Factors associated with the risk of diabetic foot in patients with diabetes mellitus in Primary Care*

ABSTRACT

Objective: To analyze factors associated with diabetic foot risk in patients with diabetes mellitus assisted in Primary Care. Method: Observational, analytic, and transversal study took place in Teresina, Piauí, with diabetic patients who are assisted in Primary Care. Data collection took place through interviews, foot clinical exams, and medical record analysis. We used the Mann-Whitney, Pearson’s Chi-square and multiple logistic regression statistics tests to analyze the data. The association power among categorical variables was measured by Odds Ratio. Results: 322 patients participated. Marital status with a partner presented a protection factor (p = 0.007). Risk factors for the development of the diabetic foot are: arterial hypertension (p = 0.045), obesity (p = 0.011), smoking (p = 0.027), not being submitted to follow ups (p = 0.046), inadequate control of capillary blood glucose (p < 0.001), indisposition to the care of the foot (p=0.014), and foot self-exam less frequently (p = 0.040). Conclusion: Sociodemographic, clinical, and self-care aspects interfere in diabetic foot development, highlighting the necessity of effective follow up tracking and educational interventions for patients with diabetes mellitus in Primary Care.

DESCRIPTORS
Diabetes Mellitus; Diabetic Foot; Mass Screening; Primary Health Care; Nursing.

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INTRODUCTION

The diabetic foot is a syndrome that affects the low members of a patient with diabetes mellitus (DM) caused by a non-effective treatment that can trigger vascular and nerve complications, ulceration, and deformities. This avoidable grievance is responsible for a high number of amputations and hospitalizations resulting in an increase in costs for health services and compromising the productivity and quality of life of the patient.

In Spain, 73% of the amputations of lower members were caused by DM, with an incidence of 11.2 for 100,000 inhabitants in the period from 2001 to 2014. In Ceará, from 2010 to 2015, 4,182 hospitalizations for treatment of diabetic foot complications were registered, which presented a strong and positive correlation between the number of hospitalizations and amputations related to DM. In Piauí, 52% of the patients with DM showed plantar protective sensitivity change, one of the predictive factors for the diabetic foot.

The diabetic foot occurs because of metabolic decontrol, deficit of knowledge, and the non-adherence of recommended treatment. Moreover, the precarious hygiene, the use of inappropriate shoes, inadequate nail cut, the presence and non-treatment of onychomycosis and onychocryptosis, the incorrect remotion of calluses, the inadequate treatment of neuroischemic ulcers, and the peripheral ischemia are aggravating factors for the diabetic foot.

Hence, we highlight the necessity of follow ups that consist of making a survey of risk factors for the development of the diabetic foot through clinical and laboratory exams. Through this strategy, nurses can implement the care plan, recommendations and follow-ups that are indispensable for DM patient’s care management. However, a study carried out in Paraíba noted that the majority of nurses did not clinically examine the foot of patients for the plantar protective sensitivity evaluation.

Therefore, nurses perform a significant role in assisting patients with DM because he/she possesses specific abilities and skills for the care and the promotion of health. That way, the effectiveness of diabetic foot follow ups, by this professional, is crucial for the better management of health and the reduction of this frequent grievance in the scope of Primary Care.

Aiming to investigate the functioning of diabetic foot follow ups and to contribute to the establishment of a care line directed to the integrality of the assistance of patients with DM, this study aims to analyze the factors associated with the risk of diabetic foot in patients with mellitus diabetes attended in Primary Care.

METHOD

DESIGN OF STUDY

Observational, analytic, and transversal study.

SCENARIO

The study was carried out in Teresina, Piauí, in the Primary Care, in six Basics Health Units (BHU) of the region of Center-North given its superior demand of patients with DM in the city.

POPULATION AND SAMPLE

The population consists of 2,015 DM patients registered in the Hiperdia Program of Family Health Strategy from the referred region that carried out routine medical examinations in June 2018. Patients integrated the sample according to the inclusion criteria: people over 18 years with type 1 or 2 DM diagnosis; and exclusion: those with neuropathy related to other factors. We used the estimation formula from the population proportion to the finite population to calculate the minimum sample necessary, with a 95% confidence level, presumed prevalence of 50%, and a maximum error of 5%, resulting in 322 patients. Nonprobability sampling was carried out by convenience.

DATA COLLECTION

Before the collecting phase, we pre-tested 32 participants to try the instrument’s application. The data collection was carried out from February to August 2019 in three phases.

In the first phase, we did interviews by utilizing an adapted form to collect clinical and sociodemographic aspects, and the Admission to the Self-care with Feet for Diabetic patients quiz to evaluate self-care practices. We highlight that all variables regarding foot self-care, for instance, the indisposition to foot care, were collected by an oral report with the interviewed patients.

