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RISK STRATIFICATION FOR DIABETIC FOOT IN A POPULATION OF ELDERLY ATTENDED IN PRIMARY HEALTH CARE

ESTRATIFICAÇÃO DE RISCO PARA PÉ DIABÉTICO NUMA POPULAÇÃO DE IDOSOS ACOMPANHADOS NA ATENÇÃO PRIMÁRIA

ESTRATIFICACIÓN DEL RIESGO DE PIE DIABÉTICO EN UNA POBLACIÓN DE ANCIANOS ACOMPAÑADOS EN CUIDADOS PRIMARIOS

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Objective: to assess the risk stratification for diabetic foot in an elderly population followed up in primary care. Method: this is a cross-sectional, analytical study with a quantitative approach. Home visits were made to 254 elderly people for neurological (plantar protective sensitivity and neuropathic symptoms), dermatological and vascular (pulses and ankle brachial index) evaluation. Results: a substantial portion (95.3%) of the participants reported some neuropathic symptom, especially fatigue (67.4%). Most were at risk for diabetic foot (64.1%), with a predominance of grade 1 (43.7%); were smokers (71.9%), had musculoskeletal comorbidity (57.8%) and had already suffered a stroke (75%). People with risk levels 2 and 3 had had the diagnosis for between 10-19 years (78.1%). Conclusion: a large part of the sample had some degree of risk for diabetic foot, in particular grade 1, and the presence of musculoskeletal comorbidity.

Descriptors: Elderly. Diabetic Foot. Primary Health Care.

Objetivo: avaliar a estratificação de risco para pé diabético numa população de idosos acompanhados na atenção primária. Método: estudo transversal, analítico, com abordagem quantitativa. Realizaram-se visitas domiciliares a 254 idosos para avaliação neurológica (sensibilidade protetora plantar e sintomas neuropáticos), dermatológica e vascular (pulsos e índice tornozelo braquial). Resultados: parcela substancial (95,3%) dos participantes referiu algum sintoma neuropático, sobretudo fadiga (67,4%). A maioria apresentava risco para pé diabético (64,1%), com

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predomínio do grau 1 (43,7%); eram tabagistas (71,9%), apresentavam comorbidade osteomuscular (57,8%) e já tinham sofrido um AVC (75%). As pessoas com grau de risco 2 e 3 tinham entre 10-19 desde o diagnóstico da doença (78,1%). Conclusão: boa parte da amostra apresentava algum grau de risco para pé diabético, sobretudo do grau 1, e presença de comorbidade osteomuscular.

Descritores: Idoso. Pé Diabético. Atenção Primária à Saúde.

Objetivo: evaluar la estratificación del riesgo para el pie diabético en una población anciana con seguimiento en atención primaria. Método: estudio analítico transversal con enfoque cuantitativo. Se realizaron visitas domiciliarias a 254 personas mayores para evaluación neurológica (sensibilidad protectora plantar y síntomas neuropáticos), evaluación dermatológica y vascular (índice de muñeca y tobillo braquial). Resultados: una porción sustancial (95,3%) de los participantes informó algún síntoma neuropático, especialmente fatiga (67,4%). La mayoría estaba en riesgo de pie diabético (64.1%), con un predominio de grado 1 (43,7%); eran fumadores (71,9%), tenían comorbilidad musculoesquelética (57,8%) y ya habían sufrido un derrame cerebral (75%). Las personas con niveles de riesgo 2 y 3 tenían entre 10 y 19 años desde el diagnóstico de la enfermedad (78,1%). Conclusión: una buena parte de la muestra tenía cierto grado de riesgo de pie diabético, especialmente de grado 1, y la presencia de comorbilidad musculoesquelética.

Descriptores: Ancianos. Pie Diabético Atención Primaria de Salud.

Introduction

Diabetic foot is the presence of infection, ulceration and/or destruction of deep tissues that are associated with neurological abnormalities and varying degrees of peripheral vascular disease in people with diabetes *mellitus* (DM). It is one of the main complications of DM and a socioeconomic burden for affected people and the public health system, especially in low-income countries. Estimates indicate that about 15 to 25% of people with diabetes may develop foot ulcers during their lifetime. The prevalence of these cases is between 1.3 to 12 %[1-2].

