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Research Article

Motorcycle Crash at Bouake University Hospital: Epidemiological, Injury-Related and Therapeutic Features

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Abstract

Objective: The objective of this work was, first, to reassess the epidemiological, injury-related and therapeutic features of motorcycle crash casualties and, second, to analyse the factors that influence injury severity.

Methods: This was an observational, cross-sectional and analytical study. The study was conducted over a 12-month period (31 March 2022 to 31 March 2023) in the surgical emergency department of Bouake University Hospital. It included patients of any age and of either sex admitted for an injury sustained in a crash involving a motorcycle. The variables studied were epidemiological, injury-related and therapeutic. Logistic regression was then performed to identify the factors (independent variables) associated with injury severity (the dependent variable).

Results: The prevalence was 34.23%. The mean age was 35.5 ± 13.1 years. There were 81% (n = 623) men and 19% (n = 150) women. Drivers (n = 533; 68.9%) were the most affected group. Motorcycle-to-motorcycle collisions (n = 254; 32.8%) were the most frequent type of accident. Safety helmet usage was 12.1% (n = 89). Most accidents (n = 587; 75.9%) occurred between 12:00 PM and midnight. Accidents occurred most frequently in May (n = 84; 10.8%) and on Saturdays (n = 117; 15.1%) and Sundays (n = 141; 18.2%). Injuries were located on the lower limbs (n = 419; 39.2%) and the head (n = 349; 32.7%). Soft tissue injuries (n = 277; 30.6%) and fractures (n = 201; 22.2%) were the most commonly observed injuries. Treatment was medical (n = 773; 100%) and surgical (n = 383; 49.54%). Discharges against medical advice accounted for 8.02% (n = 62) of cases. Transfers to specialized departments (n = 278; 35.96%) were primarily to Orthopedics and Traumatology (n = 137; 49.28%). The mortality rate was 1.2% (n = 9). Failure to wear a helmet, occurrence of the accident on weekends, the type of accident (motorcycle-to-motorcycle), the type of road user (motorcycle riders), and the presence of more than two injuries were factors associated with injury severity ($p < 0.05$).

Conclusion: Motorcycle accidents are frequent in Bouake predominantly involving collisions between motorcycles. Helmet use was 12.1%, and nine deaths were recorded.

Keywords: Accident Victims; Safety Helmet; Fracture; Motorcycle

Introduction

Road traffic crashes are frequent and represent a major public health problem worldwide [1]. Crashes involving motorcycles account for a substantial proportion of these road traffic crashes, in high-income as well as in low- and middle-income countries [2,3]. In the United States, motorcycle crashes account for 11% of road traffic deaths, whereas in France they account for 23.5% [4,5]. The risk factors associated with injury and death in motorcyclists are young age, the absence of protective equipment (helmet) and the poor visibility of the rider and the machine to other road users [6]. In Africa, the defective condition of road networks, excessive speed, non-compliance with the highway code and substance use among motorcycle riders aggravate the problem [7,8]. In Côte d'Ivoire, and specifically in Bouake, motorcycle crashes accounted for 79.7% of road traffic crashes, with 71.3% of the casualties, in 2012 [2]. To strengthen road safety, urgent measures have been taken by the government, in particular the upgrading of road infrastructure and the reinforcement of automated (video-based) traffic enforcement [9]. The objective of this work was, first, to reassess the epidemiological, injury-related and therapeutic features of motorcycle crash casualties and, second, to analyse the factors that influence injury severity.

Methods

This was an observational, cross-sectional and analytical study. The study was conducted over a 12-month period (31 March 2022 to 31 March 2023) in the surgical emergency department of Bouake University Hospital , Côte d'Ivoire. It included patients of any age and of either sex admitted for an injury sustained in a crash involving a motorcycle. Patients who did not give their consent to take part in the study were excluded. Injuries were diagnosed on the basis of the history, the clinical examination and plain radiographs. The reporting of this article was guided by the STROBE recommendations [10]. The minimum sample size was calculated using the Cochran formula [11]. This sample size was based on the study conducted by Bouhelo-Pam., *et al*. in Brazzaville, Congo [12], which reported a prevalence of 32.49% of road traffic crashes involving a motorcycle. Sampling was non-probability, consecutive and exhaustive. The study used the digital database collected prospectively through a tablet-based electronic data collection form of the Institut de Recherche pour le Développement (IRD, France) project on road traffic crash surveillance in Bouaké [13]. Data were collected by means of an interview with the patient or the accompanying persons and from the medical records. The study also used the admission registers of the surgical emergency department. The variables studied were epidemiological, injury-related and therapeutic. The severity and prognosis of the injuries were assessed using the shock index and the Injury Severity Score (ISS) [14]. Minor and moderate ISS categories were considered non-severe, whereas the serious, severe, critical and maximal categories were considered severe.

