Original article

RISK FACTORS FOR FOOT ULCERATION IN INDIVIDUALS WITH TYPE 2 DIABETES MELLITUS

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ABSTRACT: The aim of this study was to analyze the factors associated with the risk of foot ulceration in individuals with type 2 diabetes mellitus. Quantitative study, with 71 individuals in a Primary Health Unit of a municipality in the state of Paraná. The data were collected through a home interview and a physical examination of the feet, from July to September 2016. The foot with risk of ulceration was identified in 35.2% of the studied population. The most prevalent risk factors for ulceration were inadequate nail cutting, use of inadequate footwear, presence of mycosis, callosities and cracked or dry skin. Inadequate capillary filling, loss of sensitivity and history of ulcers were associated with the risk of ulceration. Health professionals should recognize and value the importance of the foot examination and the provision of theoretical and practical guidance regarding foot care for individuals with diabetes.
DESCRIPTORS: Diabetes mellitus; Nursing; Primary healthcare; Risk factors.

FATORES DE RISCO PARA ULCERAÇÃO NO PÉ DE INDIVÍDUOS COM DIABETES MELLITUS TIPO 2

RESUMO: Objetivou-se analisar os fatores associados ao risco de ulceração do pé em indivíduos com diabetes mellitus tipo 2. Estudo quantitativo, com 71 indivíduos numa Unidade Básica de Saúde de um município do estado do Paraná. Os dados foram coletados em entrevista domiciliar e com exame físico dos pés, no período de julho a setembro de 2016. O pé com risco à ulceração foi identificado em 35,2% da população estudada. Os fatores de risco às ulcerações mais prevalentes foram o corte inadequado das unhas, a utilização de calçados inadequados, presença de micose, calosidades, rachadura e pele ressecada. O enchimento capilar inadequado, a perda de sensibilidade e o histórico de úlceras estiveram associados ao risco de ulceração. Faz-se mister que os profissionais de saúde reconheçam e valorizem a importância do exame dos pés e do fornecimento de orientações teóricas e práticas, quanto aos cuidados necessários aos pés de indivíduos com diabetes.
DESCRITORES: Diabetes mellitus; Enfermagem; Atenção primária à saúde; Fatores de risco.

FACTORES DE RIESGO PARA ULCERACIÓN EN LOS PIES DE INDIVIDUOS CON DIABETES MELLITUS TIPO 2

RESUMEN: Fue objetivo del estudio analizar los factores asociados al riesgo de ulceración de los pies de individuos con diabetes mellitus tipo 2. Estudio cuantitativo, con 71 individuos en una Unidad Básica de Salud de un municipio del estado de Paraná. Los datos fueron obtenidos en entrevista domiciliar y con prueba física de los pies, en el periodo de julio a septiembre de 2016. El pie con riesgo de ulceración fue identificado en 35,2% de la población estudiada. Los factores de riesgo de ulceraciones más prevalentes fueron el corte inadecuado de las uñas, la utilización de zapatos inadecuados, presencia de micosis, callosidades, rajadura y piel seca. El llenado capilar inadecuado, la pérdida de sensibilidad y el histórico de úlceras estuvieron asociados al riesgo de ulceración. Se concluye que es esencial que los profesionales de salud reconozcan y valoren la importancia de la prueba de los pies y de orientaciones teóricas y prácticas acerca de los cuidados necesarios a los pies de individuos con diabetes.
DESCRIPTORES: Diabetes mellitus; Enfermería; Atención básica a la salud; Factores de riesgo.

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INTRODUCTION

Diabetes mellitus (DM) is characterized by high levels of blood glucose due to the failure of insulin production and/or inability to adequately perform its functions[1]. The complexity of this disease, associated with its high incidence and prevalence, contributes to it being considered an important public health problem[2].

By the year 2014, around 347 million people worldwide had a diagnosis of DM, which is equivalent to 6% of the global population[3]. Brazil occupies the fifth position in the ranking of the nations with the highest number of individuals affected[4].

Type 2 DM (T2DM) is the most frequent and represents 90% to 95% of the cases. Its occurrence is associated with behaviors such as unhealthy eating and sedentary lifestyle, risk factors such as obesity and hypertension, and genetic factors[1].