In the elderly it is considered one of the most devastating complications, due to the large number of cases that progress to amputation, with great socio-economic impact, including spending on treatments, as well as prolonged and recurrent hospitalization[3]. Many factors are involved in the development of this complication. It is noteworthy that the majority of diabetic foot amputations are preceded by ulcers.

In this genesis, Diabetic Polyneuropathy and Peripheral Arterial Disease (PAD) are highlighted, which, associated with limited joint mobility and repetitive trauma, lead to the formation of ulcers and contribute to lower limb amputation[4]. Linked to these factors, specific changes in the elderly, such as brain aging, osteoarticular problems and the presence of cataracts associated with diabetic retinopathy, can negatively impact self-care activities and somatize the occurrence of diabetic foot in this population[5].

However, evidence indicates that diabetic foot ulceration is preventable and the first step in preventing amputations is careful screening to identify foot problems and the detection of high-risk patients, which highlights the need for studies focused on this theme[2].

International and national guidelines recommend the clinical, neurological and vascular evaluation of the feet of people with diabetes, in all stages, as a priority in care planning. The results obtained in this evaluation may guide the planning of contextualized and effective health actions in the prevention of diabetic foot[4-6].

In this direction, one of the main groups of global experts on this topic recommend that all patients with type 2 DM (DM2) should be examined annually for the presence of PAD, including detailed history, wrist palpation and calculation of the Ankle Brachial Index (ABI), in addition to receiving guidelines for smoking cessation and other identified risk factors[1]. However, in Brazil, authors argue that few

studies performed the ABI calculation. Thus, the risk stratification for diabetic foot is only based wrist palpation and clinical signs of PAD[7].

The aim of this study is to assess the risk stratification for diabetic foot in an elderly population followed up in primary care.

Method

This is a cross-sectional, analytical study with a quantitative approach. Data collection took place from July 2016 to January 2017 in primary health care units in the urban area of the municipality of Juazeiro do Norte, Ceará, Brazil. The study was approved by the Human Research Ethics Committee of *Universidade Regional do Cari*ri under opinion number 1,536,396. All participants expressed their agreement by signing the Informed Consent Form.

At the time of the study, the number of elderly people with DM2 and in primary care services in the urban area was approximately 2,500 people. Based on this information, the sample size was obtained using the formula for finite population, using the conservative prevalence of 50% and sampling error of 5% as parameters which resulted in 254 elderly people with DM2. The proportional stratified sampling technique was used to select the number of elderly individuals by the health service selected for the study.

67 municipal FHS teams that monitor diabetic patients were visited, with regard to food, medication and exercise. However, it was only possible to collect data from 49 individuals, due to organizational issues, such as strikes at basic health units, and due to the lack of human and/or material resources.

The participants were selected by convenience, i.e., they were approached in services in the days of scheduled appointment for people with diabetes. After, home visits were scheduled to collect data related to the physical examination of the elderly. The following was used as inclusion criteria in the study: being ≥ 60 years old, diagnosed with DM2 and being registered in a FHS in the city. Among those eligible, 44 participants were excluded due to the following exclusion criteria: they did not attend the service or were not at home during data collection (23); refused to join the study (5); death (1); denies having DM 2 (6); address not found (5); lack of clinical records (2); or behavior change communication, which compromised their participation in the conference (1); concomitant diagnosis of leprosy (1).

The interview and the physical examination was conducted in the homes of the participants in a private environment by applying two instruments. In the first instrument, variables related to sociodemographic characterization (gender, age, marital status, education, income and family arrangement) and clinical (time since diagnosis of the disease, smoking, drinking, physical activity, comorbidities and complications) were considered; in the second instrument, variables related to the dermatological, vascular and neurological situation of the feet of the elderly with DM2 were explored, through the assessment and tracking of neuropathic pain, loss of protective sensitivity (PSP) and PAD. Regarding neuropathic pain, the characteristics of neuropathic symptoms – burning, numbness, tingling, cramps and pain – were considered, whose intensity was assessed using the Wong-Baker Faces Pain Rating Scale[1].

