

Incidence and causes of lower-limb amputations in the city of Ribeirão Preto from 1985 to 2008: evaluation of the medical records from 3,274 cases

Incidência e causas de amputações dos membros inferiores em Ribeirão Preto de 1985 a 2008: avaliação de 3.274 casos

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ABSTRACT: *Objective:* It was to identify trends of traumatic and non-traumatic causes of lower limb amputations, as well as the role played by population aging, traffic violence increase, public health policy of diabetes control program and drivers anti-alcohol laws on these amputations. *Method:* Hospitalization data recorded in the discharge forms of 32 hospitals located in the region of Ribeirão Preto, Brazil, from 1985 to 2008 were analyzed. *Result:* A total of 3,274 lower-limb amputations were analyzed, of which 95.2% were related to non-traumatic causes, mainly infectious and ischemic complications of diabetes mellitus. Cancer (2.8%) and congenital (1.3%) causes were included in this group. Only 4.8% were related to traumatic causes. Traumatic amputation average rate was 1.5 amputations in 100,000 habitants with a slight tendency of increase in the last 5 years. Non-traumatic causes showed an average rate of 30.0 amputations for 100,000 habitants and remained relatively constant during the whole period. Non-traumatic were much more predominant in patients older than 60 years and traumatic amputations occurred more frequently in patients younger than 39 years. *Conclusion:* The overall rates of amputation and the rates of traumatic and non-traumatic amputations remained nearly constant during the study period. The impact of diabetes control policies and the introduction of traffic safety laws could not be identified on the amputation rates.

Keywords: Amputation. Traffic accidents. Diabetes mellitus. Diabetes complications. Observational study. Leg injuries.

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RESUMO: *Objetivo:* Identificar as tendências temporais de causas traumáticas e não traumáticas de amputações de membros inferiores, e os efeitos do envelhecimento da população, do aumento de violência no trânsito, da política de saúde pública do programa de controle de diabetes e das leis de controle do uso de álcool em motoristas sobre as taxas de amputações. *Método:* Foram analisados os dados das folhas de alta de pacientes submetidos a amputações de todos os 32 hospitais localizados na região de Ribeirão Preto, Brasil, de 1985 a 2008. *Resultado:* De 3.274 amputações de membros inferiores, 95,2% estavam relacionadas a causas não traumáticas, principalmente complicações do diabetes mellitus. Câncer (2,8%) e causas congênitas (1,3%) foram incluídos neste grupo. Apenas 4,8% estavam relacionados às causas traumáticas. A taxa média de amputação traumática foi de 1,5 amputações por 100.000 habitantes, com uma ligeira tendência de aumento nos últimos 5 anos. As causas não traumáticas mostraram uma taxa média de 30 amputações por 100.000 habitantes e mantiveram-se relativamente constantes durante todo o período. As causas não traumáticas foram predominantes em pacientes com mais de 60 anos, e as amputações traumáticas ocorreram mais frequentemente em pacientes com menos de 39 anos. *Conclusão:* A taxa total de amputações e as taxas de amputações traumáticas e não traumáticas permaneceram praticamente constantes durante o período de estudo. O impacto das políticas de controle do diabetes e da introdução de leis de repressão do uso de álcool no trânsito não pode ser identificado nas taxas de amputação.

Palavras-chave: Amputação. Acidentes de trânsito. Diabetes mellitus. Complicações do diabetes. Estudo descritivo. Complicações de trauma.

INTRODUCTION

The incidence rates of amputations vary among different countries¹. Approximately 134,000 procedures are annually referred in the USA, and more than 100,000 of these correspond to lower-limb amputations². In Brazil, amputations have an incidence of 13.9 per 100,000 inhabitants³, with 85.0% of the cases occurring in the lower limbs⁴. The most common causes of lower-limb amputation include peripheral arterial occlusive disease (PAOD) mainly consequent to diabetes, trauma and malignant tumors^{1,5-7}.

Diabetes is increasing rapidly all around the world, and reducing its complications is a relevant public health policy issue⁸. Amputation is a major complication of it and the relative risk is up to 9 times that of the nondiabetic population. Approximately 9.0 to 20.0% of patients who already had an amputation require another one within one year⁹.

Diabetes control programs have dropped the amputation incidence in Finland, Scotland and UK^{8,10,11}. All these programs are based on early diagnosis, systemic control and multidisciplinary teamwork focusing on foot care. A diabetes control program was introduced in Ribeirão Preto in 2002 mainly focused on facilitating spontaneous search for diagnosis and free drug distribution.