Lack of glycemic control or late diagnosis increase the chances of complications, such as cardiovascular diseases, retinopathy, nephropathy and diabetic foot[1]. Diabetic foot occurs when an injured or infected area in the foot develops an ulcer[5]. It affects approximately 15% of patients with DM throughout life and accounts for more than 60% of non-traumatic amputations[1-2], which consequently generates serious social and economic repercussions[6].

Data on persons enrolled in the health insurance system, managed by the United States of America, showed that 24.4% of the total spent on health in the country was spent on care for individuals with T2DM who had diabetic foot[7].

Thus, to identify the associated factors that increase the risk for the development of diabetic foot helps in the planning of actions to be developed by the nursing team to prevent this complication. The feet of patients with DM require continuous care and their inspection should be included in the care routine for these individuals. Accordingly, the present study aimed to analyze the factors associated with the risk of foot ulceration in individuals with T2DM.

METHOD

This quantitative, cross-sectional study was carried out in a Primary Health Unit (PHU) of a medium-sized municipality, located in the northwest region of the state of Paraná. The municipality has 15 PHUs and 100% population coverage by Family Health Strategy (FHS) teams. Up to the last quarter of 2015, 2,286 individuals with a diagnosis of DM were enrolled in the PHUs of the municipality. The PHU selected, by convenience, has two FHS teams, one of them being the obligatory supervised training of the 4th year of the nursing undergraduate course, at the time of the study.

The study participants were subjects with T2DM enrolled in selected the PHU. In 2016, 106 individuals, aged 40 years or more, diagnosed with T2DM, were registered with one of the FHS teams, the scenario of the study.

For the sample calculation, the probabilistic sampling technique was used, considering a 5% estimation of error, confidence level of 95% and prevalence of 50%, to obtain greater variability of the studied event, plus 10% for possible losses or exclusions. With these parameters, a sample number of 84 individuals was obtained. The participants were randomly drawn from the list of name and address of individuals with T2DM provided by the FHS team, so that the data collected were representative of the whole.

Data were collected from July to September 2016, through a home interview and physical examination of the feet. In order to record the information regarding the assessment of the lower limbs, including dermatological, circulatory, neuropathic and foot care conditions, the variables included in the Primary Care booklet[4] were used.

Inclusion criteria were: individuals of both sexes, aged 40 years or over. Exclusion criteria were to present sequelae that would affect communication or the diagnosis of any mental illness.

In the assessment of the lower limbs, the following variables were considered: 1. Foot care practices (after bathing drying between the toes, evaluation of the feet, descaling feet, walking barefoot, shoes used daily); 2. Examination of the feet (nail trimming, footwear used at the time of the interview, hygiene) - for the type of footwear used, the closed model was considered adequate, with an extra centimeter throughout the internal extension of the shoe, not tight nor wide, made of soft leather material or canvas\cotton[8]; 3. Dermatological aspects (presence of mycosis in the nail and between toes, callosity, cracks in the feet, dry skin); 4. Presence of neuropathy identified with the 10g gram Semmes-Weinstein monofilament test[4]; 5. Presence of deformities (hallux valgus, claw toes, hammer toes and bony prominences); and 6. Vascular alteration (palpation of the posterior tibial and pedal pulses).

The classification of the risk of ulceration was carried out according to the primary care booklet: Grade 0: Neuropathy absent (preserved sensitivity); Grade 1: Neuropathy present (sensitivity change); Grade 2: Neuropathy present, signs of peripheral vascular disease and/or foot deformity; Grade 3: previous amputation[4].

For the analysis, the data were first organized in spreadsheets of the Microsoft Office Excel 2010 program and later transferred to the IBM SPSS version 20 statistical program. The Yates's corrected Chi-square test was used to identify associations between the variables. The level of significance considered was 5% in all tests.

The study was approved in June 2016 by the Research Ethics Committee of the State University of Maringá, under authorization No. 1.606.073.

RESULTS

The study participants were 71 individuals, as 13 were not encountered after three home visits. It should be noted that the loss did not impact the results, as the prediction of possible losses was considered in the sample calculation. Of these participants, 62% (44) were female, with a mean age of 60 years (standard deviation = 10.2 years). Regarding skin color, 71.8% (51) referred to themselves as white, with 69.6% (49) having companions. Regarding the level of schooling, there was a predominance of individuals with less than six years of schooling 67.7% (48). It should be highlighted that 67.6% (48) had a diagnosis of T2DM for 10 years or more (mean time since diagnosis of 11 years) and 26.8% (19) used insulin.