The statistical analysis followed the SAMPL guidelines for the reporting and reading of statistical methods and analyses [15]. For the quantitative variables, the Shapiro–Wilk normality test was performed beforehand, with a 5% margin of error and a 95% confidence interval [16]. All quantitative variables were normally distributed. The measure of central tendency calculated was the mean, and the standard deviation was the measure of dispersion. Categorical variables were expressed as frequencies with percentages. The study population was described using the epidemiological data. The chi-square test ($p < 0.05$) was used to determine the association between injury severity (the dependent variable) and the independent variables (age, sex, type of crash, occurrence of the crash at the weekend, time of the crash, category of road user and number of injuries).

Logistic regression was then performed to identify the factors (independent variables) associated with injury severity (the dependent variable).

Results

Characteristics of victims

The surgical emergency department registered 2,258 patients during the study period. Of these, 773 had been involved in a crash involving a motorcycle, giving a prevalence of 34.23%. The characteristics of the motorcycle crash casualties are summarised in Table 1.

Characteristics of crash

The type of crash and the time, day, month and place of occurrence of the crashes are shown in Figures 1, 2, 3, 4 and 5, respectively.

Characteristic	Value
Sex	
Male	623 (80.6)
Female	150 (19.4)
Age	
Mean ± SD (range), years	35.5 ± 13.0 (1–75)
Age group, years (n = 772)	
< 20	137 (17.7)
20–39	486 (63.0)
40–59	124 (16.1)
60–79	25 (3.2)
Occupation	
Self-employed/private sector	367 (47.5)
Pupil or student	213 (27.6)
Civil servant	101 (13.1)
Homemaker	65 (8.4)
Unemployed	21 (2.7)
Retired	6 (0.8)
Category of motorcycle user	
Rider	533 (69.0)
Passenger	240 (31.0)
Helmet use	
Yes	93 (12.0)
No	680 (88.0)

Table 1: Characteristics of the motorcycle crash casualties (N = 773).

Values are n (%) unless otherwise stated. SD, standard deviation.

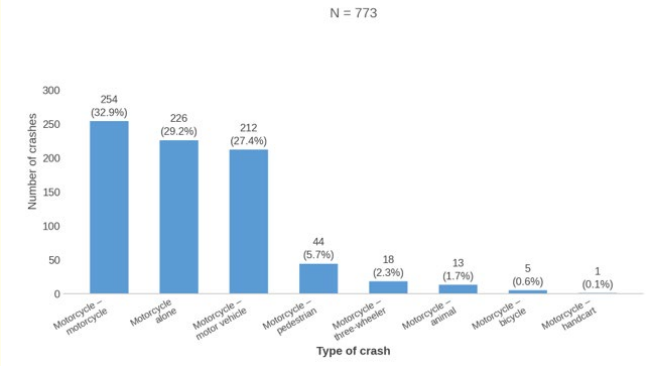


Figure 1: Distribution of motorcycle crashes according to the type of crash.

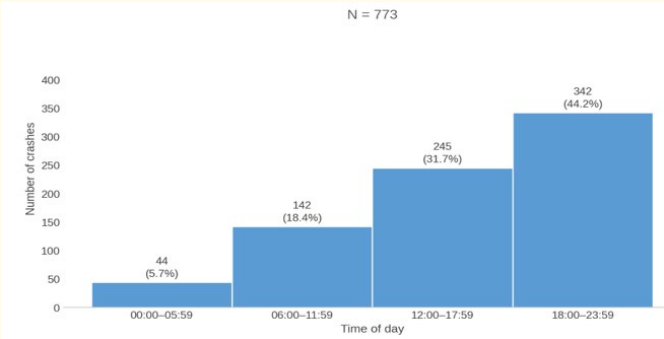


Figure 2: Distribution of crashes according to time of day.