The second most important cause of amputation is trauma due to traffic accidents, mainly those involving motorcycles, which are the main cause of trauma injuries in Brazil². In Ribeirão Preto, a Brazilian southeastern city with an estimated population of 600,000 inhabitants, the number of registered vehicles and specifically motorcycles increased, in the period of 2002

to 2008, from 38.2 to 111.8% respectively. In the same period, the incidence of traffic accidents and injuries increased from 27.3 to 61.9% respectively¹². It is worth to mention that a law restricting the use of alcohol by drivers was implemented in Brazil in 2008.

The aim of this study was to analyze some epidemiological aspects of lower-limb amputation causes in Ribeirão Preto in a period of 23 years, and the impact of the improvements in the clinical management of diabetic patients and the legislative interventions on driver's safety on these occurrences. The role played by population aging and traffic violence increase was considered as well. The high relevance of studies of the main epidemiological characteristics of amputations lies in the large variation in the profiles and demands of amputees due to different causes, as the repercussions of those variations focus on personal (life expectancy and functionality) and social aspects, including absenteeism, early retirement and treatment costs¹³. Notwithstanding, there is a significant lack of data on the evolution of amputation causes, which complicates the adoption of effective measures against the causative factors.

METHODOLOGY

Data from hospitalized patients in any of the 34 public and private hospitals in the 25 municipalities that form the region of Ribeirão Preto who resided in the municipality of Ribeirão Preto during the period from 1985 to 2008 were analyzed. The hospital discharge forms listed the protocol used for data collection in the hospitals and were electronically recorded and analyzed by the Hospital Data Processing Center (*Centro de Processamento de Dados Hospitalares – CPDH*) Information System. This service is currently managed by the Regional Observatory for Hospital Care (*Observatório Regional de Atenção Hospitalar – ORAH*) of the Department of Social Medicine, Ribeirão Preto Medical School, *Universidade de São Paulo* (USP).

Only patients who were admitted for surgical lower-limb amputation were selected for this study. The International Classification of Diseases (ICD) was used to separate the diagnoses into traumatic and non-traumatic groups. The ninth revision (ICD-9) was used for the period from 1980 to 1997, and the tenth revision (ICD-10) was used for the period during and after 1998. Chapter XIX (“Injury, poisoning and certain other consequences of external causes” (S00-T98)) codes from the ICD-10 were used to identify the traumatic injuries. Chapter XVIII from the ICD-9 (“Injury and poisoning” (codes 895-897)) was also used. The following variables were also assessed from the discharge records: patient age and gender, level of amputation, year of hospital discharge, health plan (SUS [*Sistema Único de Saúde*/Brazilian National Health System] or non-SUS) and patient discharge condition (hospital discharge or death).

Resident population data from Ribeirão Preto, which were generated by the Brazilian Institute of Geography and Statistics (IBGE), were used to calculate the rate of hospital admissions¹⁴.

Possible associations between qualitative and quantitative stratified variables were assessed with the χ^2 test, and a p-value of 5% was adopted as the threshold for statistical significance.

The study was approved by the Research Ethics Committee of the Teaching Hospital of the Ribeirão Preto Medical School (*Hospital das Clínicas da Faculdade de Medicina de Ribeirão Preto – HCFMRP*); CAAE: 04584512.7.0000.5440, Opinion No. 74537 of 08/19/12).

RESULTS

A total of 3,274 lower-limb amputations were performed between 1985 and 2008 on inhabitants of the city of Ribeirão Preto; 157 of them were traumatic (4.8%) and 3,117 were non-traumatic (95.2%), all concentrated in 9 hospital units within the same city. The HCFMRP performed 40.1 and 33.6% of the traumatic and non-traumatic amputations, respectively.

Table 1 shows the distribution of traumatic and non-traumatic amputations according to gender, age group, type of care and discharge conditions. The distribution according to age groups shows a marked difference between the reasons for amputation, with a concentration of non-traumatic causes among older people, especially above 59 years, and predominance of traumatic among those up to 39 years of age ($p < 0.001$). These differences are more easily observed in Figure 1.

Table 1. Distribution of amputations for traumatic and non-traumatic causes among residents of the city of Ribeirão Preto according to gender, age group, type of care and hospital discharge condition from 1985 to 2008.

