






## PREVALENCE OF AMPUTATIONS IN DIABETIC INDIVIDUALS TREATED AT A REFERRAL CENTER

João Vitor Pereira dos Santos<sup>1</sup> , Paula Victoria Bittencourt Araújo<sup>1</sup> , Claudia Silva Marinho<sup>1</sup> ,  
Rose Ana Rios David<sup>1</sup> , Rayssa Fagundes Batista Paranhos<sup>2,\*</sup> 

### ABSTRACT

Diabetes Mellitus (DM) has high rates of morbidity and mortality due to its complications. **Objective:** To analyze the prevalence of amputations in individuals with DM treated at a referral center in Salvador, Bahia. **Method:** Cross-sectional study, with data from 160 medical records adult people with diabetes who suffered or not amputation, attended at the specialized outpatient service. Data analysis was performed using the Statistical Package for the Social Sciences®. The results are presented in absolute and relative frequencies,  $\chi^2$  test and Fisher's exact test, when appropriate, considering significance of 5%. **Results:** The prevalence of amputation was 53.75%. It was associated with male gender ( $p=0;00$ ), time since diagnosis of DM greater than 10 years ( $p=0.046$ ) and metabolic comorbidities ( $p=0.047$ ). **Conclusion:** The high rates of amputations in males of productive and working age reveal the need to control DM and its comorbidities, as well as prevention of skin lesions that lead to amputation.

**DESCRIPTORS:** Diabetes Mellitus. Diabetic Foot. Amputation, Surgical. Nursing. Enterostomal Therapy.


## PREVALÊNCIA DE AMPUTAÇÕES EM INDIVÍDUOS DIABÉTICOS ATENDIDOS EM UM CENTRO DE REFERÊNCIA

### RESUMO

O Diabetes Mellitus (DM) possui altos índices de morbimortalidade devido às suas complicações. **Objetivo:** Analisar a prevalência de amputações em indivíduos com DM, atendidos em um centro de referência em Salvador, Bahia. **Método:** Estudo transversal, com dados de 160 prontuários pessoas adultas com diabetes que sofreram ou não amputação, atendidos no serviço ambulatorial especializado. A análise dos dados foi realizada através do programa *Statistical Package for the Social Sciences*®. Os resultados são apresentados em frequências absolutas e relativas, teste  $\chi^2$  e exato de Fisher, quando adequados, considerando significância de 5%. **Resultados:** A prevalência de amputação foi de 53,75%. Mostrou-se associada ao sexo masculino ( $p=0;00$ ), tempo de diagnóstico de DM maior que 10 anos ( $p=0,046$ ) e comorbidades metabólicas ( $p=0,047$ ). **Conclusão:** As altas taxas de amputações no sexo masculino em idade produtiva, laboral, revelam a necessidade de controle do DM e suas comorbidades, assim como prevenção de lesões de pele que levam à amputação.

**DESCRIPTORES:** Diabetes Mellitus. Pé Diabético. Amputação Cirúrgica. Enfermagem. Estomaterapia

1. Universidade Federal da Bahia  – Escola de Enfermagem – Salvador (BA), Brazil.

2. Universidade Federal da Bahia  – Programa de Pós-Graduação em Enfermagem e Saúde – Salvador (BA), Brazil.

\*Correspondence author: [rayssa.paranhos@gmail.com](mailto:rayssa.paranhos@gmail.com)

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## PREVALENCIA DE AMPUTACIONES EN DIABÉTICOS ATENDIDOS EN UN CENTRO DE REFERENCIA

### RESUMEN

La Diabetes Mellitus (DM) presenta altas tasas de morbilidad y mortalidad por sus complicaciones. **Objetivo:** analizar la prevalencia de amputaciones en individuos con DM atendidos en un centro de referencia en Salvador, Bahía. **Método:** estudio transversal, con datos de 160 historias clínicas de adultos con diabetes que sufrieron o no amputación, atendidos en el servicio ambulatorio especializado. El análisis de los datos se realizó utilizando el Statistical Package for the Social Sciences®. Los resultados se presentan en frecuencias absolutas y relativas, prueba de  $\chi^2$  y prueba exacta de Fisher, cuando corresponda, considerando significancia del 5%. **Resultados:** la prevalencia de amputación fue del 53,75%. Se asoció con sexo masculino ( $p=0,00$ ), tiempo desde el diagnóstico de DM mayor de 10 años ( $p=0,046$ ) y comorbilidades metabólicas ( $p=0,047$ ). **Conclusión:** las altas tasas de amputaciones en varones en edad productiva y laboral revelan la necesidad de controlar la DM y sus comorbilidades, así como la prevención de lesiones cutáneas que conducen a la amputación.

