


Predictors of Mortality in Severe Motorcycle Trauma in Intensive Care Units in the City of Kinshasa

Alex Kalonji^{1,2}, Joseph Nsiala^{1,3}, Wilfrid Mbombo^{1,4*}, Leader Lawanga⁵, Alphonse Mosolo^{1,4}, Jean Pierre Ilunga¹, Eric Amisi¹, Julie Pembe^{1,6}, Jean Jacques Kalongo⁷, Patrick Mukuna^{1,8}, Glenn Ntsambi⁹, Hugues Albini⁹, Luc Mokassa⁹, Médard Bula-Bula¹, Berthe Barhayiga¹

¹Department of Anaesthesia and Intensive Care, University Clinics of Kinshasa, University of Kinshasa, Kinshasa, Democratic Republic of Congo

²Central Military Hospital, Kinshasa, Democratic Republic of Congo

³Department of Anaesthesia and Resuscitation, Evry Private Hospital, Evry, France

⁴Department of Anaesthesia and Intensive Care, Monkole hospital Centre, Kinshasa, Democratic Republic of Congo

⁵National Institute for Biomedical Research, Kinshasa, Democratic Republic of Congo

⁶Department of Anaesthesia and Intensive Care, General Referral Hospital of Kinshasa, Kinshasa, Democratic Republic of Congo

⁷Intensive Care Unit, Biamba Marie Mutombo Hospital, Kinshasa, Democratic Republic of Congo

⁸HJ Hospital, Kinshasa, Democratic Republic of Congo

⁹Department of Surgery, University Clinics of Kinshasa, University of Kinshasa, Kinshasa, Democratic Republic of Congo

Email: kalexkalonji161@gmail.com, mnsiala78@gmail.com, *pwmbombo@yahoo.fr, leader.ontshick@gmail.com, alphonsemosolo@yahoo.fr, drjpilunga@gmail.com, eric.amisi@yahoo.fr, juliepembendjondjo@gmail.com, patrickmukuna@yahoo.fr, nebaglen@gmail.com, hugues.albini@unikin.ac.cd, lucmokassa@gmail.com, drmebula@gmail.com, berthebarhayiga@gmail.com

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Abstract

Context: Severe motorbike trauma is a global public health problem, but has not yet been studied in Kinshasa. This study investigated the mortality of these patients in intensive care and the predictors of this mortality. **Methods:** This cross-sectional study was conducted in the intensive care units of six hospitals in the city of Kinshasa between January 1, 2021 and December 31, 2023. It involved adult patients with severe motorbike trauma whose socio-demographic, clinical and therapeutic data were analysed with SPSS 26.0 using Student's t test, Person's Chi² or Fischer's exact test and logistic regression for p < 0.05. **Results:** We included 238 patients, mean age 34.5 ± 12.3, predominantly male sex ratio 2.3, often married (50%). The victim was often the driver (75%), the mechanism of injury was motorcycle-vehicle collision (31%), motorcycle alone (31%) and motorcycle-motorcycle collision (25%). Admission was secondary in 60% of cases, and the injuries were cranial (40%), osteoarticular (25%), thoracic (20%) and abdominal (15%). The mean physiological



variables on admission were: index severity scale (25), oxygen saturation (92%), systolic blood pressure (120 mmHg), heart rate (95) and respiratory rate (20 cycles per minute), Glasgow coma scale (9 ± 4). Treatment was surgical in 40% of cases. Mortality was 71.8%, with the following predictors: age greater than or equal to 60 years, systolic pressure less than 90mmHg or greater than 140 mmHg, injury severity scale greater than 16 to 24, Glasgow coma scale less than 9/15, and use of vasopressors. **Conclusion:** The mortality rate in this series was very high and was predicted by the victim's advanced age, disturbances in physiological variables on admission and the use of vasopressors.

