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MOTOR DEFICIENCIES AND TRAUMA SEVERITY IN MOTORCYCLIST VICTIMS OF ROAD TRAFFIC ACCIDENTS*

Eunice Beatriz da Silva Freitas¹, Inácia Sátiro Xavier de França²

ABSTRACT: Objective: to relate the motor deficiencies acquired by motorcyclist accident victims to the severity of the traumas suffered. Method: a quantitative, descriptive, cross-sectional study based on secondary data extracted from 439 reports of motorcycle accidents in the state of Pernambuco in 2016. The Condensed Abbreviated Injury Scale was used to assess the severity of the injuries, and the International Classification of Functioning, Disability and Health for the classification. Descriptive statistical analysis of the data was performed. Results: alteration in the mobility of the joints prevailed in the motorcyclists with low severity (73.7%), and alterations in bone mobility, gait pattern and muscle strength prevailed in motorcyclists who presented a serious, life threatening risk (88.9% 77.8% and 33.3%, respectively). Conclusion: the findings reflect the magnitude of motorcycle accidents, and the need for preventive strategies and health promotion.

DESCRIPTORS: Disabled people; Traffic-accidents; Motorcycles; Health promotion; Nursing.

DEFICIÊNCIAS MOTORAS E GRAVIDADE DE TRAUMAS EM MOTOCICLISTAS VÍTIMAS DE ACIDENTES DE TRÂNSITO

RESUMO: Objetivo: relacionar as deficiências motoras adquiridas por motociclistas vítimas de acidentes com a gravidade dos traumas sofridos. Método: estudo quantitativo, descritivo, transversal, realizado a partir de dados secundários extraídos de 439 laudos de acidentes motociclistas ocorridos no Estado de Pernambuco no ano de 2016. Para classificação da gravidade das lesões, utilizou-se a *Condensed Abbreviated Injury Scale* e para classificação das deficiências a Classificação Internacional de Funcionalidade, Incapacidade e Saúde. Foi realizada a análise estatística descritiva dos dados. Resultados: a alteração mobilidade das articulações prevaleceu nos motociclistas com gravidade leve (73,7%), e as alterações mobilidade óssea, padrão da marcha e força muscular prevaleceram nos motociclistas que apresentaram risco grave - com ameaça a vida (88,9%, 77,8% e 33,3%, respectivamente). Conclusão: os achados refletem a magnitude da problemática dos acidentes envolvendo motocicletas, e a necessidade de estratégias preventivas e de promoção da saúde.

DESCRIÇÕES: Pessoas com deficiência; Acidentes de trânsito; Motocicletas; Promoção da saúde; Enfermagem.

DEFICIENCIAS MOTORAS Y GRAVEDAD DE TRAUMAS EN MOTOCICLISTAS VÍCTIMAS DE ACCIDENTES DE TRÁNSITO

RESUMEN: Objetivo: asociar las deficiencias motoras que adquirieron motociclistas víctimas de accidentes a causa de la gravedad de traumas sufridos. Método: estudio cuantitativo, descriptivo, transversal, que se realizó por medio de datos secundarios recogidos en 439 laudos de accidentes motociclistas que ocurrieron en el Estado de Pernambuco, en el año de 2016. Para clasificación de la gravedad de las lesiones, se utilizó la *Condensed Abbreviated Injury Scale* y para clasificación de las deficiencias, la Clasificación Internacional de Funcionalidad, Incapacidad y Salud. Se realizó análisis estadístico descriptivo de los datos. Resultados: la alteración de movilidad de las articulaciones prevaleció en los motociclistas con gravedad baja (73,7%), y las alteraciones de movilidad ósea, patrón de la marcha y fuerza muscular prevalecieron en los motociclistas que presentaron gran riesgo - con amenaza a la vida (88,9%, 77,8% y 33,3%, respectivamente). Conclusión: los resultados demuestran la magnitud de la problemática de los accidentes con motocicletas, así como la necesidad de estrategias preventivas y de promoción de salud.

