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## ORIGINAL ARTICLE

### PREVALENCE OF AMPUTATIONS AND REVASCULARIZATION BY DIABETIC FOOT AND ITS FEATURES

#### PREVALÊNCIA DE AMPUTAÇÕES E REVASCULARIZAÇÕES POR PÉ DIABÉTICO E SUAS CARACTERÍSTICAS

#### PREVALENCIA DE LAS AMPUTACIONES Y LA REVASCULARIZACIÓN PARA EL PIE DIABÉTICO Y SUS CARACTERÍSTICAS

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#### ABSTRACT

**Objective:** to estimate the prevalence of amputations and revascularization by diabetic foot and its features. **Method:** cross-sectional study, hospital-based, consisting of the medical records of all hospitalized patients from 1990 to 2005 (n = 4,633), conducted by applying a form built from the International Consensus definitions of diabetic foot. The differences between the studied periods were analyzed by chi-square test. **Results:** the prevalence of hospitalizations by diabetic foot was 27.3%, and amputations, 66.7%, 73.9% and 67.0%, respectively for the considered periods. Regarding the level of amputation, the prevalence rates for major amputation are higher than those for lower section level. **Conclusion:** despite the high rates found for admissions for diabetic foot and amputations, the movement over the period studied, especially regarding the practice of conservative procedures, points to the efforts made by primary care. **Descriptors:** Diabetic Foot; Amputation; Basic Care.

#### RESUMO

**Objetivo:** estimar a prevalência de amputações e revascularizações por pé diabético e suas características. **Método:** estudo transversal de base hospitalar, constituído pelos prontuários de todos os pacientes internados no período de 1990 a 2005 (n=4.633), realizado pela aplicação de um formulário construído a partir das definições do Consenso Internacional sobre pé diabético. As diferenças entre triênios foram analisadas pelo teste Quiquadrado. **Resultados:** a prevalência de internamentos por pé diabético foi 27,3% e de amputações foram: 66,7%, 73,9% e 67,0% respectivamente para os intervalos considerados. Quanto ao nível de amputação, as prevalências encontradas para amputação maior são superiores àquelas de menor nível de secção. **Conclusão:** apesar das altas taxas encontradas para os internamentos por pé diabético e amputações, o movimento ao longo do período estudado, sobretudo, no que diz respeito à prática de procedimentos conservadores, aponta para os esforços empreendidos pela atenção básica. **Descritores:** Pé Diabético; Amputação; Atenção Básica.

#### RESUMEN

**Objetivo:** estimar la prevalencia de las amputaciones y la revascularización para el pie diabético y sus características. **Método:** estudio transversal, hospital-basada, que consiste en las historias clínicas de todos los pacientes admitidas de 1990 y 2005 (n = 4.633) llevadas a cabo mediante la aplicación de una forma construida a partir de las definiciones de consenso internacional de pie diabético. Las diferencias entre los periodos de estudio se analizaron mediante la prueba de chi-cuadrado. **Resultados:** la prevalencia de hospitalizaciones por pie diabético fue del 27,3% y el 66,7% eran amputaciones, 73,9% y 67,0%, respectivamente, para los intervalos. En cuanto al nivel de amputación, las tasas de prevalencia de amputación mayor son más altas que los de nivel de la sección inferior. **Conclusión:** a pesar de las altas tasas encontradas para admisiones para el pie diabético y las amputaciones, el movimiento durante el período estudiado, especialmente con respecto a la práctica de los procedimientos conservadores, apunta a los esfuerzos realizados por la atención primaria. **Descriptores:** El Pie Diabético; Amputación; Atención Primaria.