In the dermatological evaluation, the following variables were considered: presence or absence of dilated dorsal vessels, dry skin, cracks, fissures, normal skin color, interdigital ringworm, nail ringworm, hairs, calluses, appropriate shoes, and were assessed by inspecting the feet. Regarding the musculoskeletal assessment, the feet were checked for the presence of deformities such as accentuation or fall of the plantar arch, bunions and clawed toes.

During the neurological verification of the feet, the 10 g Semmes-Weinstein monofilament associated with the 128 Hz tuning fork was used to evaluate the loss of plantar protective sensitivity (PSP), as recommended for the diagnosis of PSP[1,6].

The referred monofilament was applied with the elderly lying down and in four plantar areas: hallux (distal phalanx), first, third and fifth metatarsals, three times at each location, two positive and one simulated. The 128 Hz tuning fork test was applied to the distal phalanx of the

hallux, perpendicularly with constant pressure three times at the site, two positive and one simulated from the device's vibration. In cases of minor amputations, making verification impossible, it was applied to the malleolus region, as recommended in the literature, as it is the closest bone prominence[1,6].

As for vascular evaluation, palpation of the posterior dorsal and tibial pulses was performed on both feet. The DAP screening occurred by calculating ABI, amputation identification and previous and active ulcers. The ABI verification technique consisted of measuring systolic brachial blood pressure, using a sphygmomanometer and stethoscope, according to the technique recommended by the Guidelines of the Brazilian Society of Hypertension[8]. Next, the systolic arterial pressure of the distal arteries of both lower limbs was measured by means of a sphygmomanometer, with a cuff above the wrists (posterior tibial artery and dorsal pediatric artery), using the manual vascular doppler of an 8 to 10 MHz brand MEDPEJ® model DF-70001 VN, on the arterial pulse[6].

Anthropometric data were also obtained with weight and height measurements to calculate the Body Mass Index (BMI), using cutoff points less than or equal to 22 kg/m^2 (low weight), greater than 22 and less than 27 kg/m^2 (normal weight), greater than or equal to 27 kg/m^2 (overweight), recommended for the elderly[9].

After calculating the values, the highest value obtained from the distal arteries of both lower limbs was divided by the highest value of the brachial arteries measured bilaterally. The cutoff points were: ABI <0.9 (DBH), 0.9 to 1.30 (normal), ABI>1.30 (arterial calcification)[1]. As a result of the assessment, the risk of developing diabetic foot was stratified according to the SBD, using risk scores 0 (PSP and PAD absent), 1 (PSP associated or not with deformity), 2 (PAD associated or not). not PSP) and 3 (history of ulceration or amputation)[6].

Data were analyzed using descriptive and inferential statistics with hypothesis testing and modeling, using the Statistical *Software* R in *RStudio* version 1.0.136. the Chi-square and Pearson correlation tests were used to evaluated the dependence of correlation between the variables. The level of 5% (α<0.05) was adopted for the analysis of the sensitivity of the variation in the level of significance (α) and the result of the tests (p-*value*).

