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DIABETIC FOOT EXAM: RISK FACTORS OF ULCERATION IN PATIENTS WITH DIABETES MELLITUS

EXAME DO PÉ DIABÉTICO: FATORES DE RISCO DE ULCERAÇÃO EM PACIENTES COM DIABETES MELLITUS

EXAMEN DEL PIE DIABÉTICO: FACTORES DE RIESGO DE ULCERACIÓN EN PACIENTES CON DIABETES MELLITUS

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Objective: to describe the evolution of risk factors for the development of foot ulcers in patients with DM, in three subsequent exams over a period of 3 years, in a medical specialty center. Method: a descriptive, retrospective and longitudinal study, with 102 patients, between the years 2016 and 2019, who performed three sequential foot exams, based on the standard established by the international consensus of the diabetic foot, being use of footwear, collected from the Diabetic Foot System. Results: 86.27% of patients reported neuropathic symptoms, mainly burning, numbness and tingling. Most were hypertensive (74.71%) and elderly (67.65%), of these, 13.73% had previous infarction and 72.55% were female. From the first to the third examination, the "very low risk" increased 7.84% and the "low risk" 8.83%, while the "high risk" reduced 17.65%. Conclusion: the systematic clinical feet exam, associated with effective educational strategies, results in a more effective control of the risk of ulceration.

Descriptors: Diabetes *Mellitus*. Diabetic Foot. Self-care. Diabetic Neuropathies. Risk Factors.

Objetivo: descrever a evolução dos fatores de risco para o desenvolvimento de úlceras nos pés de pacientes com DM, em três exames subsequentes num período de 3 anos, num centro de especialidades médicas. Método: estudo descritivo, retrospectivo e longitudinal, com 102 pacientes, entre os anos de 2016 e 2019, que realizaram três exames dos pés sequenciais, fundamentado no padrão estabelecido pelo consenso internacional do pé diabético, sendo eles avaliação neuropática, vascular, dermatológica e uso dos calçados, coletado do Sistema do Pé Diabético. Resultados: 86,27% dos pacientes declararam sintomas neuropáticos, principalmente queimação, dormência e formigamento. A maioria hipertensos (74,71%) e idosos (67,65%), desses 13,73% com infarto prévio e 72,55% eram do sexo feminino. Do primeiro ao terceiro exame, o "risco muito baixo" aumentou 7,84% e "risco baixo" 8,83%, já o "risco elevado"

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reduziu 17,65%. Conclusão: a realização sistemática do exame clínico dos pés, associado a estratégias educativas efetivas, resultam num controle mais eficaz do risco de ulceração.

Descritores: Diabetes Mellitus. Pé Diabético. Autocuidado. Neuropatias Diabéticas. Fatores de Risco

Objetivo: Describir la evolución de los factores de riesgo para el desarrollo de úlceras en los pies de pacientes con DM, en tres exámenes subsecuentes en un período de 3 años, en un centro de especialidades médicas. Método: estudio descriptivo, retrospectivo y longitudinal, con 102 pacientes, entre los años 2016 y 2019, que realizaron tres exámenes de los pies secuenciales, fundamentado en el patrón establecido por el consenso internacional del pie diabético, siendo ellos evaluación neuropática, vascular, dermatológica y uso de calzado, recogido del Sistema del Pie Diabético. Resultados: 86,27% de los pacientes declararon síntomas neuropáticos, principalmente ardor, entumecimiento y hormigueo. La mayoría hipertensos (74,71%) y ancianos (67,65%), de esos 13,73% con infarto previo y 72,55% eran mujeres. Del primero al tercer examen, el "riesgo muy bajo" aumentó un 7,84% y "riesgo bajo" un 8,83%, mientras que el "riesgo alto" redujo un 17,65%. Conclusión: la realización sistemática del examen clínico de los pies, asociado a estrategias educativas efectivas, resultan en un control más eficaz del riesgo de ulceración.

Descriptores: Diabetes Mellitus. Pie Diabético. Autocuidado. Neuropatías Diabéticas. Factores de Riesgo.

