Correspondence Analysis As A Strategy To Investigate The Magnitude Of Orthopedic Traumas Treated In The Emergency Room Of A Public Referral Service

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Abstract:
Context: Trauma, considered a neglected pandemic, represents a serious public health problem. This study aims to evaluate the magnitude of orthopedic trauma treated at a public referral hospital, seeking to understand its impacts, improve care, and support prevention policies.
Materials and Methods: A retrospective cross-sectional survey study with a quantitative approach was carried out through the analysis of 580 medical records of patients with orthopedic trauma between 2015 and 2019. The variables were age, sex, day of the week, shift, origin, trauma mechanism, body part affected, treatment, length of hospital stay, and hospital outcome.
Results: There was a predominance of males (79.7%), with trauma to the extremities (89.1%), as a result of motorcycle accidents (33.6%), from the capital and metropolitan regions (65.9%). The deaths corresponded to car accidents, thoracic traumas and conservative treatment, while the discharges corresponded to other traumas and motorcyclists, extremity traumas and surgical treatment
Conclusion: Through a study, there is a need to plan strategies to raise awareness among the population, especially young men, to minimize orthopedic traumas resulting from these accidents, and to improve the management of services that provide care to these victims, in order to reduce their morbidity and mortality.
Keywords: Emergencies; emergency hospital service; traumatology.

I. Introduction

Trauma can be defined as a harmful event, which consists of a physical shock of great intensity, caused by abrupt action or violence that causes damage of varying extent to the body and physiological imbalance.[1] As a result, trauma has increasingly occupied a prominent space in the statistics of diagnoses and hospital admissions, is a serious public health problem, and has been characterized as a neglected pandemic of modern life.[2]

The epidemiological panorama analyzed in the studies shows a growing increase in the number of hospital admissions due to trauma in recent years in Brazil, being the main reason for death and disability in the first half of life.[3] Hospitalizations for trauma almost always require intensive care, and these types of care represent a higher cost of the care network for the health sector and for society.[4]

The causal agents of trauma are currently increasingly diversified, justified through industrial and technological development and access to them, with the increase in the fleet of vehicles and the use of weapons, the population has been increasingly exposed to this type of causative agent of injury. Car accidents and violence are among the main causes of trauma that are most frequent in the population and threaten the survival of citizens. These problems bring countless damages to life, cause, in addition to physical problems, social and psychological changes and threaten lifestyle.[1]

Due to the great magnitude of public health in Brazil, trauma must be treated with all attention, care, with interdisciplinary care, and with specialized teams that provide quality services, to treat this serious demand of the population with the minimum of complications.[5] Therefore, the care and approach to these patients must be effective and immediate to minimize the risks of possible sequelae, for which it is important to provide quality care by the entire multidisciplinary team in urgent and emergency services.[6]

Studying the extent of orthopedic trauma is essential to understand the process and identify key areas to improve care, as well as develop health policies to prevent such injuries in the population. This study aims to analyze the scale of orthopedic trauma treated in a public hospital specialized in orthopedics and traumatology.

II. Method

This is a cohort study Cross Lift Type This was a quantitative approach, through the analysis of medical records made available by the archive service of a public reference hospital in orthopedics and traumatology in the state of Pernambuco, Brazil. The eligible population includes all orthopedic emergency care records made available in the period from 2015 to 2020, at which time the hospital service archives records before the COVID-19 pandemic. The study is in accordance with the or Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) for observational studies.

Individuals over 18 years of age hospitalized with traumatic orthopedic injuries were included, excluding those with genetic syndromes, bone or metabolic diseases, pregnant women, and patients with associated cardiovascular clinical diagnosis. The trauma mechanism has been classified according to the World Health Organization (WHO).[7]

To estimate the sample size, the Sample XS8 program was used, which uses the formula: n = A/(E*E+(A/N)), where n = corresponds to the sample size; A = 3.8416PQW, P = population prevalence in percentage; Q = (100 – P); E = maximum acceptable sampling error; w = probable effect of the drawing; N = population size. To calculate the sample, the estimated prevalence of 50% was based on the conditions, since the estimated prevalence of orthopedic trauma was not known, and it was decided to maintain the largest sample value. The total population was 3,000 medical records, with a confidence level of 95%, a sampling error of 5% and a design effect of 1.5, the minimum sample size was 483 medical records. To correct any losses, this amount was increased by 20%, leaving the final sample of about 580 medical records to be analyzed.