Results

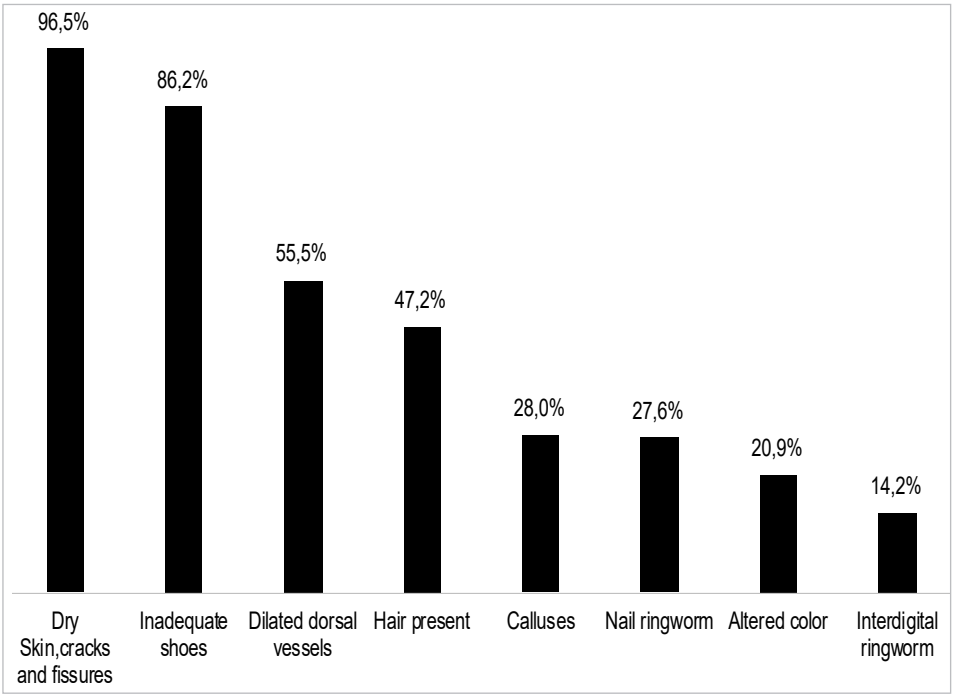
The sample was predominantly composed of women (71.7%) with up to eight years of formal education (50.4%), married (42.5%) and retired (70.9%). As for age, the elderly participants were on average 73.3 ± 7.8 years old at the time of the survey.

The participants lived with diabetes for an average of 10.1 ± 8 years and used monotherapy with oral antidiabetic (76%) as the main treatment. Most did not use tobacco (87.4%) or alcohol (92.1%) and were sedentary (80.3%). A good part (42.9%) was also overweight, especially women (45.1%). Type 1 obesity predominated (44%).

It was identified that 90.6% of the participants had some comorbidity, with a prevalence of arterial hypertension (89.7%). Regarding this, it can also be clarified that women were more affected by comorbidities, with 50% of them having 1-3 comorbidities (p=0.002). A large part of the sample (76%) already had some complication of diabetes, with a predominance of ophthalmology (88.1%), such as, for example, progressive decrease in visual acuity (61.2%) and even blindness (8.2%). Another fact is that 23.9% had already suffered a heart attack. It is noteworthy that people without complications due to diabetes had a diagnosis time of less than 20 years (p <0.000).

A substantial portion (95.3%) of the participants reported some neuropathic symptom, with emphasis on fatigue (67.4%), pain (62.4%) and cramps (61.2%). Regarding pain , it is noteworthy that in 33.9% pain intensity was "moderate". In the dermatological evaluation, dry skin, cracks and fissures were identified in almost all participants (96.5%). It is important to state that all individuals had more than one of the characteristics shown in Graph 1.

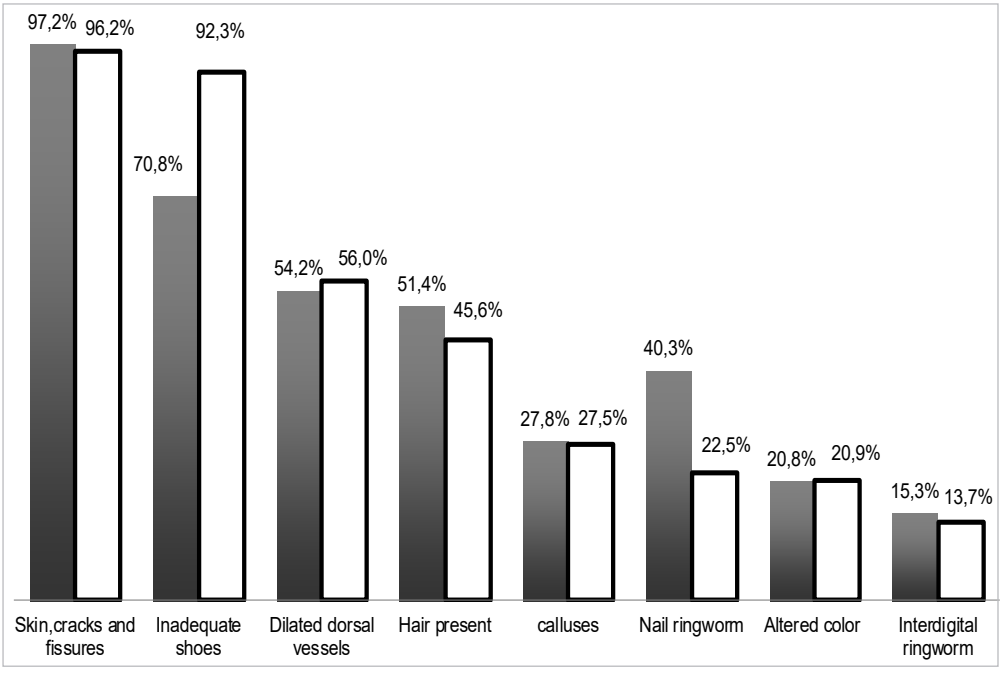
Graph 1 – Distribution of the characteristics of the participants' feet, according to dermatological evaluation. Juazeiro do Norte, Ceará, Brazil – 2017