Introduction

Diabetes *mellitus* (DM) is considered an epidemic disease and is among the four most spare non-communicable diseases in the world[1]. Until 2021, there were about 573 million people between 20 and 79 years old with this metabolic change, of which it is estimated that 50% are still without the diagnosis. According to the International Diabetes Federation (IDF), by 2045, the global estimate is about 783 million people affected and, for Brazil, about 17 million[2,3]. If the treatment of DM is not successful, the patient is vulnerable to injuries of the lower limbs, such as micro and macrovascular changes and neuropathies that affect the health of the feet. These conditions make clinical feet exam indispensable as a means of preventing, detecting and treating all the processes of foot disease in these patients[4-6].

Diabetic foot is the appearance of infection, ulceration and/or deep tissue damage, correlated with neurological dysfunctions and various levels of peripheral arterial disease (PAD) in the feet of patients with diabetes[5]. The annual incidence rate of foot ulcerations in patients with diabetes is 2% and, in the course of their lives, it reaches 34%. Preventing these ulcerations is essentially important to mitigate health problems.

The loss of tactile, vibratory and thermal sensitivity, the existence of peripheral arterial disease (PAD) and foot deformities are the most relevant risk factors, in addition to the history of previous ulcer and any degree of amputation of the lower limbs, which considerably increases the risk of ulceration[6]. Such conditions lead to long-term and costly assistance[5,7].

According to the IDF, each year, about 26 million people worldwide develop foot ulcers and more than 50% of these ulcers suffer the infectious process[7]. The factors that contribute most to the appearance of a foot ulceration are sensory neuropathy or diabetic polyneuropathy (DPN) and PAD[8]. It is noteworthy that, after 10 years of diagnosis of DM, DPN is present in about 50% of patients[9] and about half of these are symptomatic, with greater complaints at night[8,10]. Its most common symptoms are numbness, burning, tingling, shock and allodynia in the lower limbs that can reach the distal musculature, as well as neuropathic pain that is the most frequent involvement, which impacts the daily lives of individuals[9]. From the control of blood glucose and changes in lifestyle, it is possible to prevent DPN, regenerate nerve fibers and prevent foot disease, making ulceration and amputation impossible[9].

Regarding the prevention of foot sickness, the International Working Group on Diabetic Foot (IWGDF) recommends the screening of

risk factors for ulceration immediately to the diagnosis of patients with type 2 DM and five years after in the case of type 1 DM. According to the risk classification ranging from 0 (very low risk) to 3 (high risk), frequency can be annual and up to one to three months. This screening is based on expert opinion, in the absence of published evidence on the subject[10,-11]. However, a considerable percentage of patients never had their feet examined by a health professional, a fact that highlights the need to enhance the planning to control this pathology, which involves a structuring of the assistance to users with DM, based on the nursing process, and the execution of nursing care to these patients, from early diagnosis to the identification of the first signs of neurological and vascular changes, including infection, in order to result in a reduction in outcome unfavorable to patients[12].

Given this scenario, the study investigates: what is the evolution of risk factors involving the appearance of foot ulcers in patients with DM? Thus, this study aims to describe the evolution of risk factors for the development of foot ulcers in patients with DM, in three subsequent exams over a period of 3 years, in a medical specialty center of the Unified Health System.

Method

This is a descriptive, longitudinal and retrospective study[13], with the participation of 102 patients with DM who performed at least three sequential feet exams, from 2016 to 2019, in a medical specialty center in Aracaju, Sergipe. The inclusion criteria were patients over 18 years with a diagnosis of DM, excluding patients with gestational DM. This study was approved by the ethics committee according to Resolution 466 of December 12, 2012 of the National Health Council, with the CAAE-39428220.9.0000.5546 and opinion number: 4,398,218.

Data collection occurred through the reports of the foot exams, which are generated after the insertion of data to perform exams in the Diabetic Foot System (SISPED) and recorded in a form prepared by the researcher, which contained the following sociodemographic variables: sex, age, marital status, occupation, schooling and family income; clinical variables: type of diabetes, time of diagnosis, comorbidities, risk factors and target organ injury (TOI), height and body mass index (BMI); laboratory variables (fasting glycaemia, glycated hemoglobin and postprandial glycaemia); variables of clinical aspects of the feet: dermatological changes, inadequate footwear and neurological changes; in addition to the history of risk for ulceration: previous ulcer, hospitalization due to foot problems and amputation.

