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Fatores preditivos para amputações: conhecendo o problema para buscar estratégias de prevenção

Predictive factors for amputations: knowing the problem to seek prevention strategies

Factores predictivos de amputaciones: conocer el problema para buscar estrategias de prevención

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Resumo

Objetivo: Investigar os fatores preditivos para amputações no sul do Brasil. Métodos: Foi realizada uma revisão de prontuários de pacientes que realizaram cirurgia para amputação em um hospital público no sul do Brasil. Resultados: Cento e quinze prontuários foram avaliados, referentes a 51 pacientes amputados (31,37% mulheres e 68,62% homens). A principal causa de amputação em diabéticos foi a neuropatia e suas complicações. Entre os não-diabéticos, as principais causas de amputação foram polidactilia (31,58%) e traumas (acidentes de trânsito, acidentes domésticos e acidentes de trabalho). Os dados mostram que as amputações ocorrem predominantemente em homens, com idade aproximada de 60 anos, que apresentam comorbidades como diabetes e hipertensão arterial. A maioria das amputações realizadas foram do tipo "menor". Conclusão: Os dados apresentados podem contribuir para a implementação de estratégias e intervenções específicas para educação em saúde, voltadas à prevenção de amputações em pessoas diabéticas.

Palavras-chave: Amputações; Diabetes mellitus; Neuropatia; Educação em Saúde.

Abstract

Objective: To investigate the predictive factors for amputations in southern Brazil. Methods: This was a review of medical records from amputated patients in a tertiary hospital in southern Brazil. Results: One hundred and fifteen medical reports regarding to admissions of 51 amputated patients (31.37% women and 68.62% men) were analyzed. The main cause of amputation in diabetics was the neuropathy and its complications. Among nondiabetics, the main causes of amputation were polydactyly (31.58%) and traumatism (traffic accidents, home accidents, and work accidents). This data showed that the investigated amputations are predominantly in male, aging approximately sixty years old, presenting comorbidities like diabetes and arterial hypertension. Moreover, the most amputations were performed as the minor type. Conclusion: These data can contribute for implementation of targeted health education strategies and interventions, improving the prevention of amputations in persons with diabetes.

Keywords: Amputations; Diabetes mellitus; Neuropathy; Health Education.

Resumen

Objetivo: Investigar los factores predictivos de amputaciones en el sur de Brasil. Métodos: Revisamos los registros médicos de los pacientes que se sometieron a cirugías de amputación en un hospital público en el sur de Brasil. Resultados: se evaluaron 115 registros médicos, de 51 personas amputadas (31.37% mujeres y 68.62% hombres). La principal causa de

amputación en personas con diabetes fue la neuropatía y sus complicaciones. Entre los no diabéticos, la principal causa de amputación fue polidactilia (31.58%) y trauma (accidentes de tránsito, accidentes domésticos y accidentes laborales). Los datos muestran que las amputaciones ocurren predominantemente en hombres, de aproximadamente 60 años, que tienen comorbilidades como diabetes e hipertensión. La mayoría de las amputaciones realizadas fueron del tipo "menor". Conclusión: Los datos presentados pueden contribuir a la implementación de estrategias e intervenciones específicas para la educación sanitaria, destinada a prevenir las amputaciones en personas diabéticas.

Palabras clave: Amputaciones; Diabetes mellitus; Neuropatía; Educación en salud.

1. Introduction

Amputation can be defined as full or partial limb subtraction, usually surgical. This clinical condition is associated with feelings such as terror, mutilation and defeat moods, leading to incapacity and dependence situations (BROWN, 1992; BRITO, 2009; MALDONATO, et al., 1995). All amputations can be classified as either major or minor removals. Major amputations are defined as those above the ankle and minor as those below the ankle (ASSUMPÇÃO, et al., 2009).

Clinical amputations can have many etiologies, mainly related to vascular disease, neuropathy, traumatism, tumors, infections, and congenital and iatrogenic problems. Diabetes mellitus (DM) complications are one of the main conditions that can lead to limb amputations. In fact, DM takes place as one of the main significant burden to human health in the present century due to their elevated prevalence (ZIMMET, 2000).

Recent data suggest that there are currently 424.9 million of people with DM in the world (ages 20 to 79 years), and estimates point that this number reaches 628.6 million in 2045 (INTERNATIONAL DIABETES FEDERATION, 2017). It is known that the maintenance of chronic hyperglycemia in DM is associated with complications such as diabetic vasculopathy and neuropathy, which ultimately, increase the risk of diabetic foot development and amputations in the feet and legs of people with DM.