**DESCRIPTORES:** Diabetes Mellitus. Pie Diabético. Amputación Quirúrgica. Enfermería. Estomaterapia.

### INTRODUCTION

The prevalence of chronic non-communicable diseases (NCDs) increases progressively. There is a direct relationship between population aging, changes in nutritional habits, sedentary lifestyle and obesity. Among NCDs, Diabetes Mellitus (DM) and its complications represent one of the biggest public health problems in Brazil and the world<sup>1</sup>.

DM is a metabolic disorder characterized by high blood glucose levels due to insulin resistance, deficiency in its production, or both mechanisms, causing long-term complications<sup>2</sup>. Lack of diabetes control can cause dysfunctions and insufficiencies in different organs, mainly affecting the renal, cardiovascular, neurological and ophthalmological systems<sup>3</sup>.

Brazil occupies sixth place on the list of the ten countries with the highest number of diabetic people between 20 and 79 years old, equivalent to 15.7 million people. The estimate is that this number will reach 23.2 million in 2045. Concerning the number of individuals in this age group with undiagnosed diabetes, the country is in 8th place among the top 10 worldwide, with 5.7 million people<sup>2-4</sup>.

In 2021, Brazil was among the three countries with the highest expenditure related to DM, totaling 42.9 billion dollars<sup>3,4</sup>. Of these expenses, more than 50% are spent on treating complications generated by DM<sup>3,4</sup>. Among the most frequent complications is an injury to the foot of a person with diabetes, known as the “diabetic foot”, defined in the 2023 Guidelines of the International Working Group On the Diabetic Foot (IWGDF) as a set of changes that alone or simultaneously lead to the emergence of ulcers on the feet. Neurological changes arising from peripheral neuropathy and/or varying degrees of peripheral arterial disease (PAD) are the leading causes of ulcers, which serve as a gateway for infections and can lead to amputation of the affected limb<sup>4</sup>.

Lower limb amputation is twice as common in diabetic people. According to the World Health Organization, in Brazil, 80% of non-traumatic amputations carried out in the lower limbs are due to peripheral vascular disease caused by DM<sup>2</sup>. According to the IDF, in 2021, Brazil had a prevalence of 21% for foot ulcers related to DM, in addition to having a prevalence of amputations performed on lower limbs ranging from 10 to 13% and a mortality rate of 20% in the first two years after the procedure<sup>5</sup>.

Considering global and Brazilian statistical data, it is understood that it is essential to know the social, demographic and clinical profile of a population affected by DM and lower limb amputations in a unit specialized in the care of people with ulcers resulting from diabetes to direct actions of greater efficiency and effectiveness in the prevention, treatment and control of complications. In this sense, the study aims to analyze the prevalence of limb amputations in individuals with diabetes mellitus treated at a reference center in Salvador, Bahia. To this end, we seek to describe and verify the association between the prevalence of amputations and the social and clinical characteristics of these individuals.

## METHOD

The present is an observational, cross-sectional, analytical study with a quantitative approach. The Strobe International Guide was used as a basis for preparing the article.

The place where the study was carried out was the *Centro de Referência Estadual para Assistência ao Diabetes e Endocrinologia-CEDEBA* (State Reference Center for Diabetes Care and Endocrinology), medium complexity care unit of the state public network located in Salvador, part of the Sistema Único de Saúde -SUS (Unified Health System) state and national reference, for people with diabetes and other endocrinopathies. It has a multidisciplinary team and an exclusive outpatient clinic for risk prevention and treatment of diabetic foot wounds.

The population that comprised the study was diabetic individuals, adults aged 18 or over, who had or had not suffered an amputation, registered and treated in the outpatient service from January to December 2017.