Source: Created by the authors.

Regardless of gender, the most common dermatological problem found in the dermatological examination was dry skin, with cracks and fissures. There was greater disparity between the sexes in inappropriate footwear items and nail ringworm, with greater involvement of women and men, respectively (Graph 2).

Graph 2 – Distribution of the characteristics of the dermatological assessment of the participants' feet, according to sex. Juazeiro do Norte, Ceará, Brazil – 2017



Caption: ■ Male □ Female

Source: Created by the authors.

As for vascular assessment, most participants had pulses (78.3%) and ABI classification (53.5%). The prevalence of abnormal ABI is identified in this study, suggesting DAP, 7.1%, and females (8.2%) being affected almost twice as much as the male (4.2%).

Although only 5.5% had a previous amputation, 15% already had an ulcer and 6.3% had an active ulcer, with a predominance of neuropathic (68.8%) ulcers, followed by neuroischemic (18.8%) and ischemic ulcers (6.3%).

Based on this data, it was noted that 43.7% of the subjects were at risk for diabetic foot, among this percentage, grade 0 (35.8%), grade 3 (15.7%) and grade 2 (4.7%). Among the elderly with some degree of risk for diabetic foot, the percentages were higher in the older age group (≥80 years) (p=0.002). In all income brackets, approximately half of the participants (40.5%, 52.5% and 50%) were classified as at risk for diabetic foot Grade 1 (p=0.024). People without any degree of risk, as well as those with Grade 2 and 3 for diabetic foot had been diagnosed as diabetic for less than 10 years of illness (sum of the lowest strata presented) (p=0.003). Approximately 40% of people at risk for diabetic foot were smokers (p=0.018), had musculoskeletal comorbidity (p=0.021) and had already suffered a stroke (p=0.018) (Table 1).

Table 1 – Numerical and percentage distribution of the risk classification of developing diabetic foot, according to sociodemographic and clinical variables of the elderly with type 2 diabetes. Juazeiro do Norte, Ceará, Brazil – 2017 (n=91)

(continued)