In the second phase, we did a clinical examination of the foot through the Michigan Neuropathy Screening Instrument (MNSI), considering the presence of neuropathy equal or greater than 2.5, with at least one sign or symptom. The classification of risk of developing diabetic foot was carried out by the instrument for diabetic foot examination in 3 minutes. Patients were considered with a diabetic foot when there were open wounds or ulcerative areas with or without signs of foot infection.

Patients were properly guided and seated on the stretcher or on a chair to ease the examination. Previous demonstrations of the procedure were carried out so that the patient could understand the stimulus they could feel during the examination of the feet, besides being oriented to keep their eyes closed during the examination, to prevent inaccurate results. For the tests, we utilized 10 g Semmes-Weinstein monofilament, 128 Hz tuning fork, and the neurological hammer.

In the third phase, we analyzed the handbook for the anthropometric data collection and laboratory exams. We emphasize that we collected the data during the a day when the patient had a scheduled consultation with the Hiperdia Program, before seeing the patients in a reserved room in the BHU.

The independent variables were sociodemographic, clinical, and related to self-care and dependent to the risk of developing diabetic foot, the outcome was having or not the risk of developing diabetic foot.
Data analysis and treatment

Data tabulation, with double digitations, was carried out on Microsoft Excel 2013. Subsequently, we exported the data to the Software Statistical Package for Social Science (SPSS), 22.0 version. For the analysis, we held descriptive and inferential statistics. In the descriptive, for numerical variables, we calculated median, minimum and maximum values. For the categorical, we utilized absolute frequency and percentage. In the inferential statistic, we applied bivariate and multivariate statistical tests.

To verify the numerical distribution of the variable pattern, we utilized the Kolmogorov-Smirnov normality test, which demonstrated nonnormality in the distribution. In the inferential analysis, for bivariate statistics, we applied Mann-Whitney tests to compare a numerical variable with a dichotomous categorical, and Pearson’s Chi-square to verify the association between two categorical variables. The Odds Ratio (OR), with 95% Confidence Intervals (IC), was utilized to verify the association strength between the categorical variables. We highlight that the adopted reference category occurred based on clinical importance.

In the multivariate statistics, we created a multiple logistic regression model through the stepwise forward method, in which we first introduced the variable of greatest statistical significance and, later, the other variables, following the decreasing order of identified association in the bivariate analysis. The variable inclusion criteria in the multivariate model was the value of p ≤ 0.20 obtained in the bivariate analysis(14). We identified the multicollinearity between independent variables through the Variance Inflation Factor (VIF), in which the value greater than four was adopted as a point of cut for the diagnosis of VIF multicollinearity(15). The value of p < 0.05 was considered significant for all statistical tests.

Ethical aspects

This study followed the ethical aspects of the 466/2012 Resolution of the National Health Council and it was approved by the Ethics Research Committee from the Universidade Federal do Piauí, in 2018, under the No. 2.817.426

Results

In the sociodemographic characterization, the characteristics which prevailed in participants were: being a young elder (53.4%), female (70.2%), brown skin (70.2%), living with partner in a marital status (62.4%), and had a personal income of one minimum wage salary(1) (64.0%). Part of them were retired (33%) and did not complete elementary school (44.4%).

Regarding the clinical aspects, the characteristics which prevailed in participants were: being diagnosed with DM type 2 (94.4%), under oral medication (as predominant medication type) (86.0%), and inadequate glycemic control (51.9%). In addition, 58.7% reported that they were living with the disease for less than 10 years, 66.1% had dyslipidemia, and 72.0% arterial hypertension. However, the majority did not present retinopathy (55.6%), nephropathy (82.0%) and obesity (72.7%), besides not smoking (89.8%) nor using alcohol (82.6%). On the other hand, 76.7% had low visual acuity.

With regards to diabetic foot follow ups, 86.3% of patients with DM had never been submitted to the clinical foot exam, 59.0% had diabetic neuropathy, 3.1% diabetic foot, and 69.6% risk of developing diabetic foot. Besides, 57.8% reported that they did not receive any type of monitoring.

In the clinical foot exam, the foot that most showed abnormal appearance was the right one (68.9%), in which dry skin and/or calluses were the most common complications (57.1%), and 1.9% presented ulcer. The presence of ankle reflex (57.1%) and the plantar protective sensibility to 10 g monofilament (68.3%) prevailed in the right foot. However, the left foot had more numbers of absence of vibration perception from the hallux to the tuning fork of 128 Hz (42.9%).

Their age (p = 0.046), DM diagnosis time (p < 0.001), education completion (p = 0.008), and the number of foot complications (p < 0.001) presented statistical significance for the development of the diabetic foot (Table 1).