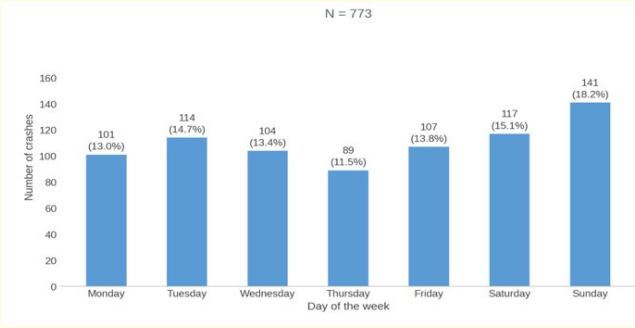


Figure 3: Distribution of casualties according to the day of occurrence.

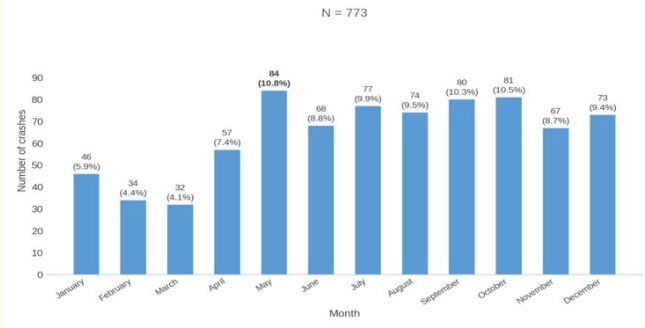


Figure 4: Distribution of casualties according to the month of the year.

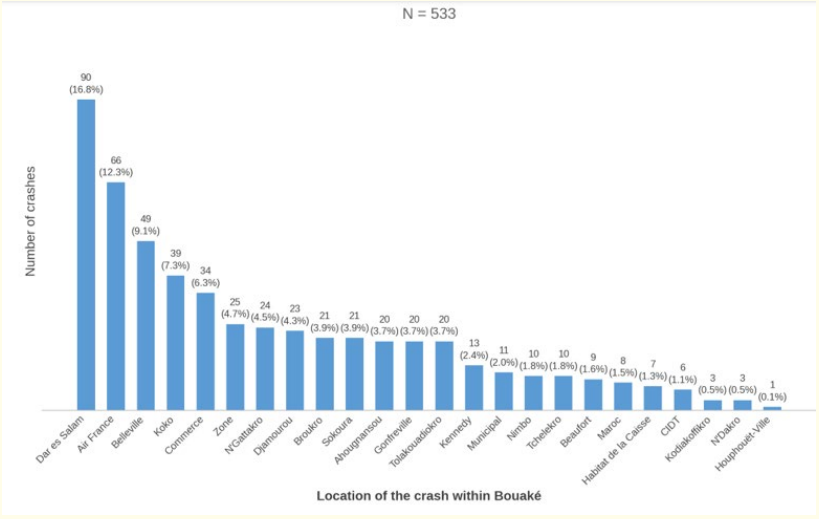


Figure 5: Distribution of crashes according to the location of the crash within Bouaké.

Crashes that occurred within the city of Bouake accounted for 69.0% of cases (n = 533).

The characteristics of the injuries and of the treatment are summarised in Table 2.

Characteristic	Value, n (%)
Shock index (n = 697)	
> 0.9	73 (10.5)
≤ 0.9	624 (89.5)
Glasgow Coma Scale score (n = 764)	
13–15	715 (93.6)
8–12	41 (5.4)
3–7	8 (1.0)
Injury Severity Score (n = 773)	
Non-severe	614 (79.4)
Severe	159 (20.6)
Number of injuries (n = 733)	
One injury	302 (41.2)
More than one injury	431 (58.8)
Site of injury (n = 1,067 injuries)	
Head and neck	349 (32.7)
Lower limb	419 (39.3)
Upper limb	215 (20.1)
Spine	15 (1.4)
Chest	23 (2.2)
Abdomen	19 (1.8)
Pelvis	27 (2.5)
Type of injury (n = 921 injuries)	
Soft-tissue wounds	277 (30.1)
Fractures	201 (21.8)
No apparent injury	150 (16.3)
Traumatic brain injury	143 (15.5)
Muscle contusion	85 (9.2)
Spinal cord injury	15 (1.6)
Dislocations	14 (1.5)
Other injuries	36 (3.9)
Time to admission (n = 733)	
< 1 hour	333 (45.4)
1–6 hours	250 (34.1)
> 6 hours	150 (20.5)
Method of treatment (n = 733)	
Surgical	383 (52.3)
Medical only	231 (31.5)
Orthopaedic	119 (16.2)

Table 2: Injury-related and therapeutic characteristics.