Keywords

Severe Trauma, Motorbike, Resuscitation, Kinshasa

1. Introduction

Two-wheeled motorcyclists are more likely to die in road traffic accidents. A motorcyclist is 34 times more likely to die and 8 times more likely to be injured than a car driver in a road accident [1]. These accidents are a major cause of death. This is why road safety has become a major and growing public health issue worldwide [2]. The advent of new, powerful and financially more accessible models has been accompanied by an increase in the frequency of accidents and mortality from serious injuries caused by motorbikes around the world, particularly in low-income countries [3]. It should also be noted that motorised two-wheelers are constantly on the increase in most countries, and are currently distributed as follows: 77% in Asia, 14% in Europe, 5% in Latin America, 2% in North America, 1% in the Middle East and 1% in Africa [3]. In the Democratic Republic of Congo, there are currently more than 400,000 motorbikes in the provincial city of Kinshasa alone, according to the number-plate register (provincial ministry of transport). According to the WHO, they are a vulnerable group, accounting along with pedestrians and cyclists for half of all road deaths worldwide. While the risk of death is often highlighted, the risk of serious injury, and often lifelong disability, is also higher. The number of years of life lost or spent in suffering and disability is considerable. In France, for example, the fall in the number of fatalities among car drivers between 2001 and 2005 was 42%, while that for motorcyclists was just 21.8%. The proportion of motorbike users killed increased, even though they accounted for only 1.1% of traffic [4]. A multicentre cohort study using data from the French National Trauma Registry (Trauma Base) from 1 January 2019 to 20 December 2022 found that, of the 5233 two-wheeled trauma victims, 4094, or 78%, were motorcyclists [5]. In Cotonou, Benin, out of a population of 9.8 million, two-wheeled vehicles account for 80% of means of transport, and the incidence of motorbike accidents was 1.77%, with a fatality rate of 5.2% [6]. Motorcyclists accounted for 57% of head injuries treated at Lomé hospital between January 2015 and Decem-

ber 2017 [7]. Motorbikes were involved in 70.3% of cases, and motorcyclists were the victims most often involved (76%) in road traffic injuries seen in the emergency department of a hospital in N'djamena, Chad, between July and December 2020 [8]. In a single-centre study in Senegal, moped accidents accounted for 57.8% of victims, with a mortality rate of 4.6% [9].

In Kinshasa, the increased need to travel in response to society's current problems, such as the cost of petrol, saturation of the road network and the growing need for cheaper means of transport, the use of motorised two-wheelers is constantly on the increase, with over 400,000 motorbikes currently registered according to the provincial Ministry of Transport. In addition to the growing number of motorbikes on the road, it is deplorable to note the failure of motorcyclists to obey the highway code, resulting in a large number of avoidable accidents, some of which are fatal and others serious. However, motorbikes have become an almost indispensable means of transport in certain parts of the city. The renewed interest in the use of motorbikes could be accompanied by a deterioration in accident figures. There is no pre-hospital care in the city of Kinshasa or anywhere else in the Democratic Republic of Congo. Universal health cover has not yet been extended to trauma patients, and local health facilities are not always equipped to deal with serious trauma, which has a very high mortality rate in Kinshasa. Patients have to provide their own medical care, which is often very expensive. Trauma victims are brought to hospital by people of goodwill, sometimes on motorbikes, despite the fact that any injuries they suffer may be more serious. Nsiala has conducted two studies: one in 2014 [10] which found a mortality rate of 90.7% for serious trauma victims. In 2018 [11], after the establishment of a care network that unfortunately was not universally supported, this mortality rate had fallen to 73.3%. However, these studies did not look specifically at severe motorbike trauma patients admitted to intensive care, and to date no study has been devoted to them. We therefore thought it would be useful to carry out this study to determine the mortality of patients with severe motorbike trauma admitted to intensive care units in the city of Kinshasa, and the factors associated with it.

2. Methods

2.1. Type, Period and Scope of the Study

This was a cross-sectional, multicentre study covering the period from 1 January 2021 to 31 December 2023. It was based on the records of severe trauma patients treated in six hospitals in the city of Kinshasa: University Clinics of Kinshasa, General referral Hospital of Kinshasa, Central Military Hospital, Monkole Hospital Centre, Biamba Marie Mutombo Hospital and HJ Hospital.

2.2. Study Population and Sampling

The study population consisted of all patients with severe motorbike trauma admitted to the intensive care units of the hospitals concerned during the study period. Sampling was non-probability based and patient recruitment was exhaustive

and consecutive based on registry.

2.3. Patient Selection Criteria

2.3.1. Inclusion Criteria

All adult patients (aged 18 and over) with serious motorbike trauma (driver, passenger or pedestrian) admitted to the emergency or intensive care units of the hospitals concerned were included in this study.