The data source used was secondary, with data from medical records. 319 medical records were explored, corresponding to patients treated at the specialized outpatient clinic, made available by the *Serviço de Arquivo Médico e Estatístico-SAME* (Medical and Statistical Archive Service) from the Center. Of these, a convenience sample of 160 medical records was selected to compose this study; thus, to achieve the study's objective, medical records that did not have complete records of interest, referring to the patient's social, demographic and clinical conditions, were excluded.

Data was collected from August to October 2018, on Mondays, Wednesdays and Fridays, in the afternoon shift at SAME, by three research assistants, nursing graduates duly trained and under the supervision of the responsible researcher.

A checklist-type instrument was previously developed and tested by the researchers. It contained social, demographic and clinical variables related to DM and risk factors and involved information about the person, their treatment and the injuries.

The selected variables of interest were gender, age group, time since DM diagnosis, type of DM, comorbidities, presence of amputation and level of amputation of patients seen at the outpatient clinic in 2017.

The data were entered and organized into a Microsoft Excel spreadsheet and later imported into the statistical program Software Statistical Package for the Social Sciences (SPSS) 16.0 for analysis purposes. The results are presented using absolute and relative frequencies, in addition to an association test, Fisher's exact  $\chi^2$  test, when appropriate, considering a 5% level of statistical significance.

The research was approved by the Comitê de Ética e Pesquisa-CEP ( Research Ethics Committee) da *Escola de Enfermagem da Universidade Federal da Bahia* (School of Nursing at the Federal University of Bahia) opinion nº 2,776,572, complying with the ethical requirements as provided for in Resolutions 466/2012 and 510/2016, of the National Health Council.

This work is an excerpt from the study entitled: *Caracterização dos usuários diabéticos portadores de lesão atendidos em um ambulatório do pé diabético* ("Characterization of diabetic users with injuries treated at a diabetic foot clinic"). The matrix study was carried out in partnership with the Grupo de Pesquisa em Cuidados com a Saúde da Pele-GESPEL (Skin Health Care Research Group) linked to the School of Nursing of the Federal University of Bahia in collaboration with the Centro de Diabetes e Endocrinologia do Estado da Bahia -CEDEBA (Diabetes and Endocrinology Center of the State of Bahia).

## RESULTS

The prevalence of amputation in the studied population was (53.75%), with a more significant number in males (69.77%) aged between 41 and 60 years (50.0%), followed by those over 60 years (46.51%). Regarding the time since DM diagnosis, a significant incidence is noted among those who have had the disease for more than 10 years (69.77%). The most common type of DM for amputation was type 2 (95.35%), and cardiovascular comorbidities stood out (84.89%).

Male sex, time since DM diagnosis and metabolic comorbidities showed a statistically significant association with the condition of lower limb amputation in this population,  $p=0.00$ ;  $p=0.046$ , and  $p=0.047$ , respectively, observed in Table 1.

**Table 1.** Distribution of the population according to sex, age group, time since diagnosis and type of diabetes Mellitus and associated comorbidities. Salvador - BA, 2021

Variables	Non-amputees		Amputees		p-value
	n (74)	%	n (86)	%	
<b>Gender</b>					
Male	27	36.49	60	69.77	<b>0.00</b>
Female	47	63.51	26	30.23	
<b>Age range</b>					
18-40 years	5	6.76	3	3.49	0.190
41-60 years	27	36.48	43	50.00	
>60 years	42	56.76	40	46.51	
<b>DM diagnosis time</b>					
< 5 to 10 years	13	17.57	26	30.23	<b>0.046</b>
> 10 years	61	82.43	60	69.77	
<b>Type of DM</b>					
DM1	9	12.16	4	4.65	0.074
DM2	65	87.84	82	95.35	
<b>Comorbidities*</b>					
Cardiovascular	67	90.54	73	84.89	0.201
Renal	21	28.38	27	31.39	0.405
Metabolic	28	37.84	45	52.33	<b>0.047</b>
Others**	3	4.05	2	2.33	0.429

Source: Research data, Salvador- BA (2021). \*Individuals may present more than one comorbidity. \*\*Others: Asthma, Depression; Psychiatric Disorder; Anxiety disorder, Hepatitis B and C.