DESCRIPTORES: Personas con deficiencia; Accidentes de tránsito; Motocicletas; Promoción de salud; Enfermería.

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● INTRODUCTION

Road traffic accidents are a worldwide social phenomenon and are responsible for high rates of morbidity and mortality. They can cause early death and injuries of different severities, leaving the victims with sequelae that temporarily or permanently prevent the continuation of a normal life⁽¹⁾. In the current scenario, traffic accidents involving motorcycles have been highlighted in relation to accidents with other types of vehicles⁽²⁾. With the problem of traffic congestion, the use of the motorcycle is increasing, as an alternative and fast mode of transport, with greater ease of movement, and also because of their reduced cost, both in relation to the acquisition of this type of vehicle and its running costs⁽³⁾.

Proportional to the growing number of motorcycles, traffic accident rates involving this type of transportation have also increased. In addition to high mortality rates, morbidity rates are also considerable, largely because of the vulnerability of this public, especially due to the limited protective mechanisms⁽⁴⁾. For them, there is no protection, as there is for occupants of four-wheeled vehicles, causing all the energy generated during the impact of the accident to be absorbed by the body. As a consequence, polytraumatized victims are encountered, a fact observed from the attendance of motorcyclists in emergency units⁽⁵⁾.

The injuries caused by traffic accidents lead to a series of changes in the tissues of the victims, which can affect skin, blood vessels, muscles and bones, among others. Deficiencies related to sensory and neuromusculoskeletal functions arise from these injuries, thus compromising people's quality of life.

The increase in the number of traffic accidents involving motorcyclists has become an important cause of motor deficiency and physical incapacitation due to the different types of injuries and severities suffered during the trauma⁽⁶⁻⁷⁾. When analyzing the claims paid out by the Personal Injury Caused by Road Vehicles Insurance (DPVAT) for Permanent Disability in the years of 2013 and 2014, it was observed that, in 2014, the incidence was greater in accidents involving motorcycles, corresponding to 80%, and that this type of accident was also the one that presented the greatest increase from one year to the other, with a variation of 39%⁽⁸⁾.

Based on this evidence, this study aimed to relate the types of motor deficiencies presented by motorcyclist victims of road traffic accidents with the severity of the traumas suffered by them.

● METHOD

This was a descriptive, documental, quantitative study with a cross-sectional design, developed as part of a wider study entitled "Motor deficiencies in motorcyclist victims of road traffic accidents".

The study was carried out at the Antônio Persivo Cunha Legal Medical Institute (IML-PE), located in the city of Recife, state of Pernambuco. As one of its functions, this institute has the performance of the evaluation examinations of the bodily injuries resulting from traffic accidents, and the emission of reports containing the classification of the degree of bodily compromise, including disabilities and deficiencies.

All the reports of motorcyclists who were victims of traffic accidents during the period from January 1, 2016 to December 31, 2016 were analyzed. The choice of the year 2016 was due to its proximity to the period in which the data collection was performed, thus allowing for more recent results regarding the motorcycle accident scenario.

The reports that included some type of motor deficiency as a result of the accident were selected for this study, considering as inclusion criteria: reports made by the Legal Medical Institute of Pernambuco on traffic accidents with motorcycles that occurred in 2016; with the patient having been the driver of the motorcycle at the time of the accident; and the report being legible. The reports that were still under review were excluded from the sample.

Data collection was carried out during July 2017, using secondary data extracted from the victim evaluation reports, using an instrument for the collection prepared by the authors of the study and

containing variables related to the characteristics of the injury suffered, such as type of injury and body parts affected; as well as the identification of the type of motor deficiency acquired and its respective classification as being temporary or permanent.