Typical complications of the diabetic foot are mainly due to chronic conditions as macro and microangiopathy, by decreasing arterial reserve; neuropathy, by inducing decreased pain sensation, muscular weakness and deformities, dry skin and fissures. However, the major accidents leading to gangrene, long hospitalizations and often amputations, are almost always precipitated by trivial episodes such as wearing shoes which are too tight, a little bleeding from a cut toenail, or a burn due to a hot-water bottle (MALDONATO, et al., 1995).

Importantly, amputations are 10 to 20 times more common in people with DM than in non-diabetics, and over the past decade have ranged from 1.5 to 3.5 events per 1000 persons per year in populations with diagnosed DM (VAN DAM, et al., 2005; WHO, 2016).

The expenses with DM and its complications must double in the next 25 years in the U.S., generating overload to the health system (HUANG, et al., 2009; INTERNATIONAL DIABETES FEDERATION, 2017). Even more alarming, records from the International Working Group on the Diabetic Foot (IWGDF) have demonstrated that problems with the diabetic foot are among the most serious and onerous complications of DM (IWGDF, 2017). Epidemic reports indicate that more than a million amputations are made in diabetic patients every year. This indicates that to every 20 seconds, one leg is lost due to DM in the world (HUANG, et al., 2009).

Despite the unfavorable scenario, evidences indicate that many amputations could be avoided with health education measures and adoption of foot care practices by people with DM. In fact, diabetic individuals who received health education are more committed to foot care practices (SALGUEIRO, et al., 2015). Education strategies should be directed especially at males with low schooling levels who are the most likely to suffer from amputations (SALGUEIRO, et al., 2015).

Considering the facts above, this study aims to investigate the predictive factors for amputations and the profile of the amputees in a city of southern Brazil. This study can provide key information useful for the adequate implementation of health educational strategies, thus improving the prevention of amputations in persons with diabetes.

2. Methods

This is an investigative cross-sectional study, where data collection occurred with the support of the medical records division of a tertiary hospital of southern Brazil. A Research Ethics Committee approved this study (0132.0.243.000-09).

Medical records of amputees who had hospital stay in a period of up to four years prior to the survey were analyzed. The information analyzed in the medical records were gender, age, schooling and occupation of the patient, cause of amputation, level of amputation, medicines used, hospitalization plan (public or private), number of days hospitalized, need for re-amputations and clinical outcome. The presence of arterial hypertension was also investigated. The experimental design is shown in Figure 1.

Statistical analyses were performed using GraphPad Prism version 6.00 for Windows (GraphPad Software, La Jolla California USA). Data were assessed by frequency, descriptive

analysis (minimum, maximum, mean, standard deviation) and chi-square test. Results are expressed as means ± SD, and differences were considered significant when $p<0.05$.