Regarding laterality, it was observed that 91.86% of amputations in patients were unilateral. Social and clinical variables were also analyzed according to the level of amputation, highlighting the levels of amputation of the phalanges and forefoot for all categories.

Table 2 highlights the distribution of social and clinical variables according to amputation levels; regarding gender, males had a higher frequency of amputations at all levels; the most recurrent were phalanges and forefoot, with 32.56% and 19.77%, respectively. In women, the frequency obtained for the same highlighted levels was 22.09% and 4.65%.

According to the age group between 41 and 60 years old, the occurrence of amputation at the level of the phalanges was more significant (36.04%), and among the age group over 60 years old, amputation at the forefoot level was higher (19.76%).

Patients with DM for more than 10 years also stood out in terms of the frequency of amputation at the level of the phalanges (33.72%) and forefoot (22.09%). Regarding the type, the most common type of amputation was DM type 2, with (50%) for phalangeal levels and (24.41%) for the forefoot level.

Of the comorbidities, cardiovascular and metabolic ones stood out in terms of phalangeal amputation levels (43.02%) and (24.41%), respectively, in addition to the forefoot level, being (22.09%) for cardiovascular and (16.27%) for metabolic.

Of the variables explored, male gender ( $p=0.00$ ) aged between 40 and 60 years ( $p=0.005$ ), with DM for more than 10 years ( $p=0.037$ ), are characteristics that showed a statistically significant association with amputation at the level of phalanges. The type of DM, as well as the presence of comorbidities, were not related to the outcome of amputations.

**Table 2.** Levels of amputations according to gender, age range, time since DM diagnosis and comorbidities. Salvador - BA, 2021

Variables	Amputation Levels				p-value
	Flanges n 47 (%)	Forefoot n 21 (%)	Foot n 10 (%)	Leg n 8 (%)	
<b>Gender</b>					
Male	28 (32.56)	17 (19.77)	9 (10.47)	6 (6.98)	<b>0.00</b>
Female	19 (22.09)	4 (4.65)	1 (1.16)	2 (2.32)	
<b>Age range</b>					<b>0.005</b>
18-40 years	2 (2.32)	-	-	1 (1.16)	
41-60 years	31 (36.04)	4 (4.65)	6 (6.97)	2 (2.32)	
>60 years	14 (16.27)	17 (19.76)	4 (4.65)	5 (5.81)	
<b>DM diagnosis time</b>					<b>0.037</b>
< 5 to 10 years	18 (20.93)	2 (2.32)	3 (3.48)	3 (3.48)	
> 10 years	29 (33.72)	19 (22.09)	7 (8.13)	5 (5.81)	
<b>Type of DM</b>					0.280
DM1	4 (4.65)	-	-	-	
DM2	43 (50.00)	21 (24.41)	10 (11.62)	8 (9.30)	
<b>Comorbidities*</b>					
Cardiovascular	37 (43.02)	19 (22.09)	9 (10.46)	8 (9.30)	0.257
Renal	11 (12.79)	8 (9.30)	4 (4.65)	4 (4.65)	0.445
Metabolic	21 (24.41)	14 (16.27)	5 (5.81)	5 (5.81)	<b>0.160</b>
Others**	-	1 (1.16)	-	-	0.443

Source: Research data, Salvador – BA (2021). \*Individuals may present more than one comorbidity. \*\*Others: Asthma, Depression; Psychiatric Disorder; Anxiety disorder, Hepatitis B and C.

## DISCUSSION

The prevalence of amputations being higher in males is a frequent finding in several studies, which consider the male social behavior of not carrying out preventive consultations, late seeking healthcare services and neglecting self-care<sup>6-8</sup>. Females, despite the lower prevalence of amputation, are the most vulnerable to death during the procedure and up to 1 year later due to circulatory complications<sup>8</sup>.

Advanced age is confirmed in the literature as a risk factor for the development of type 2 DM, as well as the age group over 60 years old with a high prevalence of amputation.<sup>6-8</sup> Contrary to this data, this research revealed an age range of middle-aged adults between 40 and 60 years old. It is worth highlighting that this group is part of the social productive force; suffering from the disease and especially the amputation event generates a personal and social burden, with absenteeism from work, leaves of absence, absences, readaptations, absences and early retirements<sup>9</sup>.