Percentages for the site and type of injury are calculated on the total number of injuries recorded, since a patient could present more than one injury. Denominators differ between items because of missing data.

According to the shock index, 624 patients (89.5%) had no sign of shock associated with a high risk of mortality. Six hundred and fourteen patients (79.4%) had a minor or moderate ISS. Table 2 summarises the injury-related and therapeutic data.

At the end of management, 424 patients (54.9%) were discharged after a favourable medical opinion, whereas 62 patients (8.0%) were discharged against medical advice. Clinical and paraclinical investigations led to the transfer of 278 patients (36.0%) to specialist departments, of whom 137 (49.3%) were transferred to orthopaedics and traumatology and 72 (25.9%) to neurosurgery. Nine patients (1.2%) died.

Statistical analysis

The chi-square test demonstrated a significant association ($p < 0.05$) between the ISS and the explanatory variables age, sex, helmet use, time of the crash, day of the crash, period of the year, type of crash, category of road user and number of injuries (Table 3).

Variable	Non-severe	Severe	Total	p
Age (years)				< 0.001
< 35	423	48	471	
≥ 35	191	111	302	
Sex				< 0.001
Male	546	77	623	
Female	68	82	150	
Helmet use				0.005
Yes	84	9	93	
No	530	150	680	
Time of the crash				< 0.001
00:00–11:59	393	38	431	
12:00–23:59	221	121	342	
Day of the crash				< 0.001
Weekday	478	37	515	
Weekend	136	122	258	
Period of the year				0.71
January–June	257	64	321	
July–December	357	95	452	
Type of crash				< 0.001
Motorcycle/motorcycle	390	127	517	
Motorcycle/car	182	30	212	
Motorcycle/pedestrian	42	2	44	
Category of road user				< 0.001
Riders	436	97	533	
Passengers	155	41	196	
Pedestrians	23	21	44	
Number of injuries				< 0.001
Up to two injuries	546	13	559	
More than two injuries	68	146	214	

Table 3: Bivariable analysis of the factors associated with injury severity.

Values are numbers of patients. Severity was defined by the Injury Severity Score. p values were obtained with the chi-square test.

The search for factors associated with the severity of injury in the casualties is summarised in Table 4. The absence of helmet use, the occurrence of the crash at the weekend, the type of crash (motorcycle/motorcycle), the category of road user (motorcycle riders) and the presence of more than two injuries were factors associated with the severity of the trauma ($p < 0.05$).

Independent variable	Coefficient ± SE	OR (95% CI)	p
Age ≥ 35 years	1.559 ± 0.994	1.07 (0.41–7.64)	0.68
Male sex	5.231 ± 0.994	3.11 (1.87–66.00)	0.14
No helmet use	0.871 ± 0.808	7.39 (1.00–10.98)	0.02
Crash between 00:00 and 11:59	3.696 ± 1.252	14.30 (1.26–95.64)	0.82
Crash at the weekend	2.696 ± 8.120	5.56 (4.28–90.47)	0.03
Motorcycle/motorcycle crash	13.560 ± 5.714	11.67 (3.60–26.89)	< 0.001
Motorcycle rider	1.230 ± 4.105	5.21 (2.21–87.78)	0.04
More than two injuries	1.335 ± 2.714	9.77 (3.46–16.89)	0.01

Table 4: Logistic regression analysis of the factors associated with injury severity.

CI, confidence interval; OR, odds ratio; SE, standard error.

Discussion

The objective was, first, to reassess the epidemiological, injury-related and therapeutic features of motorcycle crash casualties and, second, to analyse the factors that influence injury severity.

The prevalence of motorcycle crash casualties was 34.23%. The mean age of the casualties was 35.5 years. The casualties were young male subjects. Riders were the road users most frequently affected and were most often not wearing a helmet. Motorcycle-to-motorcycle crashes were the most frequent. Crashes occurred more often at the weekend and in the months of May and October. The injuries were located in the lower limb and in the head. Soft-tissue wounds and fractures were the most frequently observed types of injury. Medical treatment was instituted, followed by surgical treatment.