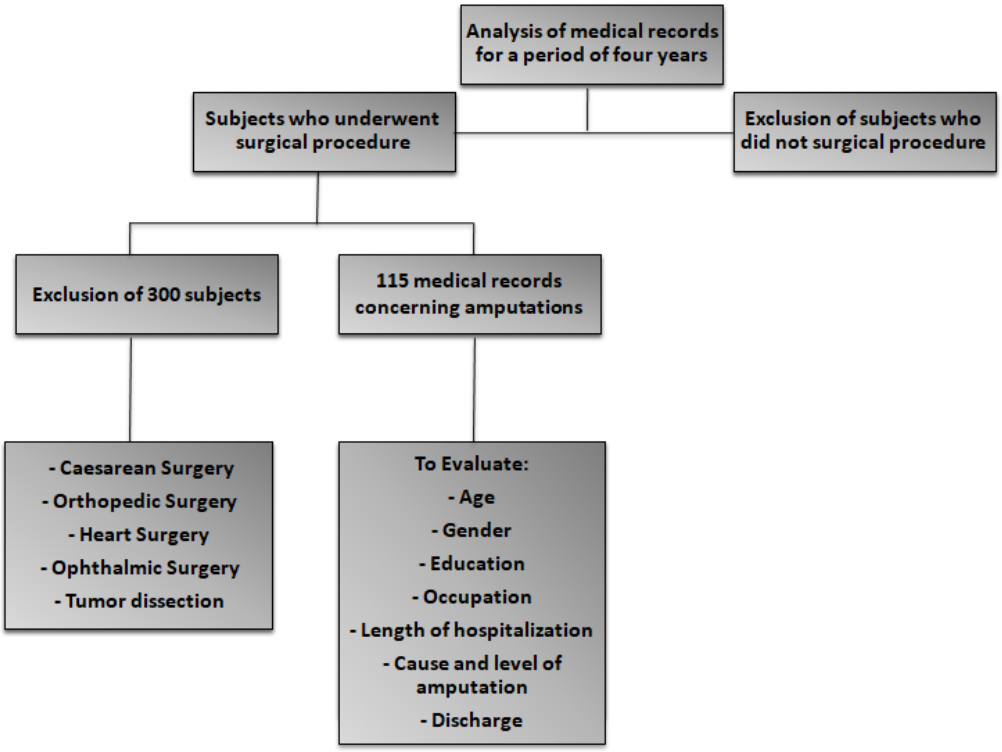

Figure 1: Experimental Design.

3. Results

We analyzed 115 medical records regarding hospital admission of 51 amputated patients (patients with more than one hospitalization present more than one medical record). The majority were male. Data show that more than 60% were diabetic patients. Age at the time of amputation was lower in men (Table 1). General data from dossiers indicated that small amount of amputations was in children (preschoolers). Moreover, most of the patients presented incomplete primary education (1 to 7 school years) and less than 2% had higher education (more than 11 study years) (Table 1).

Table 1: Socio-demographic profile of amputees in 115 medical records analyzed

Total documents (n)	**115**
Sample of amputees (n)	**51**
Gender (%)	
Men	68.6
Women	31.4

Mean Age	50.89 ± 25.17
Age by gender	
Men	49.15 ± 25.14
Women	54.57 ± 25.61
School years (%)*	
0	13.7
1-7	31.4
8	27.5
9-10	1.9
11	15.7
11 or +	1.9
Main occupation: retired (%)	41.2
Number of amputations	1.35 ± 0.72
Amputation type (%)	
Minor	60.7
Major	39.3
Number of admissions	2.16 ± 1.9
Days of hospitalization	27.98 ± 22.25
Outcome (%)	
Discharge from hospital	90.2
Death	9.8

Data are shown as mean ± S.D. or as absolute frequency (relative frequency).
* Not Specified (%): 7.8

Related to the clinic profile, the main cause of amputations was neuropathic complications for diabetic patients. The overall mean age for the diabetic patients was similar for men and women (Table 2). Diabetic patients had more hospital admissions and remained hospitalized for more days. The mean age, the number of hospital admissions and hospitalized time was lower for non-diabetics (Table 2). Among non-diabetics, the main cause of amputation was polydactyly, traffic accidents, home accidents and work accidents.

Table 2: Clinical profile of the diabetic and non-diabetic subjects

Variable	Diabetic	Non-diabetic
Amputated patients (%)	62.75	37.25
Mean Age	61.43 ± 13.82	33.15 ± 30.02*
Age		
Men	61.45 ± 14.00	28.32 ± 26.48
Women	61.40 ± 14.17	43.59 ± 37.00
Gender (%)		
Men	68.70	68.40
Women	31.30	31.60

Number of amputations	1.50 ± 0.84	1.10 ± 0.31
Amputations (%)		
Minor	65.62	57.89
Major	34.38	42.11
Number of admissions	2.50 ± 2.24	1.57 ± 1.17
Days of hospitalization	32.40 ± 20.82	20.52 ± 23.11
Outcome (%)		
Discharge from hospital	87.50	94.70
Death	12.50	5.30

Data presented as mean ± S.D or as absolute frequency (relative frequency). * Indicates statistic difference with $p<0.05$.

Minor amputations (toe and forefoot) occurred in more of 60% of cases in diabetics ($p<0.0001$) (Figure 2). Major amputations in diabetics occurred mostly in the foot, between non-diabetics occurred mostly in fingers (Figure 2). For better understanding, Figure 3 has been divided into major and minor amputation by age between groups. The minor amputations occurred primarily between the ages of 57 and 66 years of diabetic patients, compared to 37 years in the patients without diabetes (Figure 3A) ($p<0.0001$). In diabetic patients, major amputations occurred predominantly in ages between 67 and 76 years (Figure 3B). In relation to non-diabetics, where this procedure was more incident, the patient's age ranged from 47 to 56 years (Figure 3B) ($p<0.0415$). In the non-diabetic patients, amputations occurred in male, with mean age of 33 years old and all were motorcyclists who were victims of traffic accidents (data not show).