2.3.2. Exclusion Criteria

Excluded from the study were patients whose records were missing important study variables, non-serious motorbike trauma patients and trauma patients whose accident did not involve a motorbike.

2.4. Data Collection Procedure

The data were collected by the principal investigator and the secondary investigator, as well as by the department's trained physicians. Data were collected retrospectively from patient records and hospital registers. The principal investigator, with the help of the secondary investigators, took a census of all patients involved in road traffic accidents during the study period. The files of all the trauma victims were then consulted. This made it possible to retain the files of patients who had all the parameters of the study, but certain important variables such as alcohol consumption could not be retained because they were absent from many of the files. A data collection form containing all the study variables was drawn up for this purpose. Patients were not followed up until they were discharged from the intensive care unit.

2.5. Study Variables

The variables collected were divided into independent variables (predictors) and dependent variables (vital outcome) and were as follows:

Variable	Type	Description
Period	Qualitative	Period of study (year, month)
Provenance	Categorical	The hospital where the patient was treated
Sex	Binary	Sex of u patient (male/female)
Age	Continuous	Age of patient in years
Level of education	Categorical	The patient's level of education (primary, secondary, higher or university)
Marital status	Categorical	Married, single, divorced or widowed
Victim	Categorical	Driver, passenger or pedestrian
Type of admission	Binary	Primary or secondary
Mechanisms of trauma	Categorical	Type of accident (e.g. motorbike collision, pedestrians knocked down, etc.)
State of consciousness (Glasgow)	Categorical	Glasgow coma scale

Continued

Vital parameters	Continuous	Systolic blood pressure, diastolic blood pressure, heart rate, respiratory rate, peripheral oxygen saturation
ISS (Injury Severity Score)	Continuous	Injury severity score
Pupil examination	Categorical	Normal, reactivity of pupil
Administered treatment	Categorical	Oxygen therapy, mechanical ventilation, transfusion, etc.
Surgical procedure	Categorical	Type of surgical procedure
Dependent variable:		
Variable	Type	Description
Vital issue	Binary	Deceased, survivor

It should be noted that other factors, particularly organisational, hospital equipment and human skills, have not been addressed in this study, although they also influence mortality.

In this work, severe trauma is defined as a patient who has suffered a violent trauma which suggests that such lesions exist. Potential severity is defined by the Vittel criteria (see [Table 1](#)).

Table 1. Vittel Criteria.

Initial patient examination	Glasgow coma scale < 13
	Oxygen saturation < 90%
	Systolic blood pressure < 90 mmHg
Accident circumstances	Victim ejected - thrown - crushed
	Death in accident
	Fall > 6 cm - Explosion - Blast
Pre-hospital management	Assisted ventilation
	Filling > 1000 ml
	Catecholamines
Observed or suspected injuries	Penetrating trauma - Chest flap
	- Pelvic trauma - Limb amputation -
	Acute limb ischaemia - Burns
	- Suspected spinal injury
Patient characteristics	Age > 65 years
	Pregnancy in second or third trimester
	Associated defects

2.6. Statistical Analysis

The data collected were entered into Excel 2019 and then analysed using SPSS 26.0

software. Quantitative variables were described as mean \pm standard deviation or median and extreme values and compared using the student t test or Mann Whitney test. Qualitative variables were presented as frequencies and percentages and compared using Pearson's chi-square test or Fisher's exact test to determine the relationship between the variables. Logistic regression was used to identify predictors of with mortality. The strength of association between significant predictors and mortality was measured by calculating hazard ratio (HR) and their 95% confidence intervals. The significance threshold was set at $p < 0.05$ for all tests.

2.7. Ethical and Regulatory Aspects

The study protocol was approved by the Scientific Committee of the Department of Anaesthesia and Intensive Care of University Kinshasa Clinics. The heads of the hospitals involved in the study had given their agreement by means of the letter of research recommendation drawn up by the head of the department. The study protocol was approved by the Ethics Committee of the School of Public Health under number ESP/CE/21/2025. The study was conducted in accordance with the ethical principles of the Helsinki Convention. We have no conflict of interest in this work.

3. Results

3.1. Patient Flow Diagram

Figure 1 shows the patient flow diagram.