In the clinical examination of the feet, 81.7% (58) of the participants presented good hygiene conditions. Nail cutting was inadequate in 36.6% (26) and partially adequate in 29.6% (21). The habit of drying the spaces between the toes daily was reported by 59% (41).

According to the reports of the participants, 43.7% (31) self assessed the feet daily and 32.4% (23) sometimes. A total of 59% (41) of the participants reported not performing foot descaling. Never or sometimes walking barefoot was reported by 63.4% (45) and 29.6% (21) of the interviewees, respectively. The footwear at the time of the interview of 71.8% (51) of the individuals examined was inadequate.

There was no statistically significant association between the foot self-care actions and the classification of risk of ulceration, as shown in Table 1.

Table 1 - Distribution of foot self-care, according to the classification of risk of foot ulceration in type 2 diabetic patients. Paranavaí, PR, Brazil, 2016 (continues)

Self-Care	(%) Ulceration Risk (n = 71)			
	Grade 0	Grade 1	Grade 2	P-value
Hygiene				
Adequate	63.8	36.2	-	0.080
Inadequate	69.2	23.1	7.7	

Dry between toes				
Never	54.5	45.5	-	0.506
Sometimes	85.7	14.3	-	
Daily	66.7	31.0	2.3	
Evaluate the feet				
Never	52.9	47.1	-	0.566
Sometimes	69.6	30.4	-	
Daily	67.7	29.0	3.2	
Descale feet				
Never	64.3	33.3	2.4	0.763
Sometimes	63.0	37.0	-	
Daily	100.0	-	-	
Walk barefoot				
Never	57.8	40.0	2.2	0.152
Sometimes	85.7	14.3	-	
Daily	40.0	60.0	-	
Nail cutting				
Adequate	70.8	29.2	-	0.663
Partially adequate	66.7	33.3	-	
Inadequate	57.7	38.5	3.8	
Footwear used				
Adequate	76.2	19.0	4.8	0.086
Inadequate	60.0	40.0	-	

Regarding the dermatological alterations, 52.1% (37) of the individuals presented onychomycosis, while 18.3% (13) presented mycosis in the spaces between the toes. The presence of callosities was verified in 56.3% (40), cracks in 60.6% (43) and 78.9% (56) had xerosis. However, these changes had no statistically significant association with the risk of ulceration, as shown in Table 2.

Table 2 - Distribution of dermatological alterations, according to the classification of risk of foot ulceration in type 2 diabetic patients. Paranavaí, PR, Brazil, 2016 (continues)

Dermatological Alterations	**(%) Ulceration Risk (n = 71)**			
	Grade 0	**Grade 1**	**Grade 2**	**P-value**
Onychomycosis				
Yes	62.2	35.1	2.7	0.594
No	67.6	32.4	-	
Mycosis between toes				
Yes	53.8	38.5	7.7	0.088
No	67.2	32.8	-	
Callosities				
Yes	65.0	32.5	2.5	0.663
No	64.5	35.5	-	
Cracks				
Yes	55.8	41.9	2.3	0.129
No	78.6	21.4	-	

Xerosis				
Yes	60.7	37.5	1.8	0.364
No	80.0	20.0	-	

Regarding vascular alterations, it was verified that the pedal pulse was decreased in 23.9% (17) and absent in 8.5% (6). The posterior tibial pulse was decreased by 38% (27) and absent in 22.5% (16). Sensitivity was absent in 22% (15) of the individuals and 25% (18) presented inadequate capillary filling. Inadequate capillary filling, loss of sensitivity and history of ulcers were statistically associated with the risk of ulceration.