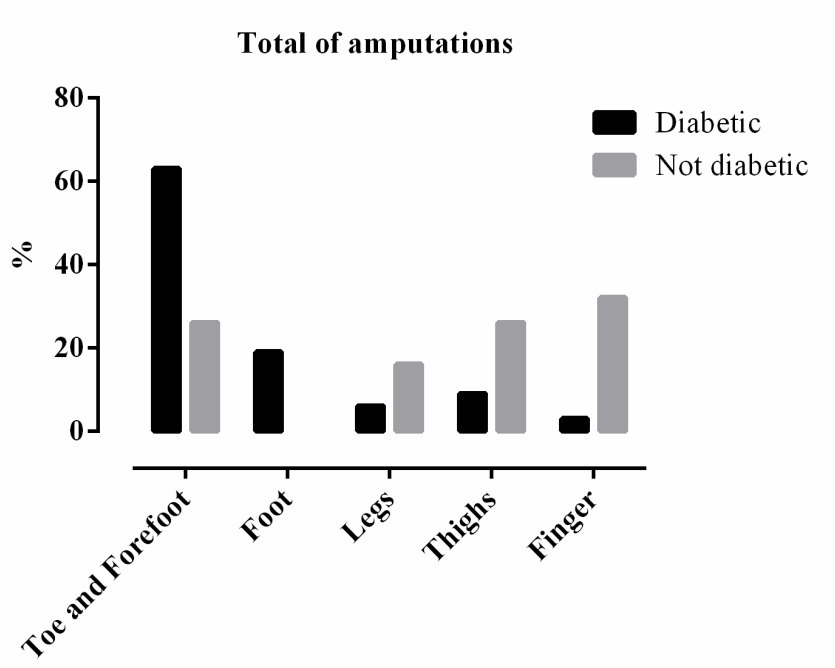

Figure 2: Amputation level (minor or major) in diabetic and non-diabetic patients. Data are expressed as percentage. *P* value was determined by Chi-square test.

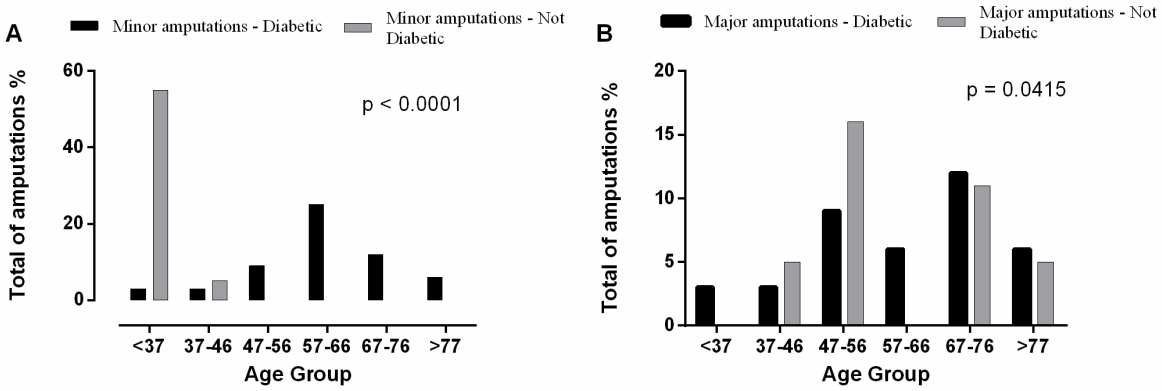

Figure 3: Amputation level: minor (A) or major (B) in diabetic and non-diabetic patients according age group. Data are expressed as percentage. *P* value was determined by Chi-square test.

Comorbidities, such as DM and arterial hypertension (AH), were found in 43.14% of investigated dossiers (data not show). Statistical analysis showed that the chance of DM and AH simultaneous occurrence was significant (p=0.0004) (Table 3). Another variable that indicated a strong relationship with DM was age ≥ 51years (p=0.0002) (Table 3).