The presence of neuropathic symptoms and signs was evaluated in two distinct ways. For the Neuropathic Symptom Score (NSS), six questions that appear in the SISPED form were asked, with scores according to the level of the change: 1) Do you feel some discomfort or pain in the feet or legs? 2) What kind of sensation bothers you most? If burning, numbness or tingling - 2.0 points; if fatigue, cramps or itching - 1.0 point. 3) What is the most frequent location of the described symptom? If in the feet - 2.0 points; if in the calf - 1.0 point; if another location or none - there is no score (0.0). 4) Is there any time of day when this described symptom increases in intensity? If night - 2.0 points; if during the day and night - 1.0 point; if only during the day or no time - there is no score (0.0). 5) Have you already been woken up by this symptom during the night? If “yes” - 1.0 point; if “no” - there is no score (0.0). 6) Was any maneuver performed by you able to reduce the described symptom? Walking - 2.0 points; standing - 1.0 point; sitting, lying down or none - 0.0 point. In the total final score, NSS was considered normal between 3 and 4, moderate between 5 and 6 and severe between 7 and 9. The sum of points of each foot for the NSS ranged from 0 to 9 points[14].

In the evaluation of the Neuropathic Impairment Score (NIS), the following tests are included: 1) Aquileu reflex, whose score is 2.0 when absent, 1.0 when present with effort and 0.0 when present; 2) Vibration sensation with the tuning fork of 128 Hz, considered 1.0 when absent/reduced and 0.0 when present; 3) Painful

sensation performed with the wooden (pointed) toothpick, considered 1.0 in case of absent/reduced sensitivity and 0.0 when sensitivity was present; 4) Thermal sensation, tested by counting with the (cold) hammer handle on the back of the foot, considered 1.0 if reduced/absent and 0.0 if present. The sum of the points of each foot for the NIS varied from 0 to 10 points[14].

To perform the evaluation of PAD, palpation of the pedius and posterior tibial wrists of each foot was used, considering "normal" in case of noticeable palpation, and changed when the wrists were not palpable.

For the classification of the risk of ulceration, the categories standardized in the SISPED were used, based on the International Consensus on the Diabetic Foot, namely: Degree 0 - Very low risk, without loss of protective sensitivity (LPS) and without peripheral arterial disease (PAD); Grade 1 - Low risk, presence of LPS or PAD; Grade 2 - Moderate risk, presence of LPS + PAD or LPS + podological deformity or PAD + podological deformity; Grade 3 - High risk, presence of LPS and/or > 1 of the following factors: a) history of previous ulcer, b) history of amputation (minor or major), c) chronic end-stage kidney failure[14,15].

The Diabetic Polyneuropathy (DPN) was classified after neurological tests, also according to standardization of the International Consensus on the Diabetic Foot and used by SISPED: if ETS is <5 and NIS <3, it is considered negative, if ETS is ≥ 5 and NIS ≥ 3, negative, and, if the NIS is ≥ 6, even without symptoms, it is considered positive for neuropathy[14,15].

Concerning the LPS tests, the orange monofilament of 10gr was used in three different points of the foot: a) plantar region of the hallux; b) plantar region of the head of the metatarsal of the first and fifth pododactyl of each foot[14]. A pressure was performed with the monofilament, in perpendicular position, until forming a "C", lasting 2 seconds for each pressure. Three tests were performed at each point, if two of these were perceived by the patient sensitivity was considered preserved, when not perceived, was considered altered.

For the analysis, the data were obtained through an Excel database and the nominal and ordinal qualitative variables, as well as the quantitative variables, were related and recorded in a descriptive and univariate way. Regarding the qualitative variables, the analysis was performed with the categorization of the data and definition of the respective simple and relative frequencies, and, in the case of the quantitative variables, the measures of central tendency (mean) were used, with the variability (standard deviation) and the minimum and maximum position.

