performed due to the difficulty of performing it in the public health system. Thus, we used data from diabetics with possible or probable DN.

Stata 13.0 software was used and descriptive analyzes are presented in terms of percentages, means, medians and standard deviations according to the nature and

distribution of the variable. Hypothesis tests for the differences between the Possible and Probable groups were applied according to the nature and distribution of the variables, with the Chi-square for categorical variables and the t-Student test for numerical variables.

For the analysis of the relevance of the signs in the discrimination of possible and probable neuropathies, the Likelihood Ratio (LR) approach was used, defined by the percentage of Probable patients with the sign, on the percentage of Possible patients who presented the sign. same sign.

For an analysis of signs associated with probable versus possible neuropathy, adjusted for gender, age and other potential confounding variables, multiple logistic regression was used. For the selection of the signals that would remain in the model, the modeling started with the signals with the lowest RV, and the ones with the highest values were added, excluding the signals that presented a p-value > 0.05.

## RESULTS

Of the total of 269 charts evaluated, 62.1% were female. The mean age was 58.7 +11.3 years and the BMI was 30.6 + 6kg/cm<sup>2</sup>. The average time of DM diagnosis was 11.5+8.1 years and the HbA1c was 9.1+2.5% - characterizing inadequate glycemic control. About 30% of the patients did not present spontaneous complaints of neuropathic symptoms. Seventy-eight percent of subjects had DN based on neuropathic examination.

The most frequent symptoms were - in descending order: fatigue, burning, numbness, tingling and pain (graph 1). The Achilles reflex was altered in almost all individuals, followed, in order of frequency, by pain, temperature, tactile sensitivity and alterations in the research on susceptibility to injury with 10g monofilament were altered in more than 60% of individuals (graph 2 ). The

symptoms and clinical examination findings were concentrated in the calves and feet in 96.8% of the patients, and the symptoms occurred during the day or at night in 83.6% of the individuals.

The alterations in the research with the 10g monofilament were associated with those of pain ( $p < 0.05$ ) and thermal ( $p < 0.05$ ) sensitivity, as well as the complaint of burning in the feet ( $p, 0.05$ ). Burning feet (64.9%), paresthesia (83.8%), numbness (73%) and neuropathic pain (54.1%) were the most prevalent complaints (graph 1). Regarding the signs, there was a significant correlation between changes in temperature and pain perceptions, absence of the Achilles reflex and the presence of DN (Chart 2). No statistically significant correlation was observed regarding vibration or tactile sensitivity with ND.

The application of the likelihood ratio analysis, with a 95% confidence interval, revealed that the symptoms are poor predictors for the diagnosis of probable DN. However, the abnormal findings of thermal and pain sensitivity and the 10g monofilament test had the best results as expressed in the Table.

When performing the logistic regression test, it was observed that the Achilles reflex could not be applied to the model because virtually all patients had abnormal findings. Thermal and painful sensitivity showed greater significance (Table 3), but the 10g monofilament was not significantly related to the presence of probable neuropathy.

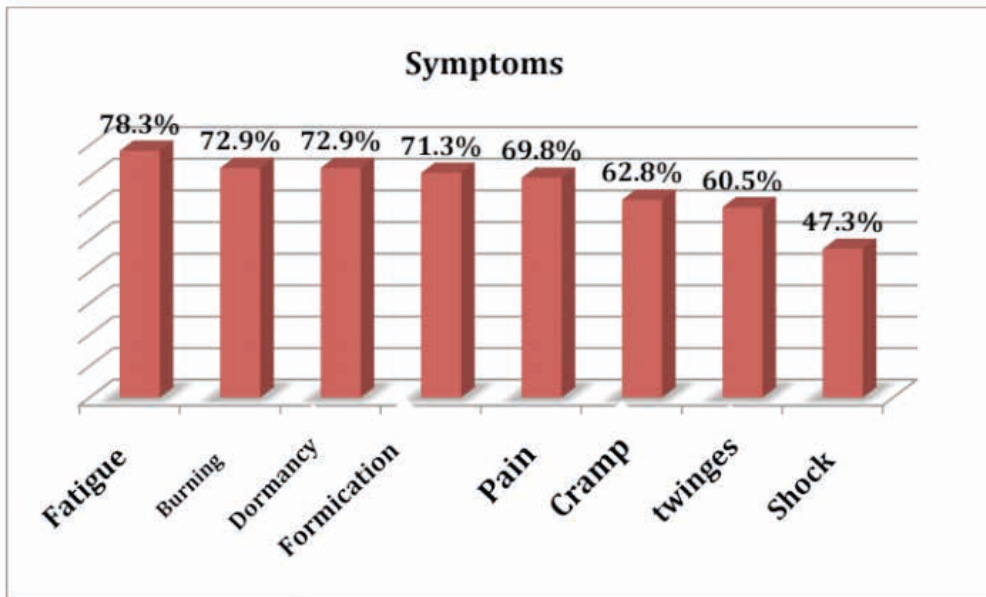
## DISCUSSION

One of the concerns facing the diabetic patient is the prevention of complications, such as the diabetic foot (PD). Aalaa et al (2012) highlights the importance of nurses in the prevention of PD and its repercussions on the individual's quality of life. This concept reinforces the need to develop a BN screening for PHC. Jurado et al. (2009) carried out a