Table 3: Analyze of DM chance in relation to outcome variables (Chi-square test)

	OR	*CI*	P
High blood pressure	11.73	2.7730 to 49.639	0.0004
Age (≥ 51 years)	0.08547	0.0219 to 0.3327	0.0002

OR= Odds Ratio, CI = 95% Confidence Interval

Concerning to the health care system, the most patients were assisted by public system in relation to private system. Diabetic patients presented a mortality rate higher than non-diabetics (Table 2). Moreover, the medicines most commonly used for glycemic control in diabetic patients were glibenclamide, metformin hydrochloride, and insulin. For hypertension control, the medicine most frequently used was captopril. Importantly, data of records indicated that there was an increase in the prevalence of amputations in the last two years evaluated, compared to the first two years. Moreover, this increase was more accentuated in diabetic patients (Figure 4).

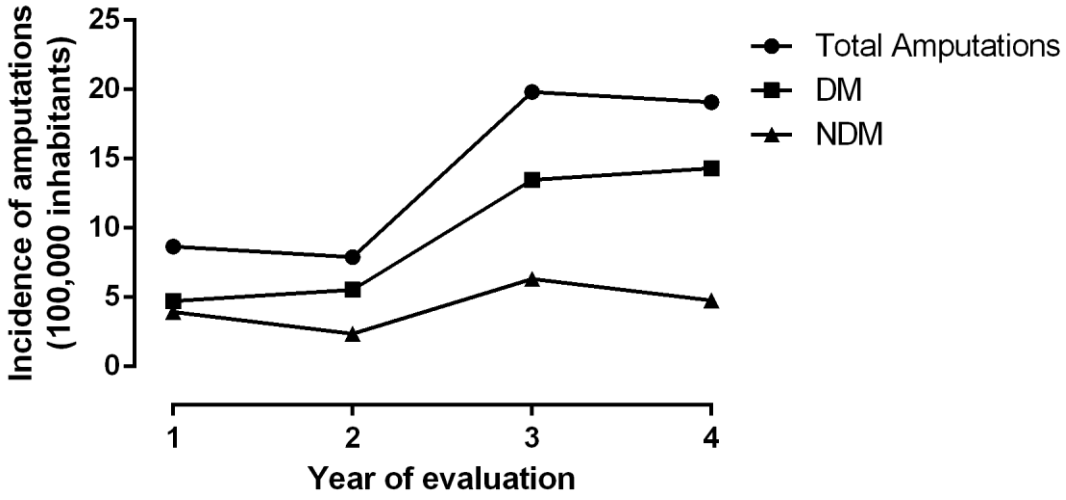

Figure 4: Prevalence of amputations in diabetic and non-diabetic patients evaluated during 4 consecutive years.

4. Discussion and Conclusion

The data presented show that amputations are more frequent in men with DM, and in the sixth decade of life. In young men, amputations occur mainly due to traffic or work accidents. These features agree with other Brazilian studies (TAVARES, et al., 2009; RODRIGUES, et al., 2017; SHIN, et al., 2017; MACEDO, et al., 2019) and it can be related to DM

complications due to disease progression. In fact, in parallel with the increase in life expectancy of the Brazilian population, have been observed increases in incidence of peripheral vascular disease and DM (AGNE, et al., 2004; GRILLO & GORINI, 2007).

Studies show that population in aging process will probably increase the prevalence of DM in European community, with complications such as cardiovascular and renal diseases and lower extremity amputations, particularly associated with the high mortality rates (HOUTUM, et al., 1996; PAPAZAFIROPOULOU, et al., 2009; SANTANA, et al., 2020). However, it is known that women have a greater self-care when compared to men, leading to prevention of risk factors related to amputations due to DM (TAVARES, et al., 2009; SALGUEIRO, et al., 2015). The high prevalence of amputations among men also could be explained by a greater exposure to the risk factors, such as those related to accidents. These data are consistent with published data showing that amputations due to traffic accidents are followed by accidents at work. In addition, 91% of the victims of these accidents were male and only 9% were female. In terms of age, 54.9% of the injured were between 19 and 30 years (CASTRO, et al., 2008; SANTOS, et al., 2008; SADO, et al., 2009).

The results also showed that diabetic patients need more hospitalizations and stay longer hospitalized when compared to non-diabetic patients (Table 2). In the case of diabetic patients, the longer time of hospitalization and readmissions are usually related to the difficulty of healing (which requires more time for medical care) and the need for re-amputations. Complications of DM are frequent, accounting for about 20% of admissions of diabetic patients. It has been estimated that diabetic patients consume approximately 5% to 6% of global health care expenditure (clinical services, drugs, and hospital admissions) in the developed world than nondiabetic patients (NUNES, t al., 2006; ROSA, et al., 2007; PAPAZAFIROPOULOU, et al., 2009; LOPZ-DE-ANDRES, et al., 2010).