In the statistical analysis of data, a descriptive analysis of the variables was initially performed, with the calculation of simple frequency and percentage, considering that all variables on the clinical, sociodemographic, clinical exam and neurological feet test aspects was done using the Chi-Square and Fisher's Exact tests, and with the calculation of the Relative Risk, with respective confidence interval. In the longitudinal analysis of antecedent risk factors and clinical feet exam, and the risk of ulceration on occasions, the MecNemar test was used. The significance level adopted was 5%, and the software used was 4.2.0.

Results

The sample consisted of 102 patients with DM, whose age varied between 31 and 92 years. The female sex was more prevalent (72.75%) and only 76 participants declared marital status, of these 75% were married/in stable union. Moreover, of the 88 participants who reported the occupation, 36.36% reported having paid activity.

Most respondents used oral drugs, followed by oral drugs combined with insulin and a lower percentage used only insulin. The mean diagnostic time of these patients was 14.17 ± 8.8 years, as shown in Chart 1.

Regarding risk factors, systemic arterial hypertension (SAH) stood out as the most prevalent comorbidity among participants. Concerning target organ injury, acute myocardial infarction (AMI) showed a considerable increase in episodes between the 1st foot exam (FE1)

and the 3rd foot exam (FE3), as well as laser eye treatment that had an increase of more than 10% between FE1 and FE3. Regarding the history of risk for ulceration, previous ulcers had an increase of almost 10% between FE1 and FE3, however, the number of amputations remained the same, according to Chart 1.

Chart 1- Distribution of patients with diabetes *mellitus* treated in a specialized service, according to clinical aspects, risk factors for DM and history of risk for ulcerations in three consecutive foot exams. Aracaju, Sergipe, Brazil, 2016-2019 (n=102)

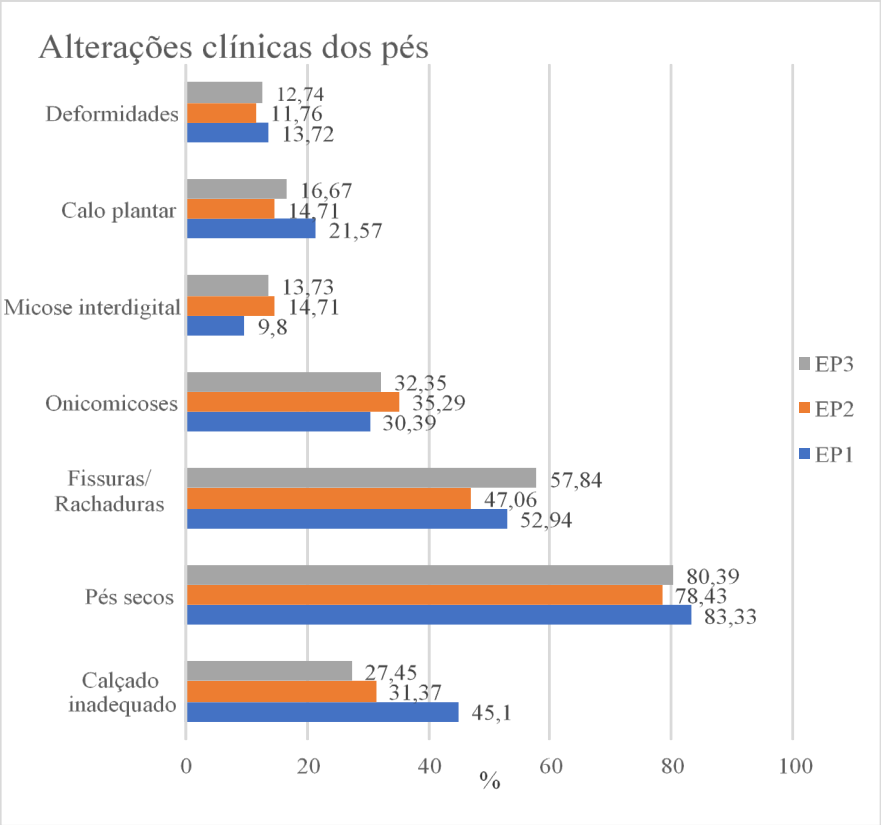
Variables	Patients with diabetes *mellitus*					
	FE1		FE2		FE3	
	n	%	n	%	n	%
Clinical aspects						
Time of Diagnosis						
0 - 10 years	48	47.06	46	45.10	44	43.14
> 10 years	54	52.94	56	54.90	58	56.86
Type of Treatment						
Oral Drugs	53	51.96	56	54.90	52	50.98
Oral Drugs and Insulin	28	27.45	25	24.51	27	26.47
Insulin	21	20.59	21	20.59	23	22.55
Risk Factors for DM						
Alcohol consumption	09	8.82	07	6.93	11	10.78
Comorbidities						
Arterial Hypertension	71	69.91	76	74.51	76	74.71
Target organ injury						
AMI	05	4.9	11	10.78	14	13.73
Laser eye treatment	32	31.37	40	39.22	43	42.16
Risk history for ulceration						
Previous ulcer	18	17.65	23	22.55	27	26.47
Hospitalization for feet problems	10	9.80	11	10.78	12	11.76
Some type of amputation	03	2.94	03	2.94	03	2.94
Severe eye impairment	36	35.29	39	38.24	41	40.20