The literature confirms that in addition to age, the more prolonged diabetes is affected, the more complications there may be, including amputation.<sup>1,4,5,10</sup>

According to the Brazilian Diabetes Society, complications such as cardiovascular diseases and atherosclerotic diseases directly or indirectly influence the risk of amputation<sup>3</sup>. In this study, there was an association between male sex, time since diagnosis longer than 10 years, and metabolic comorbidities, resulting in amputation, confirming a pattern predicted for

this population. In this sense, carrying out studies and assertive practices can contribute to prevention and health promotion measures<sup>10,11</sup>.

Regarding the type, type 2 DM was significantly crucial for the amputation outcome; its frequency is consistent with the population incidence rate for this type of diabetes. The combination of late diagnosis, difficulty changing habits, and lack of glycemic control may be related to the findings<sup>12,13</sup>. Bearing in mind that people with type 1 DM adapt their lives to deal with the disease, as it is a condition often discovered in childhood. The process of dealing with type 2 DM becomes, from this point of view, more difficult for individuals due to the need for late readaptation of habits that generate emotional and social impacts<sup>12,13,14</sup>.

It is essential to highlight that lifestyle habits directly affect the quality of life and glycemic control or lack thereof, as although most interventions to control DM involve the use of hypoglycemic drugs, dietary changes and physical activity are the main measures to combat insulin resistance<sup>15,16</sup>. The antecedents to the appearance of metabolic syndrome, such as inadequate diet and sedentary lifestyle, influence the clinical condition and consequently the appearance of cardiovascular diseases and type 2 DM<sup>15,16</sup>.

It is known that DM becomes a risk factor for multisystem complications<sup>17,18</sup>. The results of this study corroborate the literature on cardiovascular diseases, mainly PAD, the presence of metabolic syndrome and neuropathy, as risk factors for the development of diabetic foot, especially ulceration.<sup>19</sup>. The presence of PAD, according to the IWGDF, is also associated with a greater risk of non-healing ulcers and infections, which may lead to the need for amputation<sup>4</sup>. It is worth noting that the majority of participants had several comorbidities, which is also considered a risk factor for complications.

The most commonly performed amputation levels involve forefoot, midfoot, Syme, ankle disarticulation, transtibial, and transfemoral<sup>12,20</sup>. It is worth noting that people with DM complications who undergo the amputation process may end up suffering successive amputations, which is due to the risk of exposing the stump to trauma and new ulcers, in addition to the increased risk of developing atherosclerotic diseases and vascular events that make ulcer healing difficult<sup>5,13,20</sup>.

The association found between male gender and phalangeal amputation ( $p=0.00$ ) was not observed as a direct finding in any recent article. In general, the literature demonstrates a greater tendency for amputations considered minor to occur, with multiple surgical approaches being possible for other amputations, as previously described<sup>19</sup>.

The findings demonstrate a more significant number of amputations at the phalangeal and forefoot levels, and several studies point to the harm caused by more extensive amputations, considered at the transtibial and transfemoral level, the percentage of mortality for minor amputations is around 5%, while for amputations more extensive is 38.1%<sup>4,5</sup>. The impairment of bone, muscle, tendon, vessel and nerve structures hinders biomechanics and generates a series of functional changes in the individual, causing problems with gait and posture. In this sense, the larger the amputated area, the greater the individual's difficulty in dealing both physically and psychologically with the amputation.<sup>21-22</sup>

Minor amputations at the toe and metatarsal level also cause functional and biomechanical repercussions; a study carried out by Simon-Pérez et al. (2020) sought connections between the degree of ankle stiffness, amputation and the foot posture index and demonstrated that in the group of amputees, there was a higher frequency of pronation of the foot with atypical distal amputation and in the contralateral foot<sup>20</sup>. The mentioned is a crucial complication caused by amputation since feet in a prone position have an increased risk of ulcerations.<sup>20,21</sup>

In addition to the clinical/physical impacts, amputation causes a broad social impact, as well as on the labor, social security and hospital systems. Lower limb amputation can become disabling due to the drastic changes it causes in the life of the person affected. The physical damage is sometimes less than the emotional burden caused to the person and family.<sup>21,22</sup>

Physical changes, limitations imposed by amputations, changes in lifestyle, insecurities and psychological repercussions drastically influence the quality of life and impact the autonomy and personal relationships of individuals, also bringing harm to the family context, adding to hopelessness, depression, anxiety and significant disorders due to major trauma<sup>22,23</sup>.