In order to analyze the severity of the injuries, the “Condensed Abbreviated Injury Scale” (CAIS 85) instrument was used, based on the AIS (Abbreviated Injury Scale) Manual. The AIS system, created in the United States and published in 1971, is a useful instrument in the evaluation of trauma victims, allowing the determination of the severity of the injuries suffered from the classification of each specific bodily injury with a value of 1 to 5. Scores 1 corresponds to a low severity injury, 2 to moderate, 3 to a severe non-life threatening injury, 4 to severe life threatening injury, with survival probable and 5 to a severe injury with survival uncertain⁽⁹⁾. In this study, once the types of injuries and body regions traumatized were identified in the motorcyclists who were victims of traffic accidents, the CAIS 85 map was used to classify the severity of each trauma.

After classification of the severity of the traumas suffered by the motorcyclists, the classification of the types of motor deficiencies acquired was carried out using the International Classification of Functioning, Disability and Health (CIF), produced by the World Health Organization. This classification aims to standardize and unify health conditions and components of health-related well-being. These domains are described according to functionality (encompassing body functions, participation and activities) and disabilities (encompassing deficiencies, limitations in participation or restrictions in activities)⁽¹⁰⁾.

In this study, the ICF was used considering the neuromusculoskeletal and movement-related functions affected by the motor deficiencies, namely, altered joint mobility, altered bone mobility, altered gait pattern, and altered muscle strength. The alteration in the mobility of the joints is characterized by limitations in the range of motion of at least one joint of the body. The alteration in bone mobility includes a reduction in the range of bone movements that comprise the shoulder girdle, pelvic girdle, carpal bones, and tarsal bones. The alteration in gait pattern is related to the limitation in performing movements such as walking and running independently. And finally, the alteration in muscular strength is characterized by a deficit in the force generated by the contraction of a muscle or muscle groups⁽¹⁰⁾.

For data analysis, a database was constructed in the EPI INFO, version 3.5.2, program and after the data entry, the data was validated (double data entry for later comparison and correction of the divergent values). After the validation, the database was exported to a statistical program to perform the data analysis.

The prevalence of the body parts affected, types of injuries and functional categories involved in the accident were calculated. In order to evaluate the influence of the severity of the injuries of the victim for each type of motor deficiency found, the chi-square test for independence was applied. In cases where the assumptions of the chi-square test were not fulfilled, Fisher’s exact test was applied. All conclusions were drawn considering a 95% confidence interval.

Observing the ethical principles of scientific research involving human subjects, the present study was approved by the Research Ethics Committee of the University of Pernambuco, Authorization No. 2.108.062.

● RESULTS

In 2016, 1156 evaluation examinations were carried out by the Legal Medical Institute of Pernambuco on motorcyclists who were victims of road traffic accidents. Each of the reports was carefully read and analyzed, so that, in the end, 439 reports were found that fulfilled the inclusion criteria established for this study.

The most affected body parts were the hand (19.4%, $n = 85$), leg (16.6%, $n = 73$) and foot (14.8%, $n = 65$) and the body parts least affected were the neck (0%), spine (2.3%, $n = 10$) and hip (3.4%, $n = 15$). When considering the body areas from the sum of each injured part, it was noticed that the lower limbs were the most compromised (271 reports, including the thigh, knee, leg, ankle and foot), followed by the upper limbs (259 reports, including the shoulder, arm, forearm, wrist and hand).

In relation to the injuries presented by the motorcyclists that resulted in motor deficiencies, the total number of injuries was 545. This is explained by the fact that one motorcyclist may have suffered more than one different type of injury, as can be seen in the analysis of the body parts affected. Regarding the types of injuries, it was observed that closed fractures were the most common (66.5%, $n = 292$), followed by open fractures (19.4%, $n = 85$) and dislocations (9.1%, $n = 40$). The least prevalent types of injuries were vascular injuries (1.4%, $n = 6$), sprains (1.6%, $n = 7$) and nerve damage (2.3%, $n = 10$).

Considering the body parts affected and the injuries found, the classification of the severity of the traumas suffered by the motorcyclists was carried out using the Condensed Abbreviated Injury Scale (CAIS 85). It was observed that non-life-threatening injuries of CAIS <3 severity were the most prevalent among the victims, with severity 2 (moderate) being the most common. It should be mentioned that, in this study, no records of trauma with critical severity CAIS 5 with uncertain survival were obtained. Table 1 presents the assessment of the severity of the traumas.