Source: Brazil (2016-2019), created by the authors.

Notes: FE1 = 1st Foot exam; FE2 = 2nd Foot exam; FE3 = 3rd Foot exam; DM = Diabetes Mellitus; AMI = acute myocardial infarction.

As shown in Figure 1, among the clinical changes of the feet, in the three moments examined (FE1, FE2 and FE3), three aspects stand out: the use of inadequate footwear, which showed a gradual reduction; the percentages of people who had values in the three moments examined; and finally the fissures/cracks, which did not show significant changes.

Figure 1- Distribution of patients with diabetes mellitus treated in a specialized service, according to clinical changes in the feet in three consecutive foot exams. Aracaju, Sergipe, Brazil, 2016-2019 (n=102)



Source: Brazil (2016-2019), created by the authors.

Tradução da figura: Clinical changes in the feet. Y Axis - Deformities 12.74, 11.76, 13.72; Plantar callus 16.67, 14.71, 21.57; Interdigital mycosis 13.73, 14.71, 9.8; Onychomycosis 32.35, 35.29, 30.39; Fissures/Cracks 57.84, 47.06, 52.94; Dry feet 80.39, 78.43, 83.33; Inadequate footwear 27.45, 31.37, 45.1. Caption - FE3, FE2, FE1.

With regard to symptomatology, among the participants who claimed to have neuropathic symptoms, the following symptoms were highlighted: burning, numbness and tingling, in the three respective exams, with feet as the region most affected by these symptoms. As for the time when these symptoms were more frequent, the night was the most mentioned by the participants. When the participants were asked whether these symptoms woke them during the night, just under half affirmed positively during the FE1, with a reduction of almost 10% between FE1 and FE3. Among the maneuvers questioned that helped improve these symptoms, the most mentioned was "sit or lie down", as shown in Chart 2.

Regarding the risk of ulceration stratification, according to Chart 2, most of the respondents were classified as "very low risk". In the "Low risk" classification, the total number of participants doubled between FE1 and FE3. On the other hand, in the classification of "High risk", there was a reduction in more than 50% of cases.

Chart 2 – Distribution of patients with diabetes *mellitus* treated in a specialized service, according to signs and symptoms, and neurological tests for diabetic polyneuropathy from detection, during the three consecutive foot exams and risk stratification. Aracaju, Sergipe, Brazil, 2016-2019 (n=102)