During this period, 450 trauma patient files were retrieved. One hundred and fifty patients had a trauma without motorbike involvement, fifty patients had a mild trauma and 12 had missing data. A total of 238 patients were analysed, broken down as follows by hospital: University Clinics of Kinshasa: 51 patients, General Referral Hospital of Kinshasa: 47 patients, Central Military Hospital: 58 patients, Monkole Hospital Centre: 32 patients, Biamba Marie Mutombo Hospital: 30 patients and HJ Hospital: 20 patients. Of the 238 patients selected, 171 died and 68 survived, giving a mortality rate of 71.8%.

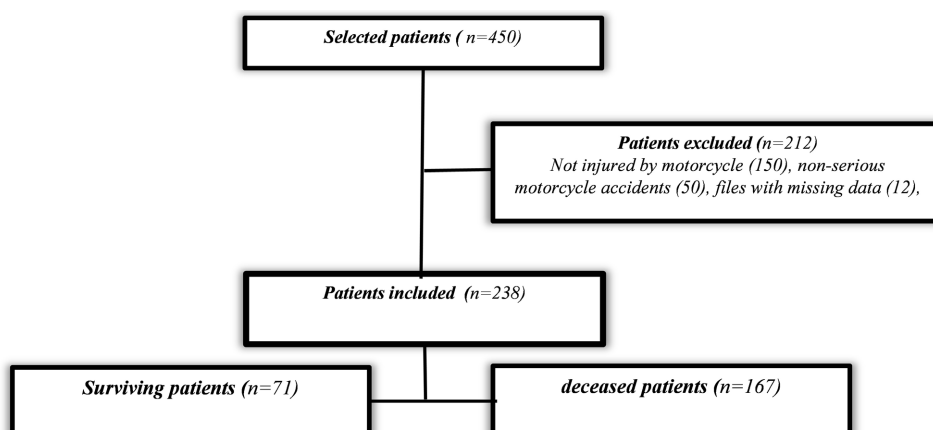


Figure 1. Flow chart.

3.2. Socio-Demographic Characteristics of Patients

Table 2 shows the socio-demographic characteristics of the patients.

The average age of patients was 34.5 years, with a standard deviation of 12.3 and extremes ranging from 18 to 79 years. The majority of patients were aged between 18 and 59 (67.4%) and 32.6% were 60 or over. Males predominated, with 63% of patients compared with 37% of females, with a M/F sex ratio of 2.3. The majority of participants had secondary education (39.6%), 24.3% of patients had tertiary or university education, 18.9% had no education and 16.7% had primary education. The majority (50%) of participants were married, 35.4% were single, 10.4% were divorced and 4.2% were widowed.

Table 2. Socio-demographic variables.

Variable	Frequency (%)
Age (mean and standar deviation)	34.5 ± 12.3
Age range	
18 - 59 years	158 (67.4)
60 years and over	80 (33.6)
Sex	
Male	150 (63.0%)
Female	88 (37.0%)
Level of education	
None	45 (18.9%)
Primary	40 (16.7%)
Secondary	95 (39.6%)
High and university	58 (24.3%)
Marital status	
Single	85 (35.4%)
Married	120 (50.0%)
Divorced	25 (10.4%)
Widowed	8 (4.2%)

3.3. Accident-Related Characteristics

Table 3 presents the accident-related characteristics.

There was an almost equal distribution between those who wore a helmet (50.6%) and those who did not (49.6%). The vast majority of victims were motorcycle drivers (75%), or 180 patients. Passengers accounted for 21% of the victims, or 50 patients. Pedestrians numbered eight, or 4%. The accident mechanism was: motorcycle-vehicle collision in 75 cases, or 31.3%, motorcycle alone in 75 cases, or 31.3%, motorcycle-on-motorcycle collision in 60 cases, or 25%, and pedestrian hit by a motorcycle in 10 cases, or 4.2%.

Table 3. Accident characteristics.

Variables	Frequency (%)
Wearing a helmet	
Yes	120 (50.4)
No	118 (49.6)
Victim	
Driver	180 (75.0%)
Passenger	50 (21.0%)
Pedestrian	8 (4.0%)
Mechanism od accident	
Collision motorcycle-motorcycle	60 (25.0%)
Pedestrian hit by motorcycle	10 (4.2%)
Collision motorcycle-vehicle	75 (31.3%)
Motorcycle alone	75 (31.3%)

3.4. Clinical Characteristics at Admission and Anatomical Injuries

Table 4 presents the clinical characteristics at admission and the anatomical injuries.