We did not estimate the percentage of diabetic patients who had foot ulcers prior to the amputation procedure. This fact was due to the recurring problem of incomplete records filling. However, it is worth to refer that 33.3% of the subjects underwent more than one amputation. Notably, a second amputation in the same or contralateral limb is frequent in diabetic patients in comparison to nondiabetics (PAPAZAFIROPOULOU, et al., 2009). A study with Greek population showed that mortality was high after the first amputation and emphasized the severity of complications from an amputation (PAGANO, et al., 2007; NATHER, et al., 2008; PAPAZAFIROPOULOU, et al., 2009).

The complications of the contralateral limb have been observed in 49-80% of patients with diabetes after a lower-extremity amputation (HOUTUM, et al., 1996; OTINIANO, et al.,

2003). Overall, 20% of diabetics and amputees die within two years after the procedure (TAVARES, et al., 2009). We found that, in a sample of 51 amputees, 62.75% were diabetics and 12.5% of them died. This data is similar to those found by Rezende et al. (2008), where 12.8% of amputated patients die. In Norway, studies have shown that patients with diabetic foot problems (DFP) have a mortality risk that is more than two times fold as compared to patients without DFP (BOYKO, et al., 2008).

Furthermore, many of amputees in this study had low schooling levels (from 1 to 7 years of schooling). In this line, we can observe that low levels of education are associated with DM and amputations (SALGUEIRO, et al., 2015; SOARES, et al., 2018). Diabetic patients present an amputations risk 15 times greater when associated to low education, low socioeconomic status, inadequate hygiene, and poor access to health services (FALCÃO, et al., 2008; ASSUMPÇÃO, et al., 2009; SALGUEIRO, et al., 2015). Studies from Italy, Turkey, Singapore, and Greece have too demonstrated that advanced age, poorer metabolic control, insulin treatment, obesity, pre-existing nephropathy, macroangiopathic disease and comorbidities have been found as independent predictors of DM that developed amputations (KARAKOC, et al., 2004; PAGANO, et al., 2007; CARDOSO & SALLES, 2008; PAPAZAFIROPOULOU, et al., 2009).

In this research, the amputations were of the minor type and derived from the diabetic foot and diabetic neuropathy, thus caused by DM complications. Besides neuropathy, other complications found in patients with DM were atherosclerosis, chronic kidney failure and the occurrence of stroke. Presence of nephropathy and peripheral artery disease increased hospitalization probability by 1.2–1.3 times (PAGANO, et al., 2007). In developed countries, diabetic nephropathy is the second cause of renal replacement therapy (HATZITOLIOS, et al., 2009). In as much stroke is associated with higher mortality and consequent neurological deficit and disability in diabetic patients (HATZITOLIOS, et al., 2009).

According to the IWGDF (2010), amputations have a vast impact on people's lives, often leading to reduced independence and taking to social isolation and psychological stress. The main component that can prevent amputations and all physical disorders, emotional, financial and social they generate in people with diabetes is linked to a continuing education of the patient (NATHER, et al., 2008; SALGUEIRO, et al., 2015). The knowledge about the own disease helps to change the lifestyle (healthy eating habits, physical activity and self-care with your body, especially feet care) and the effective glycemic control can prevent complications of diabetes, especially amputations (NATHER, et al., 2008; SALGUEIRO, et al., 2015).

In fact, DM appears as the main cause of amputation in Brazil (TAVARES, et al., 2009;

RODRIGUES, et al., 2017). In our study, 62.75% of the patients were diabetic, and it was observed an increase in the prevalence of amputations in the last two years of the investigation, which was more accentuated in diabetic patients in relation to the nondiabetics (Figure 4). Every year, more than 1 million people with diabetes lose at least a part of their leg because DM complications (BAKKER, et al., 2016). In this line, a monitoring study performed in Brazil in the six major cities, concluded that DM was the main cause of amputation in five of them (GRILLO & GORINI, 2007) and that foot ulcers precede about 85% of amputations of lower extremities. In this context, there is evidence that adopting self-care measures with the feet of diabetics may protect against foot ulcers development and lower extremity amputations.