Neuropathic symptom scores	**Patients with diabetes *mellitus***					
	FE1 n = 88		FE2 n = 82		FE3 n = 85	
	n	%	n	%	n	%
Symptoms that bother most						
Burning, numbness, tingling	81	92.05	75	91.45	75	88.24
Fatigue, cramps or itching	07	7.95	07	8.54	10	11.76
Place of the described symptom						
Feet	64	72.73	57	69.51	61	71.76
Calf	24	27.27	25	30.49	24	28.24
Greater frequency of the described symptom						
At night	46	52.27	41	50	44	51.76
Day and night	30	34.09	25	30.49	25	29.42
Only during the day	11	12.64	14	17.07	15	17.64
No time	01	1.14	02	2.44	01	1.18
Does this symptom wake you up at night?						
Yes	42	47.73	34	41.46	34	39.08
Maneuver capable of reducing the symptom						
Walking	09	10.22	12	14.63	18	21.18
Standing	11	12.50	08	9.76	06	7.05
Sitting or laying down	61	69.32	57	69.51	58	68.24
No maneuver	07	7.96	05	6.10	03	3.52
Neuropathic impairment score n = 102						
Aquileu Reflex:						
Present	26	25.49	35	34.31	30	29.41
Present with effort	19	18.63	16	15.69	19	18.63
Absent	57	55.88	51	50.00	53	51.96
Vibratory sensitivity						
Present	23	22.55	23	22.55	23	22.55
Reduced/absent	79	77.45	79	77.45	79	77.45
Painful Sensitivity						
Present	91	89.22	93	91.18	96	94.12
Reduced/absent	11	10.78	09	8.82	06	5.88
Thermal Sensitivity						
Present	92	90.20	88	86.27	95	93.14
Ulceration risk stratification n = 102						
Grade 0 - very low risk	53	51.96	52	50.80	61	59.80
Grade 1- low risk	09	8.82	21	20.59	18	17.65
Grade 2- moderate risk	06	5.88	05	4.9	07	6.86
Grade 3- high risk	34	33.34	24	23.52	16	15.69

Source: Brazil (2016-2019), created by the authors.

Notes: FE1 = 1st Foot exam; FE2 = 2nd Foot exam; FE3 = 3rd Foot exam;

Some sociodemographic and clinical variables had a higher significant association with the risk of foot ulceration, namely: male patients, over 60 years, time of diagnosis (>10 years), as well as those who needed laser eye treatment, as shown in Table 1.

Table 1- Association of sociodemographic variables and clinical/dermatological aspects with the risk of foot ulceration in patients with diabetes *mellitus*, during FE1. Aracaju, Sergipe, Brazil, 2016-2109 (n=102)

Variables	Risk of ulceration		RR	CI	*p* value
	Low Moderate High n (%)	Very low n (%)			
Sex:					
Male	20 (71.4)	8 (28.6)	1.82	(1.26-2.63)	0.007
Female	29 (39.2)	45 (60.8)			
Marital Status:					
Stable union	26 (45.4)	31 (54.4)			0.508
Without partner	11 (57.9)	8 (42.1)			
Age group:					
< 60 years	7 (21.2)	26 (78.8)	2.87	(1.45-5.69)	0.000
≥ 60 years	42 (60.9)	27 (39.1)			
Diabetes Time					
0 - 10 years	17 (35.4)	31 (64.6	0.6	(0.38-0.93)	0.027
≥ 11 years	32 (59.3)	22 (40.7)			
SAH Treatment					
Yes	35 (49.3)	36 (50.7)			0.866
No	14 (45.2)	17 (54.8)			
Acute myocardial infarction					
Yes	1 (20)	4 (80)			0.364
No	48 (49.5)	49 (50.5)			
Laser eye treatment					
Yes	22 (68.8)	10 (31.2)			
No	27 (38.6)	43 (61.4)	0.56	(0.38-0.82)	0.009

Source: Brazil (2016-2019), created by the authors.
Notes: RR = Relative Risk; CI = Confidence Interval.