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## INTRODUCTION

One of the most important and debilitating complications from diabetes mellitus (DM) are diabetic foot ulcers, accounting for almost 35% of all hospitalizations in specialized clinics. It is believed that its development results from a combination of oxygen deficiency caused by peripheral vascular disease, peripheral neuropathy, minor feet trauma, feet deformities, and infection.<sup>1</sup>

Diabetics have a risk of 15% to develop an ulcer lifelong. The incidence of diabetic foot ulcers is continuously increasing, ranging from 1-4%, with a prevalence of 5.3% to 10.5%, and accounts for almost 80% of all non-traumatic lower limb amputations worldwide, also contributing to increase the mortality, considering that the survival rate of patients after amputation is only about 50% in three years.<sup>1</sup>

When analyzing the rates of amputations related to diabetes, there is a significant global variation in the incidence, which, according to researchers, may be explained by the limited access to health services and the variation in the care provision.<sup>2</sup>

Considered a sentry event, that is, preventable concerning the procedures provided by primary care, the amputations by diabetic foot are an important indicator for operational assessment of the health care quality since it reveals, when measuring the section level and analyzing the status of occurrence, the magnitude of this complication in the three levels of care, the disease progression and the quality of its management, useful to managers and health professionals, especially nurses, for their commitment in preventive care.<sup>3,4</sup>

Considering the section level, the "major" amputations are those occurring from the proximal part of the foot, leg, thigh and hip disarticulation; while the "minor" ones are restricted to the toes or its front part.<sup>2,3</sup>

The status of occurrence, in turn, corresponds to the number of amputations and the sequence they occur during the course of the disease. Therefore, the first amputation is defined as a primary procedure regardless the side or the level; the re-amputation is understood as a new procedure performed at an extremity with an unhealed previous amputation; and new amputation corresponds to the amputation

of an extremity with a healed previous amputation.<sup>2,4</sup>

Studies describing the impact of this disease are scarce, especially in developing countries, with lack of resources for population-based surveys. Therefore, in the absence of reliable population data, hospital-based research shall be used.<sup>5</sup>

## OBJECTIVE

♦ To estimate the prevalence of amputations and revascularization by diabetic foot and its features.

## METHOD

Descriptive study, with an epidemiological approach, developed in one of the hospitals of the public health network of Pernambuco, one of the three hospitals of the state specialized in vascular clinic.

Three transversal sections were established, corresponding to the three-year periods 1990-1992, 1995-1997 and 2003-2005. This division was necessary due to loss of records regarding the admissions of the period from July 1998 to July 2001 in the selected hospital. This division is also due to the purpose of match the incidence of amputations to the period of implementation of SUS and, thereafter, PSF in Recife.

The study population consisted of the medical records of all patients admitted from 1990 to 2005, observing the mentioned division of periods (N = 5.055 admissions). Taking into account the valid records (the quality of records), were analyzed: in the first three years, 977 records; in the second, 1606; and, in the last three years, 2,050 hospitalizations, totaling 4.633 patients.

For data collecting, a form built from the International Consensus settings about diabetic foot was used.<sup>6</sup>

The analyzed variables were: year of admission, hospitalized diabetic foot patients, conservative procedures (debridement and/or revascularization), amputations in the last hospitalization by diabetic foot, amputation level and situation of amputation (first amputation, new amputation and re-amputation).

The average and prevalence for each interval were calculated, with an interval of 95% of confidence (95% CI). The differences between the studied periods were analyzed by the chi-square test. The SPSS software,

version 13.0, was used for data entry, with double entry, and analysis.

This article is part of the research project approved by the Research Ethics Committee of the Restoration Hospital, registration number CAAE: 0079.0.102.000-10, and is in accordance with the CNS Resolution Number 466/2012.

RESULTS

From the total number of hospitalizations in nine years (4.633), there was an occurrence of 1.267 admissions for diabetic

foot, with a prevalence of approximately 27.3% for the total studied period. The distribution by triennium can be seen in Figure 1.

In this chart, there is a drop in the prevalence of this disease for the second triennium and, then, it grows again. The prevalence for each tri-annual segment was respectively: 33.0%, 22.4% and 29.1%.

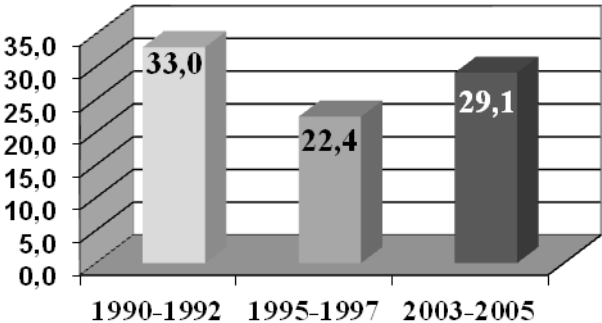


Figure 1. Prevalence of diabetic foot patients according to the studied trienniums.