According to Salgueiro et al. (2015), individuals who received information about foot care are more committed to foot care practices. Differences between male and females were found in foot care activity profiles, with men presenting more amputations. Lower rates of amputation were detected in individuals who engaged in foot care activities. Furthermore, relationships were found between schooling level and forms of diabetes control, and schooling level and number of foot injuries. Indeed, the authors demonstrated that health education directed to care of diabetic foot should be a constant practice in health services. Health education should consider key factors such as gender and educational level of individuals, promoting effective selfcare and preventing the onset of foot injuries (SALGUEIRO, et al., 2015).

Moreover, our data revealed that most diabetic amputees present AH (Table 3), a factor that contributes to DM complications as atherosclerosis, kidney disease and stroke. The coexistence of DM and AH is a common clinical scenario that can set off an increased cardiovascular morbidity and mortality (PADILLA & MEHLER, 2001; SILVA, et al., 2007; FALCÃO, et al., 2008). Another fact found was the association of higher probability of amputations in individuals older than 51 years. With these data, we can see that the main causes of amputations (DM and its complications) are modifiable factors that could be prevented through lifestyle changes and effective monitoring of them, well as affirm Salgueiro et al. (2015).

In this line, lifestyle and behavioral factors play an important role in the development of type 2 DM. Furthermore, DM management involves a combination of medication and lifestyle changes. However, DM lifestyle programs have been found unsuccessful unless they are intensive and continued over long periods of time (CLARK & HAMPSON, 2001). Behavioral changes require knowledge, skill and motivation. Educational science teaches us

how to improve people's knowledge and skill, but it is the common experience that these are not enough. For someone modify a particular behavior, the perceived advantages of the change must outweigh the perceived disadvantages (MALDONATO, et al., 1995). Even in the presence of advanced vasculopathy and neuropathy, adverse consequences are largely preventable by avoidance of any possible foot lesion, due to physical, chemical or biological agents (MALDONATO, et al., 1995).

Education of diabetic patients, proposed as an essential therapeutic tool since the early 1920s and accepted as such by official medicine only in the 1970s, has generated great enthusiasm over the last decade, with increasing concern for greater effectiveness by improved motivation of both patients and doctors (MALDONATO, et al., 1995). Structured education depends on the precise definition of agreed, short-term objectives, whose attainment shall be verified. Educational objectives may be set at different levels: knowledge of the disease, skills required for treatment, capacity to integrate therapy in everyday life (MALDONATO, et al., 1995). Furthermore, education demands a lot from health care providers: specific training, teaching skills, good communication, and supportive attitude, readiness to listen and to negotiate. Patients' motivation to learn and adhere to treatment is also greatly influenced by individual factors, both psychological and environmental, that need to be considered (MALDONATO, et al., 1995). The educational objectives can be set at different levels for different patients on different occasions. Published works are aimed at: (i) improving the knowledge of the disease; (ii) improving the technical skill required for the treatment; (iii) inducing those behavioral changes which are necessary to integrate therapy in everyday life; and (iv) fostering self-management to ensure an adequate adjustment of treatment during unusual events (BROWN, 1992).

Indeed, the amputation should not be seen as the end of the therapeutic procedure, but as the beginning of a long term in the self, social, familiar learning. After amputation, the patient in a process of rehabilitation should be instructed about self-care comprising the stump, the better healing, prevention of infection, and proper hygienic procedures, so preventing new amputations (GRILLO &GORINI, 2007). Therefore, DM teams may consider offering some of the promising new forms of social support that were found: patient group consultations with diabetes care providers, peer social support group sessions in or following diabetes education programs, and Internet-based or telephone-based peer support and counseling programs (INTERNATIONAL DIABETES FEDERATION, 2017).

In conclusion, our findings are relevant to provide base for prevention of new cases of amputations, from the knowledge of the most vulnerable populations. Our data indicate the

target population for health education and counseling programs directed at foot care practices.

4.1. Practice Implications

- All health professionals involved in amputation care need to be aware that amputations occur more in elderly diabetics.
- This knowledge is important so that health professionals can draw strategies of counseling and health education target for amputations prevention, aimed at this specific population.
- When it is not possible to prevent amputations, it is important that professionals have the information to design strategies for post-operative management and rehabilitation, specific to these people (men, elderly, at risk of new amputations).

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