The frequency of the variables analyzed in the study and their significance in each foot exam are described in Chart 3:

Chart 3- Association of variables from the clinical exam and neurological tests of the feet, with the risk of ulceration in patients with diabetes mellitus, during FE1. Aracaju, Sergipe, Brazil, 2016-2109 (n=102)

(continued)

Variables	Risk of ulceration		RR	CI	*p* value
	Low Moderate High	Very low			
	n (%)	n (%)			
Footwear					
Inadequate	20(43.5)	26(56.5)			0.525
Adequate	29(51.8)	27(48.2)			
Any discomfort in the feet or legs?					
Yes	47(53.4)	41(46.6)	3.74	(1.02-13.69)	0.008
No	2(14.3)	12(85.7)			

Chart 3- Association of variables from the clinical exam and neurological tests of the feet, with the risk of ulceration in patients with diabetes mellitus, during FE1. Aracaju, Sergipe, Brazil, 2016-2109 (n=102)

(conclusion)

Variables	Risk of ulceration		RR	CI	*p* value
	Low Moderate High	Very low			
	n (%)	n (%)			
Sensation that bothers you most - Burning/numbness/tingling?					
Yes	45(55.6)	36(44.4)			0.142
No	2(25)	6(75)			
Was the "walking" Maneuver able to reduce the described symptom(s)?					
Yes	7(77.8)	2(22.2)			0.163
No	40(50)	40(50)			
Aquileu reflex					
Normal	6(23.1)	20(76.9)			
Present with effort	10(52.6)	9(47.4)	2.51	(1.0-5.18)	0.012
Absent	33(57.9)	24(42.1)	2.28	(1.2-5.24)	
Vibratory Sensitivity					
Present	7(30.4)	16(69.6)			0.092
Reduced/absent	42(53.2)	37(46.8)			

Source: Brazil (2016-2019), created by the authors.

Discussion

This study aimed to describe the evolution of risk factors for the development of foot ulcers in patients with DM over three years, through three subsequent exams. When analyzing the sociodemographic characteristics obtained, there is a predominance of female people in stable union or married and elderly. Historically, women have the characteristic of seeking more health services, reflecting constant and frequent self-care, as well as the responsibility to care for members of their families[16-18]. The lack of self-care by men can be seen in the context of prevention of diabetic foot[19] in this study. When the association of sex with the risk of foot ulceration was performed, men were more likely to have this indicator (p=0.007), since it corroborates the findings presented in the literature[16-19].

Regarding age, the data obtained demonstrate that the elderly presented 2.87 times more chances of ulceration risk, which confirms previous findings[20, 21], as well as another study states that patients with history of previous ulcer are associated with longer duration of DM[22]. In addition, the time of diagnosis is directly proportional to the onset of complications, especially when added to other risk factors of DM[21]. Considering these factors, it is worth emphasizing the need for stratification of cardiovascular risk as prevention of unwanted outcomes[23].

Another investigation brings evidence that confirms the importance of education focused on prevention, intensifying comprehensive care[24]. Moreover, the guidelines of the Brazilian Society of Diabetes (BSD) state that patients with more than 10 years of diagnosis, at any age, are now classified as high cardiovascular risk[25].

Given the difficulties and limitations that this public presents in the context of self-care and the educational process, it is important to highlight the importance of developing educational methodologies more appropriate for this age group, taking into account the inclusion of the caregiver [17].

According to the literature[22], the results of this study showed a significant number of participants with hypertension, in addition to a subtle growth between the first two exams. Considering these findings and considering that blood pressure values <150x85mmhg influence the reduction of risk of death, cerebrovascular accident (CVA) and microvascular complications from DM, in 32%, 44% and 37%, respectively[25], it is of paramount importance to add this theme as routine in the content of educational programs, especially concerning the relationship with DM, treatments and rate control.

Moreover, DM and SAH are considered as substantial risk factors for AMI[23]. Unfortunately, there is a growing trend in episodes of AMI in the participants of this study. This condition is significantly associated with the risk of foot ulceration in relation to FE1 and FE2. Therefore, stratification of cardiovascular risk based on the conduction of clinical conditions of correlated diseases is recommended[23].

Based on the International Consensus on the Diabetic Foot, the Ministry of Health points out that ulcers and prior amputation are included as antecedents of risk for foot ulceration[5], an association that has been previously evidenced[22]. In this context, the data presented in this study indicate that the absence of these variables in the three exams is related to the protection factor of the feet.