Table 1 - Sociodemographics and clinical variables differences in relation to the risk of developing diabetic foot - Teresina, Piauí, Brazil, 2019.

| Variables                  | Median | Minimum | Maximum | p value |
|----------------------------|--------|---------|---------|---------|
| Age in years               | 62.0   | 26.0    | 87.0    | 0.046   |
| Years of study             | 7.5    | 0.0     | 18.0    | 0.008   |
| Income in reais            | 998.0  | 0.0     | 5998.0  | 0.429   |
| DM diagnosis time in years | 6.5    | 0.0     | 63.0    | < 0.001 |
| BMI                        | 27.9   | 19.1    | 46.4    | 0.195   |
| Number of foot complications| 2.0    | 0.0     | 8.0     | < 0.001 |

Mann-Whitney test.
n = 322

Table 1 The minimum wage per month in Brazil corresponds to R$ 1.100,00 reais or US$ 196.42 American dollars according to the Central Bank of Brazil on March 1st, 2021.
We identified that arterial hypertension (OR:1.96; IC:1.17-3.26) and obesity (OR:1.85; IC:1.04-3.29) increased the chances of developing the diabetic foot. However, marital status with a partner (OR:0.70; IC:0.51-0.98) and follow ups (OR:0.57; IC:0.33-0.99) are protection factors according to Table 2.

Table 2 - Sociodemographic and clinical aspects association with the risk of developing the diabetic foot - Teresina, Piauí, Brazil, 2019.

| Variables            | Risk of diabetic foot | OR raw | IC 95%     | p value |
|----------------------|-----------------------|--------|------------|---------|
|                      | Yes (n (%) )          | No (n (%) ) |          |         |
| Marital status       |                        |        |            |         |
| With a partner*      | 148 (73.6)            | 53 (26.4) | 0.70       | 0.51 – 0.98 | 0.046 |
| No partner           | 76 (62.8)             | 45 (37.2) |            |         |       |
| Diabetes type        |                        |        |            |         |
| Diabetes type 1*     | 14 (77.8)             | 4 (22.2) | 1.57       | 0.50 – 4.89 | 0.436 |
| Diabetes type 2      | 210 (69.1)            | 94 (30.9) |            |         |       |
| Arterial hypertension|                        |        |            |         |
| Yes*                 | 171 (73.7)            | 61 (26.3) | 1.96       | 1.17 – 3.26 | 0.010 |
| No                   | 53 (58.9)             | 37 (41.1) |            |         |       |
| Obesity              |                        |        |            |         |
| Yes*                 | 69 (78.4)             | 19 (21.6) | 1.85       | 1.04 – 3.29 | 0.034 |
| No                   | 153 (66.2)            | 79 (33.8) |            |         |       |
| Smoking              |                        |        |            |         |
| Yes*                 | 28 (84.8)             | 5 (15.2)  | 2.66       | 0.99 – 7.10 | 0.044 |
| No                   | 196 (67.8)            | 93 (32.2) |            |         |       |
| Alcohol use          |                        |        |            |         |
| Yes*                 | 38 (67.9)             | 18 (32.1) | 0.91       | 0.49 – 1.69 | 0.760 |
| No                   | 186 (69.9)            | 80 (30.1) |            |         |       |
| Follow ups           |                        |        |            |         |
| Yes*                 | 25 (56.8)             | 19 (43.2) | 0.57       | 0.33 – 0.99 | 0.048 |
| No                   | 199 (71.6)            | 79 (28.4) |            |         |       |
| Monitoring           |                        |        |            |         |
| Yes*                 | 92 (67.6)             | 44 (32.4) | 0.86       | 0.53 – 1.38 | 0.522 |
| No                   | 132 (71.0)            | 54 (29.0) |            |         |       |

* Reference category. Pearson’s Chi-square test. n = 322

Associating the self-care with the risk of developing the diabetic foot, inadequate glycemic control (OR:3.47; IC:2.11-5.70), indisposition to the care of the foot (OR:3.45; IC:1.73-6.87), non-square cut shape of the nails (OR:1.88; IC:1.16-3.07), and not using moisturizer (OR:2.16; IC:1.33-3.50) increase the chances of developing the diabetic foot. The self-exam of the foot (p < 0.001), checking the shoes before wearing them (p = 0.009), drying the gaps between the toes (p = 0.016), and using homemade solution for dressing (p = 0.004) showed significant association with the risk of developing the diabetic foot statistically, according to the Table 3.