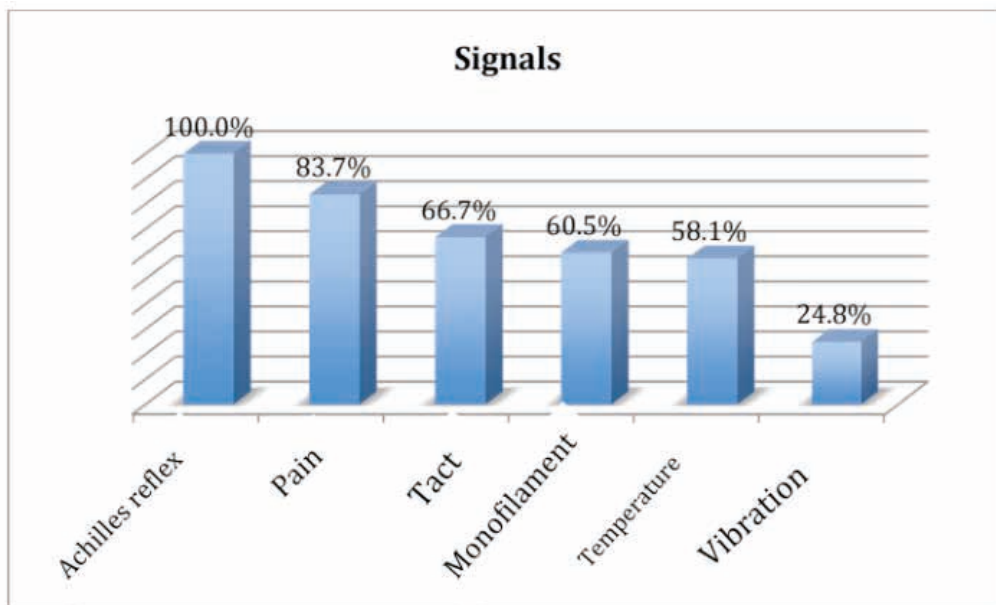
study, in primary care, in which a simplified test was developed for the detection of DN from a complete neurological examination and it was shown that the symptomatology, the physical examination and the quantitative and semi-quantitative tests make up a reasonable way to the diagnosis of ND. In Brazil, we do not have an instrument that allows the screening of DN in PHC. This fact has a negative impact when it comes to approaching early and avoiding the complications of DN (such as amputation of lower limbs, for example).

The average age was over 58 years old and the average time since DM diagnosis exceeded 11 years. OBMI and HbA1c had high averages, which clearly reveals the correlation between metabolic imbalance and the development of DN. High HbA1c is associated with poor glycemic control and the risk of developing DN, as well as age, HDL-cholesterol levels and the presence of retinopathy, as reported by Jurado et al (2009). However, when performing the statistical analysis, no association was observed between HbA1c levels and the presence of probable DN in our sample. DM duration, due to the long duration of metabolic and microvascular alterations in peripheral nerves, is considered a factor directly related to the risk of developing DN. However, the study demonstrated that the duration of DM proved to be a protective factor for the development of DN, as also observed by Al-Geffari (2012).

The risk of developing PD and amputation make imperative the need for a screening proposal for patients with DN. PD is characterized by infection, ulceration and/or destruction of soft tissues due to DN and/or peripheral arterial disease (PAD) affecting the lower limbs of diabetic patients (Guideline of the Brazilian Society of Diabetes, 2 Upper part of the form). DN is the main risk factor for PD, accounting for 70% of cases. It is also known that between 70 and 100% of patients with lower limb ulcers have signs of



Graphic 1- Frequency of neuropathic symptoms



Graph 2- Frequencies of neuropathic signs

	No ND	Possible	Probable	Probable/Possible Reason
Dormancy	100,00%	77,70%	72,90%	0,94
Burning	58,30%	66,90%	72,90%	1,09
Twinges	41,70%	54,60%	60,50%	1,11
Cramp	50,00%	54,60%	62,80%	1,15
Shock	50,00%	40,00%	47,30%	1,18
Formication	83,30%	58,50%	71,30%	1,22
Fatigue	58,30%	63,80%	78,30%	1,23
Pain	50,00%	56,90%	69,80%	1,23
Tactile	0,00%	56,20%	66,70%	1,19
Vibration	0,00%	18,50%	24,80%	1,34
Thermal	0,00%	36,20%	58,10%	1,61
Monofilament 10g	0,00%	36,90%	60,50%	1,64
Achilles reflex	0,00%	36,20%	100,00%	2,77