Variables	Risk classification for diabetic foot								p - value
	Grade 0		Grade 1		Grade 2		Grade 3		
	n	%	n	%	n	%	n	%	
Sex									0.307
Female	63	34.6	84	46.2	10	5.5	25	13.7	
Male	28	38.9	27	37.5	2	2.8	15	20.8	
Age									
60 - 69 years	48	45.7	38	36.2	3	2.9	16	15.2	0.002*
70 - 79 years	32	32.3	47	47.5	6	6.1	14	14.1	
80 years and older	11	22.0	26	52.0	3	6.0	10	20.0	
Family income									
1 - 2 minimum wages	68	36.8	75	40.5	9	4.9	33	17.8	0.024*
3 - 4 minimum wages	12	30.0	21	52.5	1	2.5	6	15.0	
More than 5 minimum wages	1	25.0	2	50.0	-	-	1	25.0	
Diabetes diagnosis time									
<10 years	51	72.9	1	1.4	6	8.6	12	17.1	
10 - 19 years	26	21.8	62	52.1	5	4.2	26	21.8	0.003*
20 - 29 years	12	24.5	36	73.5	1	2.0	-	-	
30 - 39 years	2	2.9	10	14.3	-	-	2	2.9	
From 40 years old	-	-	3	100	-	-	-	-	
Smoking	9	28.1	14	43.8	5	15.6	4	12.5	0.018*
Alcohol use	7	35.0	9	45.0	-	-	4	20.0	0.732
Comorbidities									
SAH	72	34.3	93	44.3	12	5.7	33	15.7	0.233
Dyslipidemias	45	37.2	49	40.5	8	6.6	19	15.7	0.494
Musculoskeletal	34	28.1	54	44.6	7	5.8	9	7.4	0.021*
Complications									
Renal	7	26.9	12	46.2	1	3.8	6	23.1	0.822
Ophthalmology	52	30.6	80	47.1	10	5.9	28	16.5	0.907
Cardiovascular	12	26.1	24	52.2	1	2.2	9	19.6	0.537
Stroke	9	25.0	16	44.4	6	16.7	5	13.9	0.018*

Table 1 – Numerical and percentage distribution of the risk classification of developing diabetic foot, according to sociodemographic and clinical variables of the elderly with type 2 diabetes. Juazeiro do Norte, Ceará, Brazil – 2017 (n=91)

(conclusion)

Variables	Risk classification for diabetic foot								p - value
	Grade 0		Grade 1		Grade 2		Grade 3		
	n	%	n	%	n	%	n	%	
Physical activity									
Yes	25	50.0	20	40.0	1	2.0	4	8.0	0.070
No	66	32.4	91	44.6	11	5.4	36	17.6	

Source: Created by authors.

Notes: Conventional sign used:
- Numerical data equal to zero, not resulting from rounding.

* p <0.05 = statistical significance.

Discussion

Essentially, the study was composed of elderly women with more than 10 years of DM2 who already had some complication of the disease. Previous studies have shown similar data regarding this profile[10-11]. Lifestyle and general health status of Brazilian women have increased the number of cases of DM2, in addition to the question of greater survival in relation to men. Incidentally, data in the last ten years have already shown this trend in the last ten years. The percentage of women with diabetes in 2018 increased from 6.7 % to 8.1%, compared to an increase of 5.7% to 7. 1 % among men[12].

The predominant neuropathic complaint in this research was fatigue. A divergent fact from a previous study with a similar design that showed a higher prevalence for burning, numbness or tingling[7]. However, it is important to note that this study investigated not only elderly people, but also people aged 10 and over.

The self-report of fatigue favors the early identification of more severe problems, such as ischemic pain caused by peripheral vascular disease. Thus, in addition to recognizing the symptom, it is necessary to assess the associated fatigue and pain regarding its intensity, quality, location, duration and impact on the elderly with diabetes as a routine during health care[5].

A possible aggravating factor in this case would be the sedentary lifestyle of this sample, which was considerable, since the practice of regular physical activity is favorable to tissue perfusion and the prevention of micro and macro vascular complications of DM.

Regarding the dermatological evaluation, the report of changes such as dry skin, cracks and fissures in the feet of the participants was substantial. Research conducted with a public of people with DM in primary care services and in specialized outpatient clinics found the same finding[7,13-15].

People with DM already have thinner dermis and epidermis layers and decreased skin hydration. Therefore, there is a need for additional care regarding guidance on preventing skin dryness with emollient agents and preventing mycosis with the use of antifungals and drying of interdigital spaces after washing the feet, through health education sessions in the various scenarios of the health care network in the country, respecting possible regional differences in a continental country such as Brazil.

The predominance of cracks, fissures and dry skin in men and women was not surprising. As an example, the predominance of wrong footwear among women is mentioned, as it is an accessory with more options for this audience and, culturally, a preferable item to the female audience in everyday life.

This finding was also verified in another publication, which identified, among women, a higher prevalence of care needed to prevent injuries and, in men, better habits related to adequate footwear[16]. However, regarding this, it is possible that the female vanity in the use of

shoes may have interfered with the percentage presented in this research.