Table 3 - Self-care association with the risk of developing diabetic foot - Teresina, Piauí, Brazil, 2019.

| Variables                                           | Risk of diabetic foot | RawOR | IC 95%     | p value |
|-----------------------------------------------------|-----------------------|-------|------------|---------|
|                                                     | Yes (n (%) )          | No (n (%) ) |       |         |
| Patient searches for professional health care whenever she/he has a problem with her/his foot |                        |        |            |         |
| No*                                                 | 123 (72.8)            | 46 (27.2) | 1.38       | 0.86 – 2.22 | 0.187 |
| Yes                                                 | 101 (66.0)            | 52 (34)  |            |         |       |
…continuation

| Variables                                                                 | Risk of diabetic foot | RawOR | IC 95%     | p value |
|---------------------------------------------------------------------------|-----------------------|-------|------------|---------|
|                                                                           | Yes (n)               | No (n) | IC 95%     |         |
| Patient has someone who encourages or helps her/him in the care of the foot |                       |       |            |         |
| No*                                                                      | 130 (69.9)            | 56 (30.1) | 1.04 | 0.64 – 1.68 | 0.881   |
| Yes                                                                      | 94 (69.1)             | 42 (30.9)  |     |           |         |
| Patient practices physical activity for at least 30 minutes/day          |                       |       |            |         |
| Not once*                                                                | 133 (72.7)            | 50 (27.3)  | 1.4  | 0.87 – 2.26 | 0.164   |
| At least once a week                                                     | 91 (65.5)             | 48 (34.5)  |     |           |         |
| Patient controls the capillary blood glucose levels                      |                       |       |            |         |
| No*                                                                      | 154 (80.2)            | 38 (19.8)  | 3.47 | 2.11 – 5.70 | < 0.001 |
| Yes                                                                      | 70 (53.8)             | 60 (46.2)  |     |           |         |
| Patient takes prescribed medications as recommended                      |                       |       |            |         |
| No*                                                                      | 16 (76.2)             | 5 (23.8)   | 1.43 | 0.51 – 4.02 | 0.495   |
| Yes                                                                      | 208 (69.1)            | 93 (30.9)  |     |           |         |
| The health professional advises about the care of the foot               |                       |       |            |         |
| No*                                                                      | 159 (71.0)            | 65 (29.0)  | 1.24 | 0.75 – 2.07 | 0.403   |
| Yes                                                                      | 65 (66.3)             | 33 (33.7)  |     |           |         |
| Patient has disposition to take care of the foot                         |                       |       |            |         |
| No*                                                                      | 68 (86.1)             | 11 (13.9)  | 3.45 | 1.73 – 6.87 | < 0.001 |
| Yes                                                                      | 156 (64.2)            | 87 (35.8)  |     |           |         |
| Patient examines the foot frequently                                     |                       |       |            |         |
| No                                                                       | 122 (80.3)            | 30 (19.7)  |     |           | < 0.001 |
| Weekly                                                                   | 71 (64.0)             | 40 (36.0)  |     |           |         |
| Daily                                                                    | 31 (52.5%)            | 28 (47.5)  |     |           |         |
| Patient dries the gaps between her/his toes                              |                       |       |            |         |
| No                                                                       | 100 (77.5)            | 29 (22.5)  |     |           | 0.016   |
| Weekly                                                                   | 73 (68.2)             | 34 (31.8)  |     |           |         |
| Daily or after each bath                                                 | 73 (68.2)             | 34 (31.8)  |     |           |         |
| Patient checks the shoes before wearing them                             |                       |       |            |         |
| No                                                                       | 65 (79.3)             | 17 (20.7)  |     |           | 0.009   |
| Rarely                                                                   | 73 (73.7)             | 26 (26.3)  |     |           |         |
| Always                                                                   | 86 (61.0)             | 55 (39.0)  |     |           |         |
| Patient cuts the toes’ nails in a square shape                           |                       |       |            |         |
| Never*                                                                   | 117 (76.5)            | 36 (23.5)  | 1.88 | 1.16 – 3.07 | 0.010   |
| Yes, although it is not possible to assume how frequently                | 107 (63.3)            | 62 (36.7)  |     |           |         |
| Patient applies moisturizer in the foot                                  |                       |       |            |         |
| Never*                                                                   | 134 (77.0)            | 40 (23.0)  | 2.16 | 1.33 – 3.50 | 0.002   |
| Every day or almost every day                                            | 90 (60.8)             | 58 (39.2)  |     |           |         |
| Patient makes dressings at home with homemade solutions or with other products |                 |       |            |         |
| Yes*                                                                     | 63 (82.9)             | 13 (17.1)  | 2.56 | 1.33 – 4.91 | 0.004   |
| No                                                                       | 161 (65.4)            | 85 (34.6)  |     |           |         |