	Lower-limb amputation				Total		p-value*
	Traumatic		Non-traumatic		n	%	
	n	%	n	%			
Gender							
Male	125	79.6	1,973	63.3	2,098	64.1	
Female	32	20.4	1,144	36.7	1,176	35.9	< 0.001
Age group							
< 10	28	17.8	51	1.6	79	2.4	
10 – 19	22	14.0	59	1.9	81	2.5	
20 – 29	29	18.5	85	2.7	114	3.5	
30 – 39	26	16.6	169	5.4	195	6.0	
40 – 49	9	5.7	305	9.8	314	9.6	
50 – 59	14	8.9	557	17.9	571	17.4	
≥ 60	29	18.5	1,891	60.7	1,920	58.6	< 0.001
Type of care							
SUS	108	68.8	2,497	80.1	2,605	79.6	
Non-SUS	49	31.2	620	19.9	669	20.4	< 0.01
Discharge condition							
Discharge	151	96.2	2,909	93.3	3,060	93.5	
Death	6	3.8	208	6.7	214	6.5	0.158
Total	157	100	3,117	100	3,274	100	

χ^2 test was used for statistical analysis.

In total, 79.6% of the amputations occurred at the expense of the SUS, nearly the same proportion as that for non-traumatic amputations (80.1%). Among the traumatic amputations, however, the proportion of cases covered by the SUS was reduced to 68.8% ($p < 0.01$, comparing traumatic and non-traumatic causes). A total of 214 post-surgery deaths occurred (6.5%), which comprised 3.8 and 6.7% of the traumatic and non-traumatic amputations, respectively ($p = 0.158$).

Figure 2 demonstrates the logarithmic evolution of the amputation incidence rates throughout the study period. Although the absolute number of procedures due to both

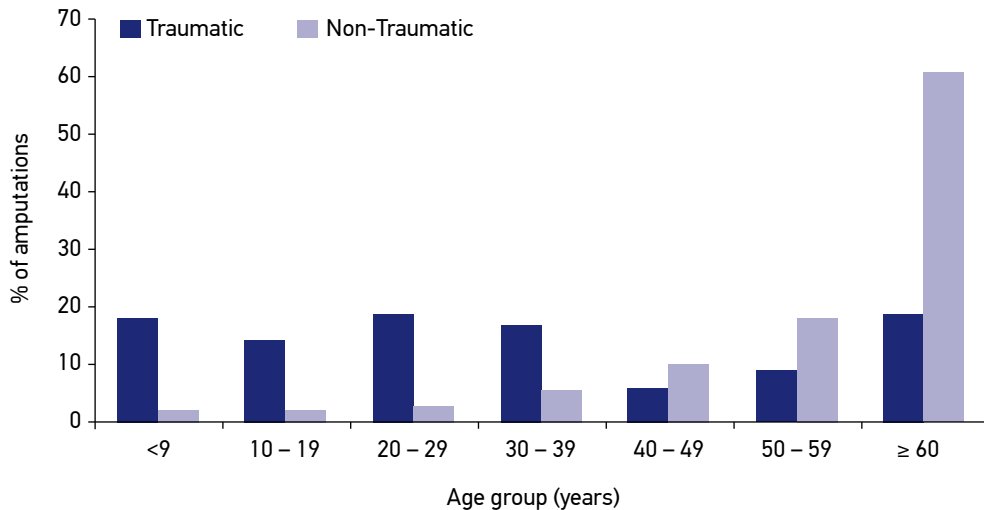
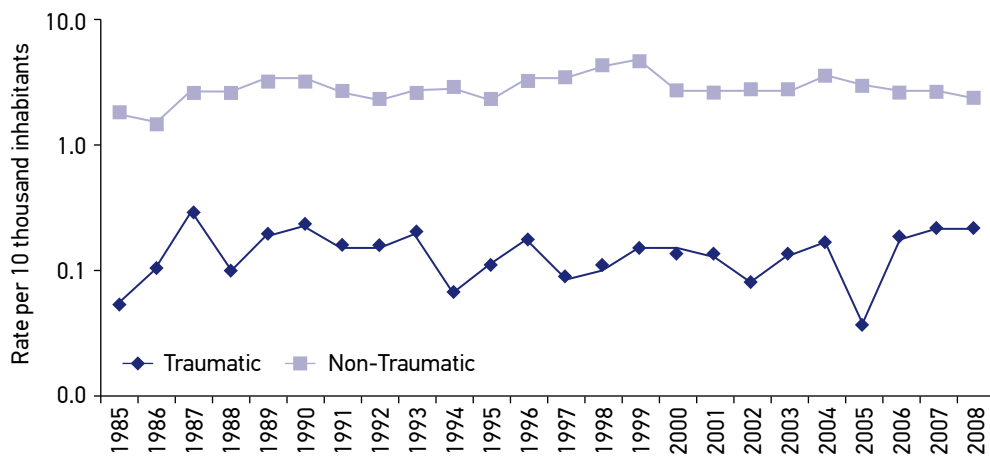