Table 1 - Evaluation of the severity of the trauma suffered by motorcyclists according to the CAIS 85 ($n = 439$). Recife, PE, Brazil, 2016

Evaluated factor	N	%
Assessment of the severity of head and neck trauma		
Without injury	436	99.4
CAIS85 (2) Moderate	1	0.2
CAIS85 (3) Severe - no threat to life	1	0.2
CAIS85 (4) Severe - threat to life	1	0.2
Assessment of the severity of limb and pelvic girdle traumas		
Without injury	2	0.5
CAIS85 (1) Mild	76	17.3
CAIS85 (2) Moderate	234	53.3
CAIS85 (3) Severe - no threat to life	119	27.1
CAIS85 (4) Severe - threat to life	8	1.8

It was observed that, of the three motorcyclists who presented injuries to the head and neck regions that resulted in motor deficiency, one presented a classification of 2 according to the CAIS 85 - moderate severity; another presented a classification of 3, which corresponds to a severe trauma, however not life-threatening; and only one motorcycle rider was classified as 4, presenting serious life-threatening injuries.

In relation to the injuries suffered in the limbs and pelvic girdle, the parts most affected, it was observed that the majority of accidents (53.3%, $n = 234$) caused traumas of CAIS85 2 - moderate severity in the motorcyclists (Table 1). The categories of functional impairments that the acquired motor deficiencies caused were also established, from the International Classification of Functioning, Disability and Health (CIF). In order to perform the classification according to the categories of this instrument, the neuromusculoskeletal functional impairments of the motorcyclists were analyzed, associating them with the functional disabilities that fit within each category of the CIF.

Among the motorcyclists that presented motor deficiency as a consequence of traffic accidents, four categories of functional impairment could be identified: alteration in joint mobility; alteration in bone mobility; alteration in gait pattern; and alteration in muscle strength. The alterations in joint mobility was more prevalent in the group of motorcyclists who presented mild severity (73.7%, $n = 56$). It was also possible to verify by means of data analysis that the prevalence of this motor deficiency decreased with the increase in severity of the trauma (70.5%, $n = 165$ for the group with moderate severity, 50.8%, $n = 61$ for the group with serious - not life threatening injuries and 44.4%, $n = 4$, for those with severe - life threatening injuries). The independence test was significant ($p < 0.001$), indicating that the severity of the injury was determinant for the alteration in joint mobility (Table 2).

Table 2 - Distribution of the alteration in joint mobility according to the severity of the injury (n = 439). Recife, PE, Brazil, 2016

Motorcyclist injury severity	Alteration in joint mobility (b710)		P-value
	Yes N(%)	No N(%)	
Mild	56(73.7)	20(26.3)	<0.001 ¹
Moderate	165(70.5)	69(29.5)	
Serious - no threat to life	61(50.8)	59(49.2)	
Serious – life threatening	4(44.4)	5(55.6)	

¹p-value of the chi-square test for independence (if p <0.05 the severity of the injury significantly influenced the alteration in joint mobility).

The distribution of the alteration in bone mobility according to the severity of the injury showed that this impairment was more prevalent in the group of motorcyclists who presented a serious - life threatening risk (88.9%, n = 8), as can be seen in Table 3 (42.1%, n = 32 for the mild degree, 59.4%, n = 139 for the moderate degree and 65.0%, n = 78 for the serious - not life threatening degree). In addition, the independence test was significant (p = 0.003), indicating that the severity of the injury was determinant for the alteration in bone mobility.

Table 3 - Distribution of the alteration in bone mobility according to the severity of the injury (n = 439). Recife, PE, Brazil, 2016

Motorcyclist injury severity	Alteration in bone mobility (b720)		P-value
	Yes N(%)	No N(%)	
Mild	32(42.1)	44(57.9)	0.003 ¹
Moderate	139(59.4)	95(40.6)	
Serious - no threat to life	78(65.0)	42(35.0)	
Serious – life threatening	8(88.9)	1(11.1)	

¹p-value of the Fisher's exact test (if p <0.05 the severity of the injury significantly influences the alteration in bone mobility).