To select the sample, a survey of the 2020 medical records was carried out. To ensure proportionality, the draws were carried out randomly using the Randomizer program, based on the numbers in the medical records.[9] The final sample of the study consisted of 580 medical records analyzed from July to September 2020.

The information on the personal and socioeconomic data of the eligible participants in the medical records contained socioeconomic and demographic variables, based on the Brazilian Institute of Geography and Statistics (IBGE)[10], epidemiological and clinical variables.

Data analysis was performed using the correspondence analysis technique. Data tabulation was performed with the aid of the Epidata version 3.1 program, a system in the public domain, with which electronic data entry control procedures were also performed.[11] To detect errors, the data entry was repeated, and through the "validate" duplicate file comparison function, the typos were detected and corrected. The data were analyzed with the aid of the statistical program SPSS version 20.0. [SPSS Inc., Chicago, IL, USA].

In the description of the proportions, the binomial distribution was approximated to the normal distribution by the confidence interval (95%CI). To compare the proportions, Pearson's chi-square or linear trend was used. For interpretation purposes, the error limit of type I was up to 5% ($p \leq 0.05$). To explore the joint relationships between socioeconomic and demographic factors and obesity, simple correspondence analysis was also used. Correspondence analysis is an exploratory statistical technique used to verify associations or similarities between categorical variables.[12] The relationship between the categories of variables is investigated without designating a causal structure or assuming a probability distribution and is suitable for population data and non-inferential techniques. It is useful to study the risk factors associated with specific characteristics and identify groups with similar risk factors. Graphical representation allows the positions of the categories to be interpreted at the multidimensional level as associations.[13]

The study was conducted in accordance with Resolution 466/2012 of the National Health Council,[14] and was approved by the Human Research Ethics Committee under opinion No. 4,195,139 - CAAE No. 35177320.0.0000.8807, under the title: epidemiology of orthopedic traumas treated in the emergency room of a public reference hospital in orthopedics and traumatology.

III. Findings

We examined 580 medical records of patients admitted to the emergency room of a public hospital specializing in orthopedics and traumatology in the last five years (2015 to 2019), all hospitalized for orthopedic trauma (Table 1).

The analysis of the epidemiological profile showed that the majority of orthopedic trauma victims hospitalized in the analyzed period were predominantly male (79.7% (95%CI: 76.2-82.7), adults aged 30 to 59 years 54.2% (95%CI: 50-58.1) and 65.9% (95%CI: 61.9-69.6) from the metropolitan region.

During the study period, there was a predominance of weekly days with the highest number of trauma victims: 67.6% (95%CI: 63.6-71.2). Similarly, the night shift stood out with the most attendances (58.1% (95%CI: 54-62).

The prevalence of orthopedic trauma involving motorcycles was 33.6% (95%CI: 29.9-37.6), and most patients remained hospitalized for a period of up to 10 days.

Involvement of the lower and upper limbs was predominantly observed, with a higher prevalence of extremity trauma, with 89.1% (95% CI: 86.1-91.4).

The condition of hospital outcome presented a high percentage of discharge (70.5%), followed by transfers (22.4%). Only 12 deaths (2.1%) were recorded, and the overall dropout rate was 5% of the medical records analyzed. The mean length of hospital stay was 9.71±14 days, with no difference between the sexes for rejection of the null hypothesis.

Table 1. Socioeconomic and demographic characteristics of orthopedic trauma according to sex. Recife-PE, Brazil. 2020.