* Reference category.
Pearson’s Chi-square test.
n = 322
At the final model of the multiple logistic regression, the marital status with a partner was a factor of protection for the development of the diabetic foot (ORa:0.47; IC:0.27–0.81). The time of diagnosis of DM (ORa:0.92; IC:0.88-0.95) and the number of foot complications (ORa:0.63; IC:0.51–0.77) resulted in a negative association, in other words, patients with a shorter time of diagnosis and the least number of complications have lower chances of developing the diabetic foot. Arterial hypertension (ORa:1.83; IC:1.01-3.32), obesity (ORa:2.27; IC:1.21-4.28), smoking(ORa:3.18; IC:1.14-8.86), not going through follow ups (ORa:2.1; IC:1.01-4.39), inadequate control of the capillary blood glucose levels ORa:3.02; IC:1.74–5.25), indisposition to the foot care (ORa:2.90; IC:1.24–6.79), and not self-examining the foot frequently (ORa:2.11; IC:1.03–4.32) increase the chances of developing the diabetic foot (Table 4).

| Variables                                | OR adjusted | IC 95%          | p value* |
|------------------------------------------|-------------|-----------------|----------|
| Age in years                             | 0.99        | 0.96 – 1.01     | 0.604    |
| Years of study                           | 1.04        | 0.97 – 1.11     | 0.201    |
| Marital status                           |             |                 |          |
| With a partner                           | 0.47        | 0.27 – 0.81     | 0.007    |
| Time of diagnosis in years               | 0.92        | 0.88 – 0.95     | < 0.001  |
| Arterial hypertension                    |             |                 |          |
| Yes                                      | 1.83        | 1.01 – 3.32     | 0.045    |
| Obesity                                  |             |                 |          |
| Yes                                      | 2.27        | 1.21 – 4.28     | 0.011    |
| Smoking                                  |             |                 |          |
| Sim                                      | 3.18        | 1.14 – 8.86     | 0.027    |
| Follow ups                               |             |                 |          |
| No                                       | 2.10        | 1.01 – 4.39     | 0.046    |
| Patient controls the capillary blood glucose levels | |                 |          |
| No                                       | 3.02        | 1.74 – 5.25     | < 0.001  |
| Patient has disposition to take care of the foot | |                 |          |
| No                                       | 2.90        | 1.24 – 6.79     | 0.014    |
| Patient self-exams the foot frequently   |             |                 |          |
| No                                       | 2.11        | 1.03 – 4.32     | 0.040    |
| Patient dries the gaps between the toes  |             |                 |          |
| No                                       | 1.03        | 0.48 – 2.19     | 0.928    |
| Patient checks the shoes before wearing them | |                 |          |
| No                                       | 0.98        | 0.42 – 2.30     | 0.977    |
| Patient cuts the toes nails in a square shape | |                 |          |
| Never                                    | 0.55        | 0.27 – 1.12     | 0.103    |
| Patient applies moisturizer in the foot  |             |                 |          |
| Never                                    | 1.00        | 0.51-1.96       | 0.989    |
| Patient makes dressings at home with homemade solutions or with other products | |                 |          |
| Yes                                      | 1.86        | 0.85 – 4.03     | 0.117    |
| Number of foot complications             | 0.63        | 0.51 – 0.77     | < 0.001  |

*Multiple logistic regression
n = 322

DISCUSSION

The sociodemographic characterization of this research converges, partly, with another study carried out in Paraná, in which the majority of patients with DM were, on average, 60 years old, female (62.0%), 69.6% were with a partner, 67.7% had a low educational level, with less than six years of study. However, it differed in respect to skin color, which prevailed white (71.8%)(30).
The marital status with a partner, in the multivariate model, presented protection factor for the development of the diabetic foot, that can be explained by the emotional and social support offered by a partner while facing DM, which improved the adherence to the treatment through monitoring of glycemic control, use of medication, promotion of self-care, and lifestyle changes.

In Ireland, the advanced age, being male, having a smoking background, low level of physical activity, and high cholesterol diagnosis predicted macrovascular complications. Likewise, DM diagnosis of 10 years of more, the smoking background, and the arterial hypertension were associated with increased risk of macrovascular complications. These results partially corroborated with this research because arterial hypertension and smoking increases the chances of developing diabetic foot, while the age and education level did not present any statistically significant association.

A transversal study carried out in Saudi Arabia also demonstrated prevalence on the type 2 DM (89.1%) and that oral hypoglycemic agents are the selected treatment for 57.2% of the patients. Regarding the associated comorbidities, the percent of nephropathy was similar to this research (7.6%). However, arterial hypertension (47.2%) and dyslipidemia (16.7%) were different, with lower values registered in this study. We highlight that DM associated with arterial hypertension and dyslipidemia causes an increase in cardiovascular risk and, consequently, in developing diabetic foot.