Figure 1. Number of amputations for traumatic and non-traumatic causes among residents of the city of Ribeirão Preto according to age group from 1985 to 2008.



Amputation rates are represented in logarithmic scale for aesthetic reasons.

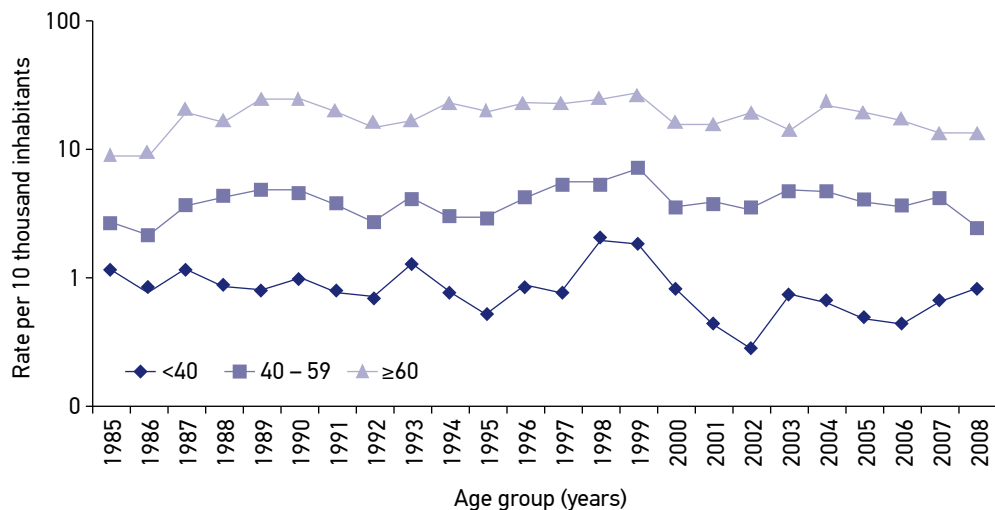
Figure 2. Rates of amputations for traumatic and non-traumatic causes among residents of the city of Ribeirão Preto according to the year of occurrence from 1985 to 2008.

causes increased from 1985 to 2008, the transformation into coefficients revealed a general trend of stability, particularly for non-traumatic amputations. In this group, the extremes were 225 occurrences in 1999 and 58 in 1986, representing a maximum ratio of 3.9. Conversely, the traumatic amputations showed greater instability, ranging from a maximum of 12 in the last 2 years of the study, to a minimum of 2 (in 1985 and 2005), for a ratio of 6.

Subdivision of the age variable into 3 categories revealed that the risk of amputation increased with age, as the values were significantly higher among individuals above 60 years of age (Figure 3).

DISCUSSION

This study shows that there was no increased risk of lower-limb amputation in the city of Ribeirão Preto during the period from 1985 to 2008, as reflected by the stability of the incidence coefficients during those years. It also shows that 4.8% of amputations were caused by trauma, including traffic accidents, work accidents and aggression, and 95.2% were the result of non-traumatic causes, including cancer (2.81%) and congenital disorders (1.31%). This data differs slightly from that of Spichler et al.⁶ who found PAOD as being responsible for 90.7% of lower-limb amputations studied in Rio de Janeiro, mainly related to diabetes, and percentages of 5.6 and 0.8% of trauma and malignant tumors, respectively. The amputation rates were not affected by other population profile characteristics, like aging, as well.



Amputation rates are represented in logarithmic scale for aesthetic reasons.

Figure 3. Rates of amputations for traumatic and non-traumatic causes among residents of the city of Ribeirão Preto according to age group from 1985 – 2008.