The amputations in diabetic foot patients in the entire studied period (1990 - 2005) accounted for 69%, totaling 874 surgeries of this type.

When analyzed by triennium, there has been an increase in the second period when

compared to the other two. The occurrence behavior of this procedure is shown in Figure 2, which shows a small difference between the three periods, although a statistical significance was found for the surveyed years ( $p = 0.002$ ).

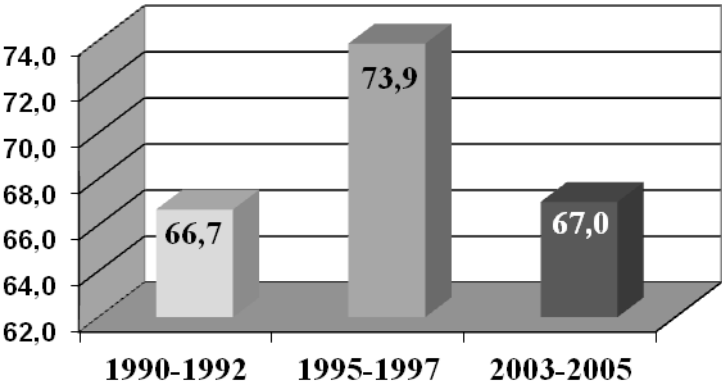


Figure 2. Prevalence of amputations for diabetic foot according to the studied trienniums.

Table 1 shows that the proportion of amputations in major level is always higher than the one of amputations in minor level, being this information valid for all trienniums ( $p = 0.037$ ). The same behavior is also observed when comparing the prevalence of first amputation with the ones of new amputation and re-amputation. The differences for the variable *first amputation* regarding the three studied periods are statistically significant ( $p = 0.001$ ).

The values found for the first amputation, new amputation and re-

amputation, when comparing the last triennium with the first one, decreased, with statistically significant differences for the first amputation and re-amputation ( $p = 0.001$  and  $0.000$ ).

Table 1. Level and status of occurrence of amputations according to the studied trienniums.

Charact. of the amputations	Hospitalization Period						
	1990 - 1992		1995 - 1997		2003 - 2005		p-valor
	%	IC (95%)	%	IC (95%)	%	IC (95%)	
Major amput.	60.4	54.8 - 65.7	56.6	51.0 - 62.0	51.4	47.0 - 55.7	0.037
Minor amput.	23.4	18.9 - 28.3	28.6	23.8 - 33.8	25.4	21.7 - 29.3	0.322
First amput.	60.6	55.1 - 65.8	56.9	51.7 - 61.9	48.3	44.3 - 52.3	0.001
New amput.	7.5	4.9 - 10.7	10.4	7.5 - 13.9	6.5	4.7 - 8.7	0.101
Re-amput	12.4	9.1 - 16.4	9.5	6.8 - 12.9	3.2	2.0 - 4.9	0.000

According to the patient’s condition on admission, procedures such as debridement and revascularization, here represented by conservative procedures, can be performed in order to save the limb.

The profile of these procedures by triennium (Figure 3) shows an increase when comparing the first and the last periods.

The ratios found were, respectively, 24.8%, 32.9% and 44.7%, totaling 34.1% for the whole period. It is possible to see that, in the last triennium, the completion of these procedures almost doubled. The differences found for the studied trienniums were statistically significant at 1% (p = 0.000) by Chi-square test.

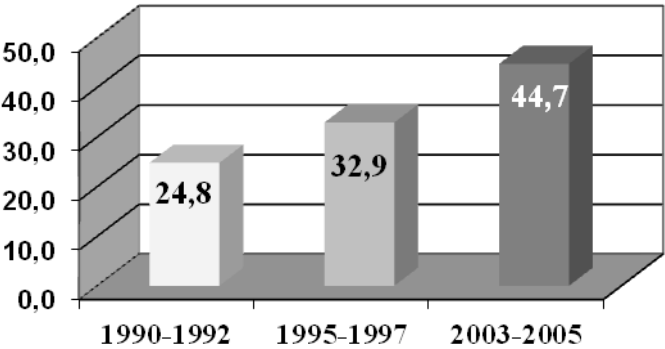


Figure 3. Prevalence of conservative procedures in diabetic foot patients according to the studied trienniums.