	Sex							
	Male 462 (79,7%)		Female 118 (20,3%)		Total			
	n(%)	95%CI	n(%)	95%CI	n(%)	95%CI	PR (95% CI)	Q†
Age*								<0.001$^\#$
Young adult	158 (85,9)	80-90	26 (14,1)	9-19,9	184 (31,7)	28,1-35,6	1	1
Adult	263 (83,7)	79,2-87,4	51 (16,3)	12,5-20,7	314 (54,1)	50,1-58,1	1,02 (0,95-1,10)	0,529
Old	33 (51,56)	39,5-63,3	31 (48,44)	36,6-60,4	64 (11)	8,7-13,8	1,66 (1,30-2,12)	<0.001
Super old	8 (44,44)	24,5-66,3	10 (55,56)	33,7-75,4	18 (3,2)	2-4,8	1,93 (1,14-3,24)	<0.001
Service shift							1,07 (0,99-1,17)	0,078
Diurnal	202 (83,1)	77,9-87,3	41 (16,9)	12,7-22,1	243 (41,9)	37,9-45,9		
Nocturne	260 (77,2)	72,4-81,3	77 (22,8)	18,7-27,6	337 (58,1)	54-62		
Trauma period							1,02 (0,93-1,12)	0,544
Weekdays	315 (80,4)	76,14-84	77 (19,6)	16-23,8	392 (67,6)	63,6-71,2		
Weekends	147 (78,2)	71,7-83,5	41 (21,8)	16,5-28,2	188 (32,4)	28,7-36,3		
Origin of the victim								0.101†
Capital and metropolitan region	295 (77,2)	72,7-81,1	87 (22,8)	18,8-27,2	382 (65,9)	61,9-69,6	1	
Zona da Mata/ Agreste	155 (85,2)	79,3-89,6	27 (14,8)	10,4-20,7	182 (31,4)	27,7-35,2	0,91 (0,83-0,98)	0,02
Sertão	12 (75)	50,5-89,8	4 (25)	10,2-49,5	16 (2,8)	1,7-4,4	1,03 (0,77-1,37)	0,83

*Age: Young adult – 18 to 29 years old; Adult – 30 to 59 years old; Elderly – 60 to 79 years old; Super-elderly - ≥ 80 years old.
RP: Prevalence ratio. 95%CI: 95% confidence interval. † Pearson's chi-square test. $^\#$ Chi-square test for trend.

Correspondence analyses based on the outcomes can be seen in Figures 1, 2, and 3. Figure 1 reports the relationship between the outcome groups of patients treated with trauma mechanism, it was found that there is a correspondence between hospital discharge and other types of trauma and motorcycles. When compared to death, the relationship was much closer to car accidents.

Fig. 1 Categories of the outcome groups with the trauma mechanism resulting from the correspondence analysis for the first two dimensions. Recife, Pernambuco, Brazil. 2022.
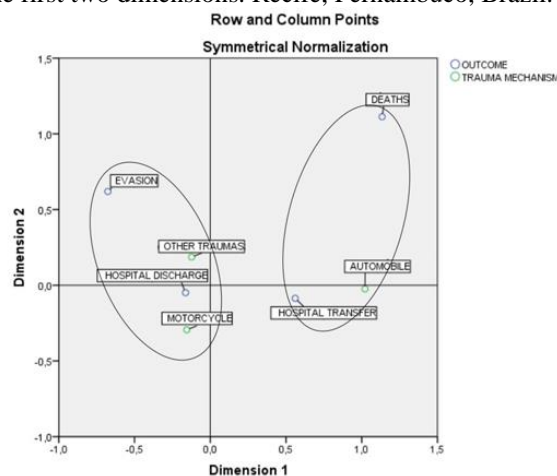
Figure 2 shows two very clear dimensions, deaths corresponding to thoracic trauma, while the other outcomes correspond to the head and neck, abdomen and pelvis, and extremities. The extremities are much closer to hospital discharge and evasion, while deaths correspond to more severe traumas, such as thoracic trauma.