Still regarding risk factors for ulceration, the use of inadequate footwear, together with barefoot walking, is considered as the main cause of traumas that precede the appearance of an ulcer[15]. During FE1, approximately 45.1% of the participants presented this practice, with a 40% reduction in this habit at the time of FE3. When the reduction of inadequate footwear use was associated with the risk of ulceration in the feet, statistical relevance was verified as a protective factor against ulceration during the three exams (p=0.008 from FE1 to FE2, and p=0.006 from FE1 to FE3). A study conducted in Uberaba, Minas Gerais, described the use of inadequate footwear 76.1% of the studied population, higher than those indicated in this study[21].

When considering the symptomatology presented by patients with DPN, neurological alteration is one of the fundamental risk factors for leading to ulceration[9]. The total number of patients in this study who presented symptomatology reached 85.29% at the time of FE3 and when the symptomatology of these patients was associated with the risk of foot ulceration, there was significant relevance (p=0.008). This datum was similar to that found in other studies[8-9].

Based on these findings, it is important to emphasize that clinical feet exam is a primary procedure to avoid ulceration[8,21]. This research strengthens this information and emphasizes that the "walking" maneuver is related to the improvement of DPN symptoms, while the absence of this maneuver contributes significantly to the risk of foot ulceration (p=0.039), when correlated with FE1 versus FE3.

In the clinical feet exam are included neurological tests used to confirm the DPN, including the "Aquileu reflex". In this study, most of the participants presented the Aquileu reflex altered, either partially or totally. This datum, when associated with the risk of ulceration, was considered significant (p=0.012), which corroborates previous studies[12,19]. Through the risk stratification of ulceration, it is possible to track the factors most predisposing to ulceration in the feet. This reality can contribute to the implementation of higher quality care, based on the promotion, prevention and treatment of risk factors and pre-ulcer lesions.

The present study showed that, in the stratification of risk of ulceration, during the three clinical exams, there was a prevalence of classification of "very low risk" and "low risk" in 77.45% of the participants, in addition, those classified as "high risk" were reduced by almost 50% at the time of FE3. Similar data were found in a study in which 79.5% of those examined were classified as very low risk and low risk[24].

In the inspection of clinical aspects and dermatological changes, anhydrosis, fissures/cracks and onychomycosis stood out, in which the first one is considered as more prevalent.

A study conducted in Juazeiro do Norte, Ceará, observed that 96.5% of the participants presented the same dermatological changes[24]. On the other hand, despite the high prevalence of these findings, there is a gap in educational approaches when referring to self-care aimed at dermatological aspects of the feet.

Conclusion

The present study showed a high number of people with hypertension, as well as a progressive increase in episodes of AMI during the exams. Both changes are negatively related to the risk of ulceration. In addition, the negative response to the "walking" maneuver and changes in the Aquileu reflex also represented significant risk factors for ulceration. Regarding the protection factors against foot ulcers, the absence of a history of previous ulcers and the use of appropriate footwear stand out. In the risk stratification of ulceration, the high risk reduction (grade 3) in more than half of the participants demonstrates the importance of performing the feet exam systematically, as well as associating effective educational strategies to the routine clinical feet exam.

Thus, it can be concluded that a more effective management is essential, in order to control the factors that lead to the onset of a foot ulceration in patients with DM. Therefore, it is suggestive that public agencies and health managers work to achieve better quality care, such as the training of care professionals, based on the promotion, prevention and treatment of risk factors and pre-ulcer lesions.

Collaborations:

1 – conception and planning of the project: Elenalda Ferreira dos Santos and Liudmila Miyar Otero;

2 – analysis and interpretation of data: Elenalda Ferreira dos Santos and Thaynara Silva dos Anjos;

3 – writing and/or critical review: Elenalda Ferreira dos Santos, Beatriz Carvalho Ferreira, Isla Evellen Santos Souza and José Rodrigo Santos Silva;

4 – approval of the final version: Elenalda Ferreira dos Santos, Beatriz Carvalho Ferreira and Isla Evellen Santos Souza.

Competing interests

There are no competing interests.

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