Table 4 shows the distribution of the alteration in gait pattern according to the severity of the injury. It was verified that this type of motor deficiency was more prevalent in the group of victims who presented a serious - life threatening risk (77.8%, n = 7). Furthermore, the prevalence of this motor impairment increased with the increase in severity of the trauma. In addition, the independence test was significant (p <0.001), indicating a strong influence of the severity of the injuries on the alteration in gait pattern.

Table 4 - Distribution of the alteration in gait pattern according to the severity of the injury (n = 439). Recife, PE, Brazil, 2016

Motorcyclist injury severity	Alteration in gait pattern (b770)		P-value
	Yes N(%)	No N(%)	
Mild	6(7.9)	70(92.1)	<0.001 ¹
Moderate	53(22.6)	181(77.4)	
Serious - no threat to life	59(49.2)	61(50.8)	
Serious – life threatening	7(77.8)	2(22.2)	

¹p-value of the chi-square test for independence (if p <0.05 the severity of the injury significantly influenced the alteration in gait pattern).

Finally, Table 5 presents the distribution of the alteration in muscle strength according to the severity of the injury. This motor deficiency was more prevalent in the group of motorcyclists who presented serious - life threatening injuries (33.3%, $n = 3$). The prevalence of this impairment increased with the increase in trauma severity (3.9%, $n = 3$ for the mild degree, 8.1%, $n = 19$ for the moderate degree, and 13.3 %, $n = 16$ for severe - not life threatening degree). Although this relationship was found, the independence test was not significant ($p = 0.010$), indicating that this relationship was not confirmed in this study.

Table 5 - Distribution of the alteration in muscle strength according to the severity of the injury ($n = 439$). Recife, PE, Brazil, 2016

Motorcyclist injury severity	Alteration in muscle strength (b730)		P-value
	Yes N(%)	No N(%)	
Mild	3(3.9)	73(96.1)	0.010 ¹
Moderate	19(8.1)	215(91.9)	
Serious - no threat to life	16(13.3)	104(86.7)	
Serious – life threatening	3(33.3)	6(66.7)	

¹p-value of the chi-square test for independence (if $p < 0.05$ the severity of the injury significantly influenced the alteration in muscle strength).

● DISCUSSION

The number of 439 people who presented some type of motor deficiency due to motorcycle accidents is quite significant and alarming. It is believed that if all the victims involved were taken into account, as well as those who were seen in other health institutes and establishments, the numbers would be even higher and more worrying.

The quantitative records of body parts affected by trauma were higher than the number of subjects of the sample, thus allowing the affirmation that the same motorcyclist can present more than one anatomical structure injured. The identification of the lower limbs as the most commonly affected body parts is common among scientific investigations with the motorcyclist public^(5-6,8,11-13). This finding is based on the absence of protective mechanisms for these body parts, which makes them more exposed to trauma at the time of the accident.

The prevalence of closed-type fractures resembles data from other studies^(5-6,8,13), and may be related to the time required for the treatment and consolidation of the fractures, through immobilizations, which is often extensive, leading to long periods of hospitalization and recovery of the victims.

Regarding the classification of the severity of the traumas suffered by the motorcyclists, it was observed that injuries of moderate severity were the most prevalent in the motorcyclists analyzed in other investigations^(6,14). The finding that injuries that are producing motor deficiencies in motorcyclists are of moderate severity, which do not lead to life-threatening injuries, suggests that the vast majority of these deficiencies could be prevented or avoided.

The categories of functional neuromusculoskeletal impairment, according to the International Classification of Functioning, Disability and Health (CIF), were also established based on the evaluation reports of the motorcyclists analyzed. It should be noted that in Brazil there is no standardization in the evaluation in relation to the use of this instrument, and the classification of the types of disability is determined by the examining physician⁽¹⁵⁾.