Fig. 2 Categories of the outcome groups with the affected body part resulting from the correspondence analysis for the first two dimensions. Recife, Pernambuco, Brazil. 2022.
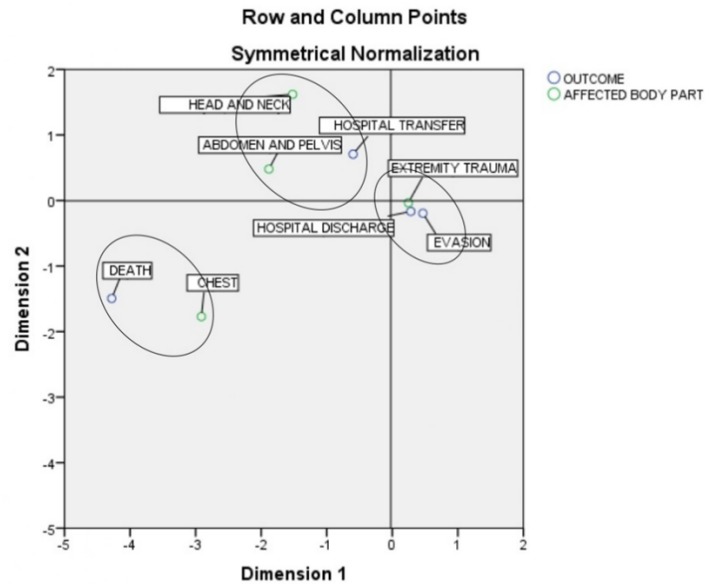

Figure 3 shows the relationship between the outcome and the treatment, where it is evidenced in the size analyses of the two correspondences that the surgical treatments corresponded to hospital discharge and the conservative treatment corresponded to deaths, while the unspecified treatment corresponded to transfers.

Fig. 3 Categories of the outcome groups with treatment performed from the correspondence analysis for the first two dimensions. Recife, Pernambuco, Brazil. 2022.
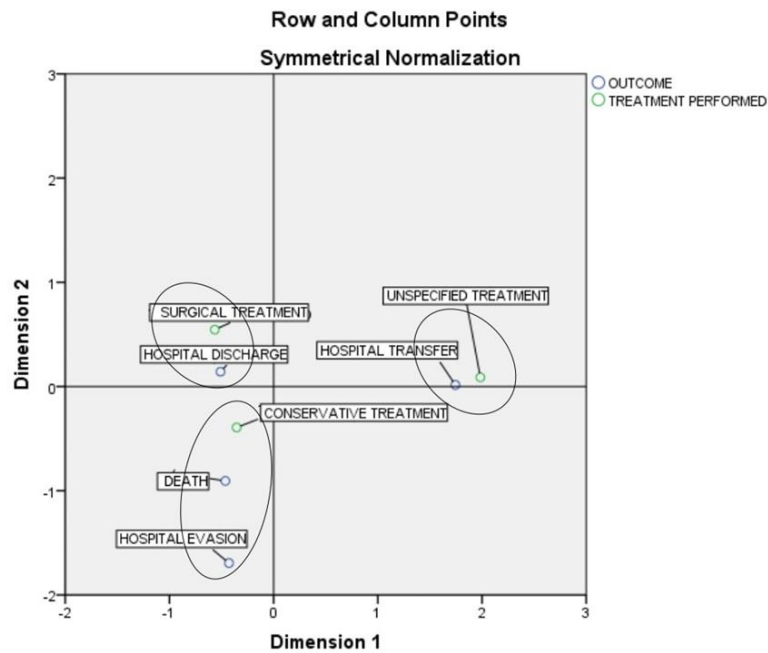
IV. Discussion

Most of the patients were male, victims of motorcycle accidents, with injuries to the extremities, coming from the capital and metropolitan region.