Table 4. Clinical characteristics at admission and anatomical injuries.

Variables	Mean ± Standar-deviation	Extreme values (Min-Max)
Heart rate	95 ± 18 beats per minute	60 - 130 bpm
Respiratory rate	20 ± 5 cycles per minute	10 - 30 cpm
Systolic blood pressure	120 ± 18 mmHg	90 - 160 mmHg
Diastolic blood pressure	80 ± 12 mmHg	60 - 110 mmHg
Oxygen saturation	92% ± 5%	80% - 98%
ISS	25 ± 10	6 - 27
Glasgow coma scale	9 ± 4	3 - 15
Pupil abnormalities (mydriasis)	48 (20%)	
Type of trauma		n (%)
Cranioencephalic trauma		95 (40)
Thoracic trauma		48 (20)
Abdominal trauma		36 (15)
Osteoarticular trauma		59 (25)
Several lesions		99 (42)
Admission type		
Primary		95 (40)
Secondary		143 (60)

The majority of victims: 143, or 60%, were admitted through secondary admission, meaning they passed through a healthcare facility before arriving at the centres where they should be treated. Only 95 patients, or 40%, were admitted through primary admission, meaning they went directly to the centres where they should be treated without passing through other healthcare facilities. Cranioencephalic trauma was the most common type of injury, affecting 95 patients (40%), thoracic trauma affected 48 patients (20%), abdominal trauma affected 36 patients (15%), and osteoarticular trauma affected 59 patients (25%). Four out of ten patients had multiple injuries. The mean heart rate was relatively high, at 95 ± 18 with a range of 60 to 130 beats per minute. The mean respiratory rate was 20 ± 5 with a range of 10 to 30 cycles per minute. The mean systolic blood pressure was 120 ± 18 mmHg with a range of 90 to 160 mmHg. The mean diastolic blood pressure was 80 ± 12 mmHg with a range of 60 to 110 mmHg. The mean peripheral oxygen saturation was $92\% \pm 5\%$ with a range of 80 to 98%. The mean ISS (Injury Severity Scale) score was 25 ± 10 with a range of 6 to 27. The mean Glasgow Coma Scale score was 9 out of 15 with a range of 3 to 15 out of 15.

3.5. Therapeutic Measures Implemented

Table 5 presents the therapeutic measures implemented.

The medical treatment administered consisted of: crystalloid fluid replacement in 166 patients (70%), vasopressor administration (norepinephrine) in 107 cases (45%), tranexamic acid administration in 71 cases (30%), and mannitol administration in 48 cases (48%).

Surgical treatment affected 95 patients (40%) and consisted of: surgical debridement in 24 cases (25%), laparotomy in 29 cases (30%), chest drainage in 19 cases (20%), pelvic compression in 14 cases (15%), and limb restraint in 9 cases (10%).

Table 5. Therapeutic measures implemented.

Variables	Frequency n = 238	%
Traitement medical		
Cristalloid	166	70
Vasopressor	107	45
Tranexamic acid	71	30
Tracheal intubation and ventilation	71	30
Mannitol	48	20
Surgical procedure	n = 95	40
Surgical trimming	24	25
Laparotomy	29	30
Chest drainage	19	20
Pelvic compression	14	15
Other interventions	9	10

3.6. Predictors of Mortality

3.6.1. Predictors of Mortality in Bivariate Analysis

Table 6(a) and **Table 6(b)** presents the predictors of mortality in bivariate analysis.

The mean age of deceased patients (35.2 ± 12.5 years) was slightly higher than that of survivors (32.4 ± 11.6 years), but the difference was not statistically significant ($p = 0.08$).

Deaths were significantly higher ($p < 0.001$) among patients aged 60 years and older (88.7% of deaths in this age group) compared to those in the 18 - 59 age group (63.7% of patients in this age group).

The distribution of men and women in the deceased and survivor groups was not significantly different ($p = 0.60$). The level of education did not show a statistically significant difference between the groups of deceased and survivors ($p = 0.15$). Similarly, marital status had no influence on mortality ($p = 0.4$). There was a slight difference between the groups of deceased and survivors regarding the type of admission, with a relatively higher mortality rate for secondary admission among survivors (62.7%).