Table 1– Analysis by likelihood ratio in ND possible and probable

	Odds Ratio	P>z	[95% Conf.	Interval]
Sex	0,9	0,629	0,5	1,6
Age	1,0	0,338	1,0	1,0
HbA1c	0,6	0,130	0,3	1,2
Time of DM (years)	1,0	0,732	1,0	1,0
<b>Painful Sensitivity</b>	<b>2,9</b>	<b>0,003</b>	<b>1,4</b>	<b>5,8</b>
<b>Thermal Sensitivity</b>	<b>2,2</b>	<b>0,008</b>	<b>1,2</b>	<b>4,1</b>

HbA1c: glycated hemoglobin; DM: diabetes mellitus

Table 3 - Statistical Analysis by Logistic Regression



peripheral neuropathy with various degrees of peripheral vascular disease (International Consensus on Diabetic Foot, 2002). PD can lead to amputation and harm the individual, the family and the health and social security system. Once an amputation has occurred in a limb, there is a high chance of contralateral amputation (Caiafa, 2012).

The use of a 128Hz tuning fork and a 10g monofilament seemed to be appropriate, easy and inexpensive. These in combination would have diagnostic sensitivity and accuracy, allowing simple and regular assessment in PHC (Al-Geffari, 2012). However, in Brazil, both have a moderate cost, especially when considering that the 10g monofilament is sold together with five more monofilaments that will not be used and still requires an adequate technique to perform the test.

The altered 10g monofilament test showed a statistically significant correlation with abnormal tests of temperature and pain sensations, but during the regression analysis it lost statistical significance for the diagnosis of DN. Conversely, Rhaman et al (2003) concluded that the 10g monofilament test is an inexpensive and easy-to-use test in PHC, while vibration sensitivity must be used at the secondary level. In our study, we observed that the study with 10g monofilament was altered in 54% of cases, but vibratory sensitivity was the most prevalent sign.

Dyck (1998) initially proposed DN staging taking into account clinical and electroneuromyographic findings. This classification ranges from grade I to V. Tesfaye (2010) divides the DN, considering signs, symptoms and ENMG findings, into typical (possible, probable and confirmed – findings of neuropathy on ENMG) and atypical. The latter served as a parameter for the research in question because of its ease and for allowing clinical correlation to be made in an easier and more objective way.

ENMG is not able to precisely assess these fibers, being able to define involvement of medium and thick myelinated fibers. Our patients do not undergo the study by ENMG routinely, as it is not available in the public network. The registered clinical observations demonstrated the presence of alterations in the autonomic function and in thermal and pain sensitivity. These manifestations are due to the involvement of unmyelinated fibers and thin myelinated fibers, respectively, and are the most prevalent in our study. Therefore, an eminently clinical method for DN screening is important. If we base ourselves on Dyck (1998) and Tesfaye (2010) proposals, the difficulty of achieving early diagnosis of DN is established if we consider ENMG essential. Due to this fact, the search for an easy and quick tool for the early diagnosis of probable DN in PHC is justified.

In this study, Jurado et al. (2009) carried out a study to establish a clinical screening for the diagnosis of DN in a study carried out in Spain. The study involved healthcare professionals (16 nurses and 12 other professionals) and neuropathy was defined by the presence of bilateral signs and symptoms. For the diagnosis of DN, the presence of two or more signals was necessary, using the Achilles reflex, 10g-monofilament and the vibration threshold using a 128Hz tuning fork. The presence of an altered signal with the presentation of two more symptoms was also considered, that is, changes in sensitivity such as altered pain perception and decreased muscle strength. Higher neuropathic symptom score scores were considered to be indicative of DN only in conjunction with the alteration of at least one neuropathic sign. Specificity and sensitivity were around 74%, corroborating the results of other European studies. The San Antonio Consensus Statement (Young, 1993) proposes that two or more tests are sufficient for research proposals when studying the five

accepted categories of DN. This complexity of approach makes it difficult for PHC nurses to triage with their multiple functions.

In our work, we found results similar to those of Jurado et al (2009), although they are different study designs. However, the statistical study revealed that thermal and painful sensitivity and the Achilles reflex are the most statistically related to the diagnosis of probable DN. When verifying the prevalence of symptoms, we observed that complaints of numbness and burning were the most prevalent. However, the symptoms had no correlation with the probable DN, while the thermal and painful sensitivity and the Achilles reflex research showed the best correlation.

This is justified by the presence of these symptoms in neuropathies of other causes, but the presence of neuropathic symptoms in diabetics must lead to a screening test for DN.

## CONCLUSION

The assessment of thermal and painful sensitivity and the Achilles reflex were the most suitable clinical tests for screening probable DN in PHC. It is a quick assessment, which allows nurses to track DN cases, optimizing the clinical approach to DN by the PHC team. The study is continuing with the application of these tests in PHC and the use of the neuroconduction study with ENMG.

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