Correspondence analysis is a statistical technique that allows the joint analysis of multiple categorical variables arranged in contingency tables, covering qualitative and continuous categorized variables.[15] It seeks to graphically analyze the associations existing in the data, reducing their dimension, evaluating the relationship between rows and columns. The correspondence analysis generates a perceptual map, which are two-dimensional graphs that allow you to demonstrate in a simple way the existence of dependence between the variables and which categories are related.[16]

The study used a simple correspondence analysis for tables of 2 variables, representing rows and columns graphically. When applied to more variables, it is called Multiple Correspondence Analysis (MCA), giving similar results. This technique has been gaining popularity as a powerful exploratory data analysis tool.[17]

Victims of motorcycle accidents accounted for 1/3 of the sample of orthopedic traumas, which is the main cause of these traumas, both in Recife and in Brazil and abroad.[18] Some studies have proven this, such as in Piauí,[2] where the prevalence of this means of transport in accidents involving orthopedic trauma is 65.8%, in Paraná,[19] where this trauma mechanism is the main one, with a prevalence above 40%, and also in several other Brazilian regions.[6,18]

The high number of motorcycle accidents as a mechanism of orthopedic trauma is due to the large circulation of motorcycles in the metropolitan region, as they are lower-cost and easily accessible cars.[11] Although most orthopedic traumas are associated with motorcycle accidents, a correspondence was identified between these accidents and hospital discharge, and deaths correspond to car accidents. A study in São Paulo shows that reducing speed on public roads reduces deaths from car accidents, which have a greater impact and cause more deaths at high speeds.[20] The present series of cases can be justified in a similar way, although there are more motorcycles on the street, it is likely that the difficulty of mobility in Greater Recife is reducing traffic speed and reducing the incidence of motorcycles in accidents involving motorcyclists.

Among the victims of orthopedic trauma, there is a predominance of males involved in motorcycle accidents. Studies show that this prevalence is due to the fact that men, culturally seen as providers, use motorcycles more for commuting, especially for work. A study carried out in São Paulo reveals that 67.3% of the victims of traffic accidents are male.[21]

Figure 2 shows that automobile accidents result in more deaths from thoracic trauma than from trauma to the extremity, abdomen, pelvis, head, and neck. In addition, there was a predominance of extremity traumas, as observed in the study by Gorios et al. in the city of São Paulo,[22] the extremities of the body are more vulnerable to trauma because they are less protected, requiring a long period of protection for recovery, often requiring surgical intervention.

Figure 3 shows that surgical treatments correspond highly to discharge and conservative treatment to deaths, while unspecified treatment corresponds to transfers, as they often require more specialized evaluation and treatment in another care unit. The study reveals that surgical treatment of trauma victims results in more hospital discharges. In Curitiba, 71% of the patients were surgical and 90% were discharged.[21] Most of the traumas in this series were extremities, and the definitive treatment for many cases is surgical, including minor traumas, justifying the observed results. Thus, delaying arrival at the operating room or opting for conservative treatment is not an appropriate approach.

Although extremity trauma is more prevalent, chest trauma causes more deaths due to its greater severity. Studies highlight chest trauma as an important cause of death in victims of traffic accidents, bladed weapons, and firearms. A study carried out in Sergipe showed that deaths due to thoracic trauma reached 34.7%, where 44% required care in the intensive care unit. In addition to the psychic damage and traumatic stress, they also generate a great economic and financial cost for families, the government and society, with a strong impact on the public budget and the income of the affected families.[23]

The positive points of the study include the use of a static technique that dynamically demonstrates the correspondence between patient outcomes, the mechanism of trauma, the affected body part, and the treatment, as well as the comparison of orthopedic trauma with the gender of the victims. The sample size was sufficient to ensure an accurate estimate of prevalence.

The study has limitations that must be considered in the interpretation of the results: it is a cross-sectional study, which prevents the determination of cause and effect relationships; many medical records were filled out inadequately, resulting in the exclusion of some variables; and there is a lack of research on the magnitude of orthopedic trauma and its implications for emergency hospital care in northeastern Brazil (area of high social vulnerability).

V. Conclusion

It is concluded that orthopedic traumas related to motorcycles represent a significant part of the care, but are less severe than those caused by automobiles in the city of Recife and the metropolitan region. It is necessary to improve the management and investments in public urgent and emergency services in Brazil to offer more effective treatment to victims of orthopedic trauma, reducing the high morbidity and mortality rates associated with these cases.

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