For the prevention of ulceration and amputation of lower members in patients with DM, performing clinical examination of the foot through anamnesis and physical exam are crucial. However, the majority of patients in this research reported that they had never been submitted to the clinical examination of the foot. This data denounces lack of integrity in the care of patients with DM, highlighting the necessity to implement a more robust care line for the Primary Care issues we face.

We noted that most of the patients were positive for diabetic neuropathy. Even though the majority did not present diabetic foot, the risk percentage of developing the diabetic foot was significant, which reinforces the necessity of clinical examination of the foot, investigating and controlling the risk factor in Primary Care. Converging with these results research carried out in Distrito Federal identified that 41.9% of patients had painful diabetic polyneuropathy and 86.6% with a risk of foot ulceration.

The main complications identified were: dry skin, caused by lack of moisturizing, and calluses, given the friction, and plantar pressure. Daily use of moisturizer prevents dry skin and fissure. On the other hand, comfortable, fitting, and seamless footwear is the most adequate because thin nozzled shoes and flip flops cause pressure points on the foot, which can lead to calluses and injuries. These self-care orientations must be intensified by the nurse during the care of patients with DM.

The examination to verify the vibratory sensitivity, through a tuning fork of 128 Hz, was the one that identified the highest number of changes between both feet. Although it effectively tracks the risk of developing diabetic foot and recommended by the Health Ministry, we noticed that this device is not available for Primary Care Nurses in research scenarios, which hampers the complete clinical examination of the foot in DM patients.

The DM diagnosis time, in the multivariate model, presented a significant statistical association with the risk of developing the diabetic foot because those who had the least time with the disease also presented less risk of developing the diabetic foot. It is known that hyperglycemia, in the long term, compromises the nervous and cardiovascular system, for that reason, patients with a longer time of diagnosis are more likely to have foot complications.

Obese patients presented 2.1 times more chances of developing diabetic foot. Indeed, overweight is one of the main factors that contributes to the hyperglycemia maintenance, through numerous physiological mechanisms, for instance the increase of free fatty acids in the blood flow, the decrease of adiponectin, and cytokine secretion through adipose tissue, which causes cellular resistance to insulin.

The number of foot complications is associated with the risk of developing diabetic foot. Corroborating the results, a study identified that diabetic patients with foot complications had 29.85% more chances of ulceration if compared to those without abnormalities. Regarding the complications, plantar calluses, also emphasized by this research, were the main factor of risk for foot ulceration.

Lack of follow ups appeared to be a risk factor for the development of the diabetic foot, and that is explained because the majority of DM patients, in the Teresina scenario, were not submitted to a clinical examination routine of the foot. Besides, we found that most of the patients were not monitored, through risk stratification and specialist follow-up, which hampers the maintenance of the care. This precariousness in the assistance, still unchanged, was reported in 2011 when 79.5% of DM patients affirmed not being submitted to clinical examination during the care, and 96.4% had not gone through the feet sensitivity test in the previous 12 months.

The glycemic control presented an association with the risk of developing the diabetic foot because patients with inadequate glycemic control had 3.02 times more chances of developing diabetic foot. A study carried out in Pernambuco reported that inadequate glycemic control was more frequent in DM patients with three or more complications of the disease and in those patients who in the previous 12 months were not sent to the endocrinologist or cardiologist. The glycemic unmanageability was also prevalent when the drug treatment became more complex, which emphasizes that the drug orientation, by the nurse, is indispensable.

Not inspecting the foot daily is statistically significantly associated with the risk of developing diabetic foot. Research carried out in Spain verified that only 48.0% of participants knew the specific self-care for preventing diabetic foot, 50.6% did daily inspection, 97.0% washed the feet daily, 45.2% moisturized the feet, and 65.7% cut the nails properly, pointing out that the self-care deficit with the feet is also a problem for developed countries.
La situación marital con compañero se presentó como un factor de protección ($p = 0,007$). La hipertensión arterial ($p = 0,045$), la obesidad ($p = 0,011$), el tabaquismo ($p = 0,027$), no haber sido policlínico ($p = 0,007$) y el no realizar el autoexamen de pies con frecuencia ($p = 0,040$) se mostraron factores de riesgo para el desarrollo del pie diabético. La recogida de datos se realizó mediante entrevista, examen clínico de los pies y análisis de las historias clínicas. Los datos fueron analizados utilizando los testes estadísticos de Mann-Whitney, Qui cuadrado de Pearson y regresión logística múltiple. La fuerza de la asociación entre las variables categóricas se midió con la Razón de Momios (Odds Ratio) y se estableció la necesidad de un seguimiento en el pie diabético. En conclusión, se sugiere la importancia de la educación en el cuidado del pie diabético, así como la necesidad de un seguimiento en los pacientes con diabetes mellitus en la atención primaria.
(p < 0.001), la falta de disposición para cuidarse los pies (p = 0.014) y la no realización del autoexamen de los pies a menudo (p = 0.040) se revelaron como factores de riesgo para el desarrollo del pie diabético. **Conclusion**: Los aspectos sociodemográficos, clínicos y de autocuidado interfieren en el riesgo de desarrollar pie diabético, lo que pone de manifiesto la necesidad de rastreos e intervenciones educativas eficaces para las personas con diabetes mellitus en la Atención Primaria.