Table 3 - Distribution of vascular, orthopedic and neurological alterations, according to the classification of risk of foot ulceration in type 2 diabetic patients. Paranavaí, PR, Brazil, 2016 (continues)

Characteristics	**(%) Ulceration Risk (n = 71)**			
	Grade 0	**Grade 1**	**Grade 2**	**P-value**
Pedal Pulse R				
Palpable	71.7	28.3	-	**0.002**
Decreased	46.2	53.8	-	
Not palpable	40.0	40.0	20.0	
Pedal Pulse L				
Palpable	72.2	27.8	-	**0.004**
Decreased	45.5	54.5	-	
Not palpable	33.3	50.0	16.7	
Tibial Pulse R				
Palpable	79.3	20.7	-	0.096
Decreased	55.6	44.4	-	
Not palpable	53.3	40.0	6.7	
Tibial Pulse L				
Palpable	82.4	17.6	-	**0.010**
Decreased	52.0	48.0	-	
Not palpable	41.7	50.0	8.3	
Capillary Filling R				
Adequate	72.2	27.8	-	**0.023**
Inadequate	41.2	52.9	5.9	
Capillary Filling L				
Adequate	34.3	17.9	-	**0.012**
Inadequate	38.9	55.6	5.6	
Deformities R				
Yes	66.7	33.3	-	0.530
No	62.5	34.4	3.1	
Deformities L				
Yes	64.9	35.1	-	0.569
No	64.7	32.4	2.9	
Loss of Sensitivity R				
Yes	0.0	95.0	5.0	**0.000**
No	90.2	9.8	-	

Loss of Sensitivity L				
Yes	0.0	94.7	5.3	**0.000**
No	88.5	11.5	-	
History of Ulcers R				
Yes	20.0	70.0	10.0	**0.001**
No	72.1	27.9	-	
History of Ulcers L				
Yes	50.0	50.0	0.0	0.879
No	65.2	33.3	1.4	

DISCUSSION

The results are in agreement with a study that demonstrated how people with low levels of education may present a greater risk for the development of diabetic foot, as lack of schooling interferes in the understanding and adherence to the treatment proposed for the control of the diabetes and its complications[9]. In addition to schooling, the time since diagnosis is also a factor indicative of the probability of the appearance of ulcers in the lower limbs[10].

Accordingly, considering that the majority of the participants of the present study presented more than 10 years since diagnosis, it is important to increase the vigilance actions by health professionals regarding the investigation of modifiable risk factors for ulceration of the feet, with a view to the development of early interventions.

One of the main initial consequences of diabetes mellitus is diabetic foot, characterized by the appearance of foot ulcers[4]. This complication has consequences beyond simple limb limitation, such as reduced quality of life, high costs with repetitive hospitalizations, long-term rehabilitation and premature mortality[11]. The prevalence of foot injuries and consequently ulcerations can be reduced through prior knowledge of the risk factors, the adoption of preventive measures and adequate care. Among the preventive measures and adequate foot care, good hygiene conditions were present in a high percentage in this study, which indicates the concern of the individuals with regards to keeping the limbs healthy and free of lesions and ulcers.

Although 59% of the participants in this study reported that they dried their feet daily, it is important to remember that the habit of not drying between the toes can promote the proliferation of microorganisms and cause cracks and diseases in the skin(4). Habits such as inadequate nail cutting, walking barefoot and wearing inappropriate shoes, prevalent among the participants of the present study, may trigger a risk to the integrity of the skin of the feet, especially in diabetics, as these individuals have decreased sensitivity[12].

In a study that investigated knowledge, attitudes and the performance of preventive measures for diabetic foot, the women were shown to perform hydration and massage in the lower extremities and practice the prevention of diabetic foot, while the men, for cultural reasons, attributed the care to women and did not follow the recommendations[13]. In this context, factors such as gender-related behaviors should be considered in the guidance provided by health professionals.

In order to obtain good results regarding adherence to self-care, it is necessary to plan preventive actions that address the adoption of specific foot care, daily examinations, hydration of the skin, proper cutting of the nails and not removing callosities, among others. Health professionals, especially those of the Family Health Strategy, are responsible for the development of health promotion, protection and recuperation actions. Therefore, the identification of the main risk factors for the development of ulceration is essential for the planning of preventive actions and for the delay of complications in the feet, favoring the quality of life of people with diabetes[13].

Despite not finding an association between self-care and the degree of risk for ulceration in this study, it is important to consider these aspects in the daily life of people with DM. Research in a Health Center in Teresina-PI found that of the 331 subjects with T2DM, 178 reported not having received guidance from nurses regarding the importance of the foot examination and drying of the spaces between the toes, with 66.5% (220) also reporting that they did not receive guidance on the inspection of their shoes before wearing them[14].

These data allow us to infer that professionals need to persist in their fundamental health promotion role. Thus, the population in general, especially individuals with chronic conditions such as T2DM, needs continuous interventions that favor quality of life and the prevention of complications.