The specific causes of amputations could not be accurately assessed in the non-traumatic group given the limitations of the instrument used. This stems from the fact that it is impossible to discriminate similar diagnoses that lead to amputations based on the ICD. The causes of diabetes-related amputations, for example, can be described in several ways, including ischemia, infection or diabetes, resulting in multiple entries for the same clinical condition. Concurrently, the hospital discharge forms are not always completed by the physician responsible for the patient, resulting in a loss of reliability with regard to the exact reason for the procedure. However, considering the high prevalence of diabetes-related amputations, it is reasonable to assume that the vast majority of amputations were caused by ischemic changes related to diabetes mellitus, a problem increasingly common given the rapid increase in the elderly population in Brazil, following a worldwide trend⁸. This might also be the explanation for the higher frequency of non-traumatic amputations in the present study^{9,13} and the higher frequency of case-fatalities among them. It is worth noting the possibility that attempts to preserve limbs in patients above 60 years of age might be less indicated or show less favorable results.

It is important to stress the fact that the populations used to calculate the rates for the periods between censuses are estimates that depart from the growth observed during the decade that preceded the last census. This possibly explains the downward trend in non-traumatic amputations observed during the census years (1990 and 2000) and those immediately following, as estimates in the years preceding the census might underestimate the actual population size. The denominator is increased when corrected according to the census count, and, therefore, the rates are reduced. This effect was more pronounced in 2000 and was more evident for non-traumatic causes (Figure 2) and between the different age groups (Figure 3). The small number of amputations due to trauma makes that effect less noticeable among those cases (Figure 2).

In 2002, the São Paulo State Department of Health launched a project to distribute medications for the control of chronic diseases. In 2005, The National Department of Health launched a similar project that came into effect in 2007 with the extensive distribution of medications. A possible effect of those projects cannot yet be assessed because this research study encompassed data until 2008, and, thus, prospective evaluations, including more years of monitoring, are required¹⁶.

The finding that approximately 80% of the amputations from all causes were performed in hospitals that served patients who were covered by the SUS is consistent with data from the 2000 census of the IBGE, which indicated that 24.5% of the Brazilian population had private health system coverage¹⁶. The lower occurrence of traumatic amputations in SUS provided health care, compared to that of non-traumatic amputations (68.8 and 80.1%, respectively), is an interesting finding for which the causes must be examined.

Traumatic amputations were 4 times more common in men, which might be explained by risk behaviors that are more frequently observed among them, including the often reckless use of motorcycles in large cities. Incidentally, the boom in sales of such vehicles in Brazil occurred in the final years of the first decade of the XXI century, followed by an increase in the incidence of trauma due to related use, particularly in males¹². The number of motorcycles

in the city of São Paulo increased by 50% between 2006 and 2010, and now corresponds to 21% of the total number of motor vehicles¹². In the present study, the mean rate of traumatic amputations in the post-2006 period doubled in comparison to the previous period (from 1985 to 2005), increasing from 6.2 to 11.3/100,000 inhabitants per year. Data from the State System for Data Analysis Foundation (*Fundação Sistema Estadual de Análise de Dados* (SEADE)) show that in 2007 deaths caused by traffic accidents surpassed those caused by homicides in the capital of São Paulo¹⁷. The rate of deaths caused by motorcycle accidents increased from 0.2 to 3.4/100,000 inhabitants per year, despite the drop in mortality rates in traffic from 15.3 to 9.5 deaths/100,000 inhabitants¹⁷. Had that study included the years immediately following 2008, it would have most likely detected more evidence of such an increase, which justifies new studies that include more recent years.

The hypothesis that greater clinical control of chronic diseases and the increase in urban violence could lead to changes in the proportions of amputations from traumatic and non-traumatic causes was not confirmed during the study period. However, recent events are likely to affect amputation rates in the coming years. The new government policies to control diabetes have the potential to reduce disease complications and diabetes-related amputations. Conversely, the increasing use of motorcycles in large urban areas, which has led to increased numbers of severe lower-limb trauma cases, might be accompanied by higher amputation rates. Given the relevance of this topic, such events should be carefully monitored in the future, and data from the present study might serve as a baseline for future comparisons that have already been planned from information routinely collected by the CPDH.

CONCLUSIONS

The overall rates of amputation and the rates of traumatic and non-traumatic amputations remained nearly constant during the study period. These rates did not accompany the increasing traffic-related deaths rates neither the aging of the population. The impact of diabetes control policies and the introduction of traffic safety laws could not be identified on the amputation rates. The growing trend of traumatic amputation rates observed after 2006 and its relation to the motorcycle fleet increase deserves more detailed studies.

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