A descriptive study to analyze the quality of life of patients with lower limb amputations who use a prosthesis demonstrated that the time elapsed since the amputation predisposes a better quality of life due to the adaptive nature.



Monitoring with the rehabilitation team was also a positive factor, as it favored continuity of care and the use of prostheses was positively associated with the emotional aspects and functional capacity of individuals.<sup>23</sup>.

The Social Security Statistical Bulletin showed that in 2022, the total amount paid in disability pensions was R\$57,574,982.00. Of these, the number of pensions granted according to gender and age range between 45 and 70+ years was 10,761 for men and 12,568 for women<sup>9</sup>.

The Ministry of Health announced that 43 lower limb amputations were registered in Brazil per day by the Unified Health System (SUS) between January and August 2020. Added to previous years, there were 10,546 amputations carried out by the SUS, costing R\$ 12.3 million at that time<sup>1</sup>.

It can be considered a much higher total expenditure to the State when considering the investments spent on prosthetics, rehabilitation, outpatient monitoring, and social security benefits related to temporary or permanent removal from the job market. It is important to note that such investment usually returns partially to the economy<sup>1,9</sup>. Studies carried out in Brazil and other countries show a rate below 89% for people who have suffered an amputation to return to the job market<sup>6,22</sup>.

The nurse, as a fundamental part of the multidisciplinary Primary Care team, has an essential role in promoting health education and encouraging self-care for all patients with diabetes, even without the risk of ulceration, care for initial injuries, assistance For patients undergoing limb amputation, skills and training to deal with biopsychosocial aspects and referral to rehabilitation is part of the care and assistance plan. Actions that significantly contribute to solving problems inherent to people with diabetes<sup>24-25</sup>.

As this research uses secondary data from medical records, it has limitations resulting from underreporting and inadequate quality of records, a problem recognized in the area. This problem made it impossible to include the total population treated at the outpatient clinic and restricted the analysis of other variables that could influence the amputation outcome.

## CONCLUSION

The prevalence of amputation found in the population of this study was 53.75%. The severity affected more men aged over 41 years, with type 2 DM for more than 10 years, and also with cardiovascular and/or metabolic comorbidities. The findings are consistent with most studies that seek to characterize the population that suffers from DM complications. Amputations at the level of the phalanges and forefoot were the most frequent.

An amputation is a preventable event through effective monitoring, health education and assessment to outline strategies for daily and adequate care of the lower limbs and/or identify early changes that may culminate in the emergence of injuries, in addition to changes in lifestyle habits, monitoring strategies for people with DM within the scope of primary health care are essential to reduce and control complications.

The role of nursing, from this perspective, is essential. To this end, nurses must be equipped with the knowledge and technical skills necessary to perform their role appropriately, from anamnesis, clinical examination of the feet, and above all, health education, focusing on prevention, treatment and rehabilitation of the individual.

Primary healthcare, as it faces promotion, control and protection actions, as well as treatment and rehabilitation of the population's health, the multidisciplinary team must be qualified for actions to improve health care for individuals with DM, way to combat the complications of the disease early, which contributes to improving the quality of life of these individuals and reducing related social and economic costs.

## AUTHORS' CONTRIBUTIONS

**Conceptualization:** Santos JVP and Araújo PVB; **Methodology:** Santos JVP; Araújo PVB; Marinho CS; David RAR and Paranhos RFB; **Investigation:** Santos JVP; Araújo PVB; Marinho CS; David RAR and Paranhos RFB; **Writing-first version:** Santos JVP; Araújo PVB; Marinho CS and David RAR; **Writing- reviewing:** Paranhos RFB; **Edition:** Santos JVP; Araújo PVB; Marinho CS; David RAR and Paranhos RFB; **Financing Acquisition:** Santos JVP; Araújo PVB; Marinho CS; David RAR and Paranhos RFB; **Resources:** Santos JVP; Araújo PVB; Marinho CS and David RAR.

## DATA STATEMENT AVAILABILITY

Data will be available upon request.

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Not applicable.

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