The absence of helmet use, the occurrence of the crash at the weekend, the type of crash (motorcycle/motorcycle), the category of road user (motorcycle riders) and the presence of more than two injuries were factors associated with the severity of the trauma.

During this study period, motorcycle crash casualties accounted for 34.23% (n = 773) of all admissions to the surgical emergency department of Bouake University Hospital. Krah., *et al*. [2], in Bouake, had found a prevalence of 71.3% of motorcycle crash casualties. This decrease in prevalence may be related to the stabilisation of the political situation, compliance with preventive measures and the resurfacing of the road network. The age group most concerned was 20–39 years (63.0%), with a mean age of 35.5 ± 13.0 years and a male predominance. This age group represents the working population, and their boldness in riding and their irresponsible behaviour predispose them to road traffic crashes. These data are similar to those found in the literature [17,18]. Motorcycle riders accounted for the majority of crash casualties (69.0%). This predominance has also been observed by several authors [9,19,20]. The fact that the rider is the first to be exposed at impact would explain this observation. Moreover, the category of road user, in particular being the rider, was strongly associated with severity (OR = 5.21; p = 0.04).

Although helmet use is an essential protective measure, it remains poorly observed in the various published series [6,12,21]. The absence of helmet use appears to be a major determinant of severity (OR = 7.39; p = 0.02). This result is consistent with the conclusions of the Centers for Disease Control and Prevention (CDC) [22], according to which the helmet reduces the risk of death by 29% and that of traumatic brain injury by 67%. Many African studies also report that the non-use of a helmet is strongly associated with the occurrence of severe head injury [23,24]. Crashes of the motorcycle-against-motorcycle type were the most frequent (32.9%). These results were contrary to those of

Kouassi., *et al*. [19] and Bouhelo-Pam., *et al*. [12], whose studies mainly reported the motorcycle-against-motor-vehicle type, with 38.7% and 28.29%, respectively. The increase in the number of two-wheelers in the road traffic of Bouake and the non-compliance with, or ignorance of, the highway code would explain this. The motorcycle-against-motorcycle type of crash constitutes another significant factor (OR = 11.67; $p < 0.001$). This result confirms that collisions between two motorcycles generate more direct and less protected impacts, resulting in multiple injuries.

Similar observations have been reported [2,22]. Crashes were frequent at the weekend because people go out a great deal at the weekend for leisure activities, with their corollary of alcohol consumption. Crashes occurring at the weekend were also associated with increased severity (OR = 5.56; $p = 0.03$). This observation is in line with the observations of Krah., *et al*. [2] and Camara., *et al*. [23], who demonstrated a relaxation of safety behaviours at weekends, often linked to risk-taking behaviour and to alcohol use. May (10.8%) was the month at highest risk of motorcycle crashes. This month marks the beginning of the rainy season, combined with speed and rider carelessness. It is also the beginning of the school holidays, with their corollary of recreational activities requiring numerous journeys. These data are similar to those of some studies in the literature [20,22].

Injuries of the lower limb (39.3%) and head injuries (32.7%) were the injuries most frequently observed in motorcycle crash victims. These results are consistent with several published studies [2,23]. This predominance is explained by the exposed position of the lower limbs and by the low use of the helmet, a major protective device. These results confirm the importance of preventive measures focused on the systematic wearing of a helmet and on safer behaviour when riding. Soft-tissue wounds (30.1%) and fractures (21.8%) were the most frequently observed types of injury. This could be explained by the fact that motorcycle crashes most often involve direct contact either with the ground or with the machine, or with both, thereby causing wounds, the limbs being without adequate protection. By contrast, in the study by Bouhelo-Pam., *et al*. [12], contusions were the most frequently encountered injuries (30.65%), followed by sprains (23.66%).

Medical treatment was administered to 100% of the casualties, followed by surgical treatment and then by orthopaedic treatment. These treatments depended on the injuries observed [12,23].

Conclusion

Motorcycle crashes are frequent, with a predominance of young male casualties who are riders. The study demonstrates several independent factors associated with the severity of the injuries, in particular the non-use of a helmet, crashes occurring at the weekend, motorcycle-against-motorcycle crashes, being the rider and the presence of multiple injuries. These results underline the particular vulnerability of motorcyclists and the importance of targeted prevention.

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