The alteration in mobility of the joints was the more prevalent functional impairment caused by the motor deficiencies among the motorcyclists analyzed. Relating this type of motor impairment to the severity of the injuries suffered, it was verified that the motorcyclists with CAIS 85 1 - mild severity,

more prevalently acquired limitations in the mobility of the joints and that the prevalence of this motor limitation decreased with the increase in the severity of the trauma.

Therefore, no matter how small the injuries involved in a traffic incident with motorcyclists, it is possible that some kind of motor impairment may result. It is also possible to conclude that, as the severity of the trauma increased, the possibilities of alterations in joint mobility decreased, however, this does not exclude the possibility of other types of motor limitations.

The second most prevalent motor impairment was alterations in bone mobility, characterized by a reduction in the range of bone movements⁽¹⁰⁾. The presence of this functional limitation can be explained by the high percentage of fractures found in motorcyclists. According to the severity of the injury, the alteration in bone mobility was more prevalent in the group of motorcyclists who presented CAES 85 4 - severe life threatening injuries (88.9%), and the prevalence of this motor deficiency increased with the severity of the injury.

The alteration in gait pattern in the motorcyclists analyzed was probably related to injuries in the lower limbs, which were the most affected body parts. This type of motor deficiency prevailed in the group of victims who presented a serious - life threatening risk (77.8%, $n = 7$), and the prevalence of this impairment increased along with an increase in trauma severity.

Finally, the alteration in muscle strength, which was found to be the least prevalent (9.3%, $n = 41$), characterized by a deficit in the force generated by muscle contraction⁽¹⁰⁾, was probably due to prolonged immobilization of the limbs. It was found that this type of disability was more prevalent in the group of motorcyclists that presented serious life-threatening injuries (33.3%, $n = 3$), and that the prevalence of this impairment increased according to the severity of the trauma. However, the independence test applied to evaluate this relationship was not significant, indicating that, in this study, the relationship between trauma severity and muscle strength impairment was not confirmed, concluding that the occurrence of this limitation can exist with any severity of trauma.

Among the four types of neuromusculoskeletal impairment found in this study, three prevailed in motorcyclists with severity score of 4 – severe, life threatening trauma, namely, altered bone mobility, altered gait pattern and altered muscle strength. This finding allows the inference that more severe traumatic injuries suffered by motorcyclists equate to greater possibilities of motor function limitations.

Regarding the limitations of this study, it is highlighted that not all the victims involved in road traffic accidents with motorcycles were included, which could increase the knowledge of the severity of the traumas suffered, the functional impairments and the motor deficiencies that affect this population.

● CONCLUSION

The results of this study showed that, regardless of the severity of the trauma, all of them can lead to functional impairments that will produce motor deficiencies. It was also found that the same individual may present more than one type of motor impairment, since different body parts can be affected during the accident.

Considering the severity of the accidents involving motorcyclists and their relation to the types of functional impairment found in this study, it was concluded that, in the vast majority of cases, the motor limitations presented by the motorcyclists were directly associated with the degree of accident severity. This knowledge is essential for the elaboration of new strategies for inspection and punishment of infractions, as well as educational and preventive measures.

The findings of this study allow a dimensioning of the magnitude of the problem of traffic accidents involving motorcyclists, and demonstrate the need for preventive and health promotion strategies, not only by the State, but also by the health sector and by society, mainly because many the motor impairments are avoidable.

It should also be highlighted that, alone, the information related to the motor deficiencies acquired by motorcyclists who are victims of traffic accidents is not enough to describe the health conditions of the individuals affected, nor the impacts they produce. Information is needed to allow a more complete

view of both the factors involved in traffic accidents and the effects of the motor deficiencies on the lives of victims.

Knowledge about traffic accidents with motorcycles, their determinant factors and the health problems affecting the population is essential for the creation of mechanisms that reduce situations of vulnerability and, consequently, the occurrence of deficiencies.

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