Self-care refers to the behaviors adopted by individuals in their daily lives. People with lower financial and educational conditions are more prone to glycemic decompensation and high rates of DM complications, which increases the mortality rate of this population[15]. Due to this scenario and the difficulty these individuals have in obtaining effective care, it is necessary to disseminate the importance of self-care and the benefits gained from it.

In addition, financial and educational difficulties also influence the acquisition of adequate footwear, as was verified in 71.8% of the participants. In this sense, the importance is emphasized of professionals offering the population possibilities for adaptations that favor the adoption of daily care practices, considering the reality experienced.

Dermatological alterations, on the other hand, are consequences of ineffective self-care that cause some impairments for the individual with DM. In the present study significant numbers of individuals with xerosis (dry skin) and onychomycosis (mycosis of the nails) were evidenced. An analogous result was found in one study[16] performed in a university hospital with 212 individuals with DM who presented some infections in the feet, among them xerosis (55.2%) and onychomycosis (43.9%), which showed how much DM impairs the integrity of the skin if care is not taken. Hence the importance of health professionals guiding the population regarding the practices of foot inspection, promoting dynamic actions capable of transmitting information in an accessible manner that involve the demonstration and supervision of specific care.

Peripheral vascular disease is considered one of the most important factors for the development of ulceration and destruction of deep tissue[17]. In the present study, there was a significant percentage of individuals with a decrease or absence of tibial and pedal pulses, similar to a study carried out in Parnaíba-PI, which identified a high prevalence of the reduction of the pedal pulse in the right and left limbs (51.3% and 53.9% respectively), with reduction of the left tibial pulse in 56.5% [18].

These data and those obtained in the present study demonstrate that individuals with T2DM present blood flow deficits in the lower limbs. This deficiency should be identified and valued during the follow-up by health professionals. It should be noted that although this factor cannot be modified, there are care actions that avoid more severe consequences, such as the practice of keeping limbs elevated for short periods during the day.

Diabetic neuropathy is a consequence of DM and is associated with a loss of skin sensitivity in approximately 80% of cases. These two factors may lead to the development of ulceration in the feet[4]. Although not very prevalent in the present study, both loss of sensitivity (22%) and inadequate capillary filling (25%) require attention in the monitoring and follow-up of these individuals, since there was a statistical significance between loss of sensitivity and risk of ulceration.

This situation shows that the greater the impairment of the sensibility, the greater chance of the limb suffering a trauma without the individual noticing, as well as the risk of an injury progressing to ulceration. It should be noted that, in addition to limb injury, this condition also wears down the individual emotionally.

Frequent glycemic changes lead to a greater chance of DM complications, including peripheral vascular disease, which may be due to a trauma in the feet, which, when associated with glycemic decompensation, may develop into diabetic foot[19]. This in itself indicates the need for these people to receive multiprofessional support, so that they are adequately instrumentalized in relation to self-care and management of their lives.

Among the chronic complications of DM, foot ulceration and amputation are the most serious and have a great socioeconomic impact[8]. In the present study, a significant association between history of ulcers and risk of grade 1 ulceration was observed. That is, the individual with a previous ulcer presents a greater chance of new cases of ulcers and a greater probability of limb amputation, which indicates that these individuals require of increased care and better management of the disease.

A limitation that should be highlighted is the fact that this study focused on factors associated with the risk of foot ulceration in individuals with T2DM, specific to one PHU. Thus, these results reveal the problem of a local reality and, therefore, by virtue of the sample and the performance in a single institution, the data cannot be generalized. It is suggested that new studies are carried out in other PHUs, thus providing a wider evaluation of the problem.

FINAL CONSIDERATIONS

The results of this study allow the inference that health professionals need to engage effectively in the care and guidance of individuals with DM, as a considerable number of the people enrolled in this PHU presented a risk of ulceration and modifiable risk factors, such as cutting nails, the use of inappropriate footwear and the presence of mycosis, callosities, cracks and dry skin.

It should be mentioned that the precariousness of the health services and the culture of the individuals, especially of the men, impact on the reorganization of the care planning by the FHS and the effectiveness of health education practices for chronic diseases.

Individuals with DM are expected to perform specific care actions and to be continuously monitored by nurses and health professionals, avoiding and minimizing the chances of developing ulceration, which interferes with the conditions and quality of life of this population.

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