Although the majority of patients were drivers (73.1% of deceased, 82.1% of survivors), the differences between the groups were not statistically significant ($p = 0.08$).

There was a significant difference between the accident mechanisms ($p = 0.03$), with higher mortality in motorcycle-vehicle and motorcycle-motorcycle accidents.

There was a trend toward higher mortality in cases of head trauma and osteo-articular trauma, with no significant difference ($p = 0.10$).

Table 6(a). Bivariate analysis of independent variables and vital outcome.

Variables	Death (n = 171)	Alive (n = 67)	Statistical test	p-value
Age (Mean \pm standar deviation)	35.2 \pm 12.5	32.4 \pm 11.6	t Student test	0.08
Age range			Chi-square test	
18 - 59 years	100 (63.2%)	58 (36.7%)		<0.001
60 years and over	71 (88.7%)	9 (11.25%)		
Sex			Chi-square test	0.60
Male	110 (73.3%)	40 (26.7%)		
Female	40 (45.45%)	48 (54.55%)		
Level of education			Chi-square test	0.15
None	30 (17.6%)	15 (22.4%)		
Primary	25 (14.6%)	15 (22.4%)		
Secondary	70 (40.9%)	25 (37.3%)		
High and university	46 (26.9%)	12 (17.9%)		
Marital status			Chi-square test	0.40
Single	55 (32.2%)	30 (44.8%)		
Married	90 (52.6%)	30 (44.8%)		

Continued

Divorced	15 (8.8%)	10 (14.%)		
Widowed	7 (4.1%)	1 (1.5%)		
Admission type			Chi-square test	0.05
Primary	70 (40.9%)	25 (37.3%)		
Secondary	101 (59.1%)	42 (62.7%)		
Victim			Chi-square test	0.08
Driver	125 (73.1%)	55 (82.1%)		
Passenger	40 (23.4%)	10 (14.9%)		
Pedestrian	6 (3.5%)	2 (3.0%)		
Mechanism of accident			Chi-square test	0.03
Collision motorcycle-motorcycle	45 (26.3%)	15 (22.4%)		
Pedestrian hit by motorcycle	8 (4.7%)	2 (3.0%)		
Collision motorcycle-vehicle	55 (32.2%)	20 (29.9%)		
Motorcycle alone	55 (32.2%)	15 (22.4%)		
Type if trauma			T Chi-square test	0.10
Cranioencephalic trauma	70 (40.9%)	25 (37.3%)		
Thoracic trauma	40 (23.4%)	8 (11.9%)		
Abdominal trauma	30 (17.6%)	6 (8.9%)		
Osteoarticular trauma	31 (18.1%)	28 (41.8%)		

Bradypnea (respiratory rate less than 12 breaths per minute) is associated with higher mortality ($p = 0.04$).

Bradycardia (heart rate less than 60 beats per minute) and tachycardia (heart rate greater than 100 beats per minute) are associated with higher mortality ($p = 0.03$).

Systolic hypotension (Systolic blood pressure < 90 mmHg) is associated with significant mortality ($p = 0.02$); however, diastolic blood pressure has no impact on mortality ($p = 0.05$).

Oxygen saturation is strongly associated with mortality ($p < 0.001$). Patients with an SpO₂ less than 94% have a high mortality rate. A low Glasgow Coma Scale (< 9) is associated with a high mortality rate ($p < 0.001$).

The injury severity scale also shows a strong association with mortality ($p < 0.001$), with patients with an SII greater than 24 having a high mortality rate.

The use of vasopressors, the use of tranexamic acid, and the need for surgery showed a significant association with mortality ($p = 0.04$, $p = 0.02$, $p = 0.05$). However, the type of surgery performed had no influence on mortality ($p > 0.05$).

However, the use of crystalloids, mannitol, and chest drainage did not show a significant difference ($p > 0.005$).

Table 6(b). Bivariate analysis of variables and vital outcome (Continued).