**DESCRIPTORES**
Diabetes Mellitus; Pie Diabético; Tamizaje Masivo; Atención Primaria de Salud; Enfermería.

**REFERENCES**
1. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Atenção Básica. Manual do pé diabético: estratégias para el cuidado de la persona con diabetes crónica [Internet]. Brasília, DF: Ministério da Saúde; 2016 [cited 2020 Mar 10]. Available from: http://189.28.128.100/dab/docs/portal/dab/publicacoes/manual_do_pe_diabetico.pdf
2. Toscano CM, Sugita TH, Rosa MQ, Pedrosa HC, Rosa RD, Bahia LR. Annual direct medical costs of diabetic foot disease in Brazil: a cost of illness study. Int J Environ Res Public Health. 2018;15(1):1-13. https://doi.org/10.3390/ijerph15010089
3. Jiménez S, Rubio JA, Álvarez J, Ruiz-Grande F, Medina C. [Trends in the incidence of lower limb amputation after implementation of a Multidisciplinary Diabetic Foot Unit]. Endocrinol Diabetes Nutr. 2017;64(4):188-97. Spanish. https://doi.org/10.1016/j.endinu.2017.02.009
4. Marques AD, Silva LM, Moreira TM, Torres RA. Association between hospitalization due to diabetes mellitus and diabetic foot amputation. Enferm Global. 2018;17(51):248-57. https://doi.org/10.6018/eglobal.17.3.286181
5. Silva HG, Lopes RM, Feitosa MC, Sousa KF, Oliveira RA. [Quality of life evaluation in type 2 diabetic patients and sensitive deficit prevalence in lower extremity]. Rev Bras Qual Vida. 2017;9(2):165-77. Spanish. https://doi.org/10.3895/rbqv.v9n2.6033
6. Netten JJ, Price PE, Lavery LA, Monteiro-Soores M, Rasmussen A, Jubiz Y, et al. Prevention of foot ulcers in the at-risk patient with diabetes: a systematic review. Diabetes Metab Res Rev. 2016;32(1 Suppl 1):84-98. https://doi.org/10.1002/dmr.2701
7. Dutra LM, Novaes MR, Melo MC, Veloso DL, Faustino DL, Sousa LM. Assessment of ulceration risk in diabetic individuals. Rev Bras Enferm. 2018;71(2):733-9. https://doi.org/10.1590/0034-7167-2017-0337
8. Oliveira PS, Bezerra EP, Andrade LL, Gomes PL, Soares MJ, Costa MM. Practice nurse family health strategy in the prevention of diabetic foot. Rev Fund Care Online. 2016;8(3):4841-9. https://doi.org/10.9789/2175-3561.2016.v8i3.4841-4849
9. Menezes LC, Guedes MV, Moura NS, Moura DJ, Vieira LA, Barros AA. Knowledge of nurses in primary health care on the treatment for the diabetic foot. Estima. 2017;15(2):100-6. Portuguese. https://doi.org/10.5327/z1806-314420170020006
10. Mello RF, Pires ML, Kede J. Clinical evaluation form of lower members for diabetic foot prevention]. Rev Fund Care Online. 2019;7(3):899-913. Portuguese. https://doi.org/10.9789/2175-3561.rfc2019.v9.5468
11. Galdino YL, Moreira TM, Marques AD, Silva FA. Validation of a booklet on self-care with the diabetic foot. Rev Bras Enferm. 2019;72(3):817-24. https://doi.org/10.1590/0034-7167-2017-0900
12. Oliveira FB, Botelho KK, Bezerra AR, Azevedo CC, Fachin-Martins F. Cross-cultural adaptation to Brazilian Portuguese of the Michigan Neuropathy Screening Instrument: MNSI-Brazil. Arq Neuro-Psiquiatr. 2016;74(8):653-61. https://doi.org/10.1590/0004-282X20160094
13. Baldassarlis ML, Martínez BB. [Cross-cultural adaptation of the diabetic foot examination instrument in 3 minutes]. Rev Bras Med Fam Comunidade. 2020;15(42):1-12. Portuguese. https://doi.org/10.5712/rbmcf15(42)2008
14. Katz MH. Multivariable analysis: a primer for readers of medical research. Ann Intern Med. 2003;138(8):644-50. https://doi.org/10.7326/0003-4819-138-8-200304150-00012
15. Garson GD. Structural equation modeling. Asheboro: Statistical Publishing Associates; 2010.
16. Teston EF, Senteio JS, Ribeiro BMSS, Maran E, Marcon SS. Risk factors for foot ulceration in individuals with type 2 Diabetes Mellitus. Cogitare Enferm. 2017;22(4):e.51508. https://doi.org/10.5380/ce.v22i4.51508
17. Tracey ML, McHugh SM, Fitzgerald AP, Buckley CM, Canavan RJ, Kearney PM. Risk factors for macro- and microvascular complications among older adults with diagnosed type 2 diabetes: findings from The Irish Longitudinal Study on Ageing. J Diabetes Res. 2016;2016:5975903:5975903. https://doi.org/10.1155/2016/5975903
18. Alshareef SM, Aldayel Y, AlKhatthab MA, AlDujaili DJ, AlShareef FG, Al-Harthi ME, et al. Diabetic patients in Saudi Arabia: the evaluation of glycemic control measures based on emergency department utilization and the percentages of adherence to the recommended follow-ups for microvascular complications. Saudi Med J. 2019;40(3):271-6. https://doi.org/10.15537/smj.2019.3.23968
19. Cubas MR, Santos OM, Retzlaff EM, Telma HL, Andrade IP, Moser AD, et al. [Diabetic foot: orientations and knowledge about prevention care]. Fisioter Mov. 2013;26(3):647-55. Portuguese. https://doi.org/10.5327/Z1806-31442013003002006
20. Queiroz MS, Iqbal M, Zubair S, Ali J, Jawed MU. Ambulatory screening of diabetic neuropathy and predictors of its severity in outpatient settings. J Endocrinol Invest. 2017;40(4):425-30. https://doi.org/10.1007/s40618-016-0581-y
21. Canto ED, Ceriello A, Rydén L, Ferrini M, Hansen TB, Schnell O, et al. Diabetes as a cardiovascular risk factor: an overview of global trends of macro and micro vascular complications. Eur J Prev Cardiol. 2019;26(1):1-8. https://doi.org/10.1177/2047487319878371
22. Ferreira LT, Saviozzi IH, Valentí VE, Abreu LC. Diabetes mellitus: hyperglycemia and its chronic complications. ABCS Health Sciences. 2011;36(3):182-8.
23. Schroeder EB, Bayliss EA, Daugherty SL, Steiner JF. Gender differences in cardiovascular risk factors in incident diabetes. Womens Health Issues. 2014;24(1):e61-8. https://doi.org/10.1016/j.who.2013.09.008
24. Rossaneis MA, Andrade SM, Gvozdi P, Pissinati PS, Haddad MD. Factors associated with glycemic control in people with diabetes mellitus. Cien Saúde Coletiva. 2019;24(3):997-1005. https://doi.org/10.1590/1413-8123201824.02022017
Factors associated with the risk of diabetic foot in patients with diabetes mellitus in Primary Care