DISCUSSION

The Family Health Program (FHP) strategy has spread nationwide since 1996, constituting a form of primary care developed, *a priori*, for populations at increased risk, both biological as socio-economic.

In order to reduce the morbidity and mortality associated with hypertension and diabetes mellitus, the Ministry of Health implemented the Care Reorganization Plan for Arterial Hypertension and Diabetes Mellitus in the country, during 2001-2003.

It should be considered, while reading the discussions here stated, that, despite not being a population-based study, a large hospital was chosen as the research’s site, representative for the care of amputations in this state.

Included in aging diseases, hospitalizations for diabetic foot reached a prevalence of 27.3% for the total studied period, accounting for over a quarter of admissions in the vascular clinic of this hospital.

When analyzing separately the periods, the prevalence of this disease decreases in

the second triennium, which corresponds to the period of the PSF implementation, when compared to the first and the last ones, when this rate increases again. This increase after the second period can be seen, hypothetically, in two ways: as a result of inadequate procedures regarding the disease, a reflection of the previous health system, or as a result of improved customer service, through higher level complexity diagnosis and reference.

This last assumption is supported by associating the prevalence found in the third triennium with the implementation of Care Reorganization Plan for diabetes in the country. Diabetic foot ulcers are among the most prevalent causes of hospitalization. The estimative is that 20% of hospital admissions among diabetic patients are the result of feet problems.<sup>1,6</sup>

The rates of performed amputations are quite high for the entire period, even the study being conducted with treatment groups, and not population-based. The rate of the first triennium, related to the beginning of SUS, may represent a vestige of the previous form of care, based on curative care that, concerning the difficulties of

access of the disadvantaged population, would result in shorter hospital access and may even be related to the increased mortality in the origin site.

The increase observed in the second triennium, related to the PSF implementation, may, at first, show the impact in terms of reference for more complex attention, in a way that results in the following decrease, in the subsequent period, of this type of procedure.

The incidence of lower limb amputations varies greatly around the world, between 46.1 to 96.00 per 10.000 inhabitants.<sup>2</sup> A population-based study, conducted in England, comparing the period between 2004 and 2008, showed an increase in the absolute number of amputations of 14.7% between the two considered periods<sup>7</sup>; the same result was found in trend analysis over a period of 8 years, in Spain.<sup>8</sup>

On the other hand, population-based studies, in Noruega<sup>9</sup>, to compare amputations for diabetic foot in two trienniums (1994-1997 and 2004- 2007), and in Scotland<sup>10</sup> (within five years), show a decline in these procedures. A hospital-based study, in a period of five years (2002-2007), conducted in Turkey, equally showed a reduction from 36.7 to 21.6%.<sup>11</sup> The decrease in these rates is attached, in most studies, to the implementation of the multidisciplinary teamwork.

In Brazil, there are few studies evaluating the occurrence of diabetic foot and, specifically, amputations. Only recently, the issue has aroused interest and, in recent years, only two hospital-based studies can be mentioned: one in the city of Trindade - Goiás, in the period of 2007-2008, which analyzed the medical records of 202 patients who underwent amputations, and noticed a prevalence of 18.32% for diabetic foot carriers<sup>12</sup>; the other one was conducted in Recife - Pernambuco, in the period of 2008-2010, with 214 hospitalized patients with diabetic foot, in which the found prevalence of amputations was 50%.<sup>3</sup>

The prevalence of amputations according to the section level is another indicator of the severity and representative of the situation's management. The results showed that major level amputations have a higher prevalence throughout the period, when compared to the other section level, with an average prevalence of 56.1%, that is, more than twice the minor level

amputation, and more than half of those who seek the hospital in need for this type of procedure. Taken as reference of the case's severity when the service is from the tertiary care level, it may reflect difficulties in preventive measures.