It is important to highlight that the use of inappropriate shoes by the elderly in this study may lead to the appearance of injuries closely related to the development of deformities, shearing of the shoes and infection, which predispose to the development of diabetic foot and other serious complications[17].

Thus, the selection of shoes is considered a prescription and must involve clinical criteria and manufacturing within standards standardized by consensus and guidelines[4,6] . However, shoes suitable for people with diabetes are expensive, making access difficult for most patients [18]. In view of the low economic level of the elderly in this study, another explanation would be the social and economic reality of the sample members.

In this study, the predominant risk of developing diabetic foot was that of grade 1. The data in the literature are divergent at this point, however most of the consulted studies identified a higher prevalence for grade 1 risk in relation to this study[15,17,19] .

There was also a considerable amount of publications in which people at risk 0 for diabetic foot predominated. However, it is noteworthy that a large part did not perform ABI calculations, but only the palpation of the pulses associated with clinical signs of PAD to infer and classify the people evaluated[14,20-22].

It was observed, in this investigation, that people with grade 1 risk were associated with variables such as smoking, income, musculoskeletal comorbidity, stroke and advanced age (>80 years).

Tobacco is an important cardiovascular risk factor, triggering endothelial changes that compromise healing and increase the risk of foot ulceration. It is also known that its use causes cellular oxidative stress, a predictor of diabetic neuropathy and insulin resistance[23]. In addition, tobacco increases the rates of PAD, decreases the oxygen transport capacity, resulting in tissue hypoxia, impairing the healing of injuries and increasing the risk of amputations[24]. Therefore, tackling smoking is crucial in preventing diabetic foot.

The association found with stroke is possibly due to the same cause of tobacco use, as the history of this event already indicates the previous presence of impaired vascularization in these patients. In addition, the presence of PAD is a marker of atherosclerosis in cardiac and brain vascular beds[25]. It is also inferred that people with diabetes and stroke sequelae may have neurological impairment that compromises the maintenance of an active lifestyle and foot associated self-care practices.

Self-care practices may also be impaired in people with musculoskeletal complications due to the impairment of the biomechanical load of the foot, causing abnormal pressure points, which may predispose to diabetic deformities and neuropathies[1] .

A statistically significant evidence observed in this study was the prevalence of cases with degree risk 1 in those with the highest age group investigated (> 80 years).

On the other hand, it was also found, with statistical relevance, that grade 2 and 3 cases predominated in those whose disease duration was < 20 years. This leads to the reflection that advancing age and its vascular, dermatological and neurological particularities may favor the lower risk of developing diabetic foot (grade 1). However, the cases of greater vulnerability for diabetic foot (grades 2 and 3) occur in those who have lived with DM for less than 20 years, possibly younger, but with metabolic control of the disease and who perform foot care.

This study has the limitation of not evaluating the cause and effect of the findings.

Conclusion

The majority of the participants in the sample under study had some degree of risk for diabetic foot (64.1%), with a predominance of risk level 1 (43.7%). It was identified that elderly people with DM2 and grade 1 risk for diabetic foot are more prevalent among smokers, those with advanced age (> 80 years), history of stroke and the presence of musculoskeletal comorbidity.

This research signals the need for more studies that can expand the investigation to the rural population, other age groups and include, in addition to capillary glycemic control, glycated hemoglobin control. However, the evidence pointed to support for the construction of educational strategies and prevention of diabetic foot in different degrees, optimizing the comprehensive care of people with diabetes.

Collaborations:

1 – conception, design, analysis and interpretation of data: Natália Pinheiro Fabrício Formiga, Paulo Renato Alves Firmino and Ana Maria Parente Garcia Alencar;

2 – writing of the article and relevant critical review of intellectual content: Natália Pinheiro Fabrício Formiga, Márcio Flávio Moura de Araújo and Ana Maria Parente Garcia Alencar;

3 – final approval of the version to be published: Natália Pinheiro Fabrício Formiga, Vitória de Cássia Félix Rebouças , Célida Juliana Oliveira and Ana Maria Parente Garcia Alencar.

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