25. Zhong A, Li G, Wang D, Sun Y, Zou X, Li B. The risks and external effects of diabetic foot ulcer on diabetic patients: a hospital-based survey in Wuhan area, China. Wound Repair Regen. 2017;25(5):858-63. https://doi.org/10.1111/wrr.12589

26. Rezende Neta DS, Silva AR, Silva GR. [Adhesion de las personas con diabetes mellitus autocuidado con sus pies]. Rev Bras Enferm. 2015;68(1):111-6. Portuguese. https://doi.org/10.1590/0034-7167.2015680115p

27. Lima RF, Fontbonne A, Carvalho EM, Montarroyos UR, Barreto MN, Cesse EA. Factors associated with glycemic control in people with diabetes at the Family Health Strategy in Pernambuco. Rev Esc Enferm USP. 2016;50(6):937-45. https://doi.org/10.1590/s0080-623420160000700009

28. Couselo-Fernández I, Rumbo-Prieto JM. [Diabetic foot risk and self-care shortfalls among Type 2 Diabetes Mellitus patients]. Enferm Univ. 2018;15(1):17-29. Spanish. https://doi.org/10.22201/eneo.23958421e.2018.1.62902

29. Chin YF, Huang TT, Hsu BR, Weng LC, Wang CC. Factors associated with foot ulcer self-management behaviours among hospitalised patients with diabetes. J Clin Nurs. 2019;28(11-12):2253-64. https://doi.org/10.1111/jocn.14822

30. Sá PN, Moura JR, Melo Júnior EB, Almeida PC, Macêdo SF, Silva AR. Knowledge, attitudes and practices for the prevention of diabetic foot. Rev Gaúcha Enferm. 2014;35(3):36-42. https://doi.org/10.1590/1983-1447.2014.03.45187

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