On the other hand, when contemplating its behavior for each triennium, one notes a statistically significant difference between the last two periods and the first one. The found decrease may endorse the efforts of primary care since its implementation, which occurred in the second triennium of this study.

The values here found for this level of amputation are consistent with the findings in hospital data studies from Finland and Tanzania.<sup>13-4</sup>

The minor level amputations are those less severe regarding the hospital care, and its low prevalence, found in the period, the small difference between the considered periods (not statistically significant), as well as when comparing to that found for the most serious amputation, imply that greater efforts need to be undertaken by primary care, in order to early diagnose this disease and to implement preventive actions.

There is a historical concept that a minor amputation is the "first step in a predictable clinical course," leading to an eventual limb loss. However, a population-based study found that 79% of patients undergoing minor amputations had their lesions healed<sup>15</sup>. Moreover, a hospital-based study found that patients with diabetes undergoing minor amputations are significantly less likely to progress to members' loss than those without the disease, and its authors attribute this difference to the most intense foot care and the multidisciplinary follow up that diabetic patients received after the surgery.<sup>16-7</sup>

The characteristics of amputations according to the status of occurrence (first, new or re-amputation), besides revealing the severity of the case when attended in the care of greater complexity, may also indicate preventive care, since they show the evolution of the disease and its management.

The first amputations are primary amputation in an individual, in certain period, regardless of the side and the amputation<sup>6</sup>, corresponding, therefore, to the first consequence of the diabetic foot's injury and, thus, its occurrence may



indicate the magnitude of the problem, since it shows new cases of this complication.

Although there was a high prevalence of first amputation for the entire period of the study, it is important to highlight the differences between the three trienniums, which point to significant improvements aimed at prevention.

The prevalence for the new amputation was low when compared to the first; however, it shall be analyzed with caution, because it can represent both the better control of the disease by monitoring the primary care of the remaining member, justified, in this study, by the decrease in its prevalence in the last triennium when compared to the first two (although this difference is not statistically significant), as may translate, referral or spontaneous search for other institutions to fulfill their needs, or also reflects the flaws in the record of this situation.

A population-based study, conducted over a period of 10 years in Sweden, showed a variation in the incidence for new amputation from 15 to 18 per 100 amputees per year.<sup>5</sup> The re-amputation fundamentally indicates the seriousness of the case when attended by the hospital and, reflects, in all instances, the inadequate control of the diabetic foot. In this study, in light of their methodological limitations, the prevalence of re-amputations was low throughout the considered period, when compared to the first amputation situation, as well as its decline between the first and last studied periods was about 75%, contributing, favorably, to the actions undertaken by primary care since the FHP implementation in this state.

Although in lower percentage number than the one found for amputations, the prevalence of conservative procedures, that is, those performed in order to save the member, showed, through the study, a significant increase over the three periods, where the last one presents an average prevalence that is almost twice the first triennium, indicating greater concern, at tertiary level, to avoid amputations, as well as the best conditions in which patients have sought hospital care, which can be a representative of the improvements in monitoring by primary care.

Patients with diabetic foot represent a significant challenge in terms of the

possibility of saving the limb. In addition to infection control, and ensuring adequate perfusion, advanced forms of care to the wound are often necessary to avoid amputation. Increasing the number of revascularization procedures may delay or reduce the high number of primary amputations in about 70%.<sup>18</sup>

## CONCLUSION

There is a significant lack of studies discussing the impact of diabetes, in terms of prevalence of amputations, in order to know the real size of the problem, once the results may indicate the quality of the disease management, even the data requiring a careful interpretation, since they come from a hospital-based analysis, providing support for the planning of combat strategies.

Despite the high rates found for admissions by diabetic foot and amputations, the movement during the studied periods, especially regarding the practice of conservative procedures, points to the efforts made by primary care. However, given the limitations here found, as it is a hospital-based study, one implies the need for further research to better knowledge of the situation.

Education for diabetics, proper care of the feet, the detection of risk factors for ulcers in the feet and early intervention are key components in the overall management of diabetic foot disorders, and assume important roles in programs for preventing amputation.

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