Variables	Death (n = 171)	Alive (n = 67)	Statistical test	p-value
Heart rate				0.003
<60 beats per minute	15 (8.8%)	2 (3.0%)		
60 - 100 beats per minute	122 (71.3%)	50 (74.6%)		
>100 beats per minute	34 (19.9%)	15 (22.4%)		
Systolic blood pressure (mmHg)			Chi-square test	
<80	15 (8.8%)	2 (3.0%)		0.02
80 - 140	127 (74.3%)	51 (76.1%)		
>140	29 (16.9%)	14 (20.9%)		
Diastolic blood pressure (mmHg)			Chi-square test	
<60	13 (7.6%)	3 (4.5%)		0.05
60 - 90	127 (74.3%)	48 (71.6%)		
>90	31 (18.1%)	16 (23.9%)		
Respiratory rate				
<12 (bradypnea)	18(10.5%)	15(22.4%)		0.04
12 - 20 (Normal)	80(46.8%)	40(59.7%)		
>20 (tachypnea)	73(42.7%)	12(17.9%)		
Oxygen saturation (O₂ %)			Chi-square test	<0.001
<94	99 (57.9%)	3 (4.5%)		
>94	72 (42.1%)	64 (95.5%)		
Injury severity scale (ISS)			Chi-square test	<0.001
10 - 15	38 (22.2%)	34 (50.7%)		
16 - 24	81 (47.4%)	18 (26.9%)		
>24	52 (30.4%)	15 (22.4%)		
Glasgow coma scale			Chi-square test	<0.001
<9	128 (74.9%)	10 (14.9%)		
9 - 12	30 (17.6%)	17 (25.4%)		
13 - 15	13 (7.6%)	40 (59.7%)		
Treatment				
Cristalloid	120 (70.2%)	46 (68.7%)	Chi-square test	0.78
Vasopressors	85 (49.7%)	22 (32.8%)	Chi-square test	0.04
Tranexamic acid	60 (35.1%)	11 (16.4%)	Chi-square test	0.02
Mannitol	40 (23.4%)	8 (11.9%)	Chi-square test	0.10
Surgical procedure	75 (43.9%)	20 (29.9%)	Chi-square test	0.05
Type of surgical procedure				
Surgical trimming	20 (11.7%)	4 (6.0%)	Chi-square test	0.32
Laparotomy	25 (14.6%)	4 (6.0%)	Chi-square test	0.12
Chest drainage	20 (11.7%)	5 (7.5%)	Chi-square test	0.32
Pelvic compression	10 (5.9%)	4 (6.0%)	Chi-square test	0.95

3.6.2. Predictors of Mortality in Logistic Regression

Table 7 presents the predictors of mortality using logistic regression.

People aged 60 and over are 4.5 times more likely to die than younger patients ($p = 0.001$).

Peripheral oxygen saturation above 94% is a protective factor (HRA: 0.13 [0.07 - 0.025] ($p < 0.001$)).

A higher ISS (International Severity Score) multiplies the risk of death by a factor of 2.71 ($p < 0.003$).

A Glasgow Coma Scale score below 9 multiplies the risk of mortality by a factor of 12.2 ($p < 0.001$). Systolic blood pressure below 80 mmHg is associated with a 7.39-fold increased risk of death ($p = 0.02$). Systolic blood pressure above 104 mmHg increases the risk of mortality by a factor of 6.05 ($p = 0.03$).

Vasopressor use is a predictor of mortality, increasing the risk of death by a factor of 2.34 ($p = 0.033$).

Tranexamic acid use, diastolic blood pressure, heart rate, and primary or secondary admission type had no influence on mortality ($p > 0.05$).

Table 7. Predictors of mortality in logistic regression.

Variables	Coefficient (β)	Standard error	p-value	Odds Ratio (HR)	Confidence interval (CI 95%)
Constants	2.15	0.75	0.004	-	-
Range age 60 years and over	1.50	0.45	0.001	4.50	[2.50 - 8.10]
Oxygen saturation < 94%	-2.00	0.45	<0.001	0.13	[0.07 - 0.25]
Injury severity scale 16 - 24	1.00	0.35	0.003	2.71	[1.35 - 5.46]
Glasgow coma scale < 9	2.50	0.60	<0.001	12.20	[5.60 - 26.45]
Use of vasopressor	0.85	0.40	0.033	2.34	[1.06 - 5.14]
Use of tranexamic acid	-0.20	0.29	0.49	0.82	[0.47 - 1.43]
Heart rate < 60beats per minute (bmp)	0.60	0.75	0.20	1.82	[0.45 - 7.42]
Heart rate between 60 - 100 bpm	-	-	-	-	-
Heart rate > 100beats per minute	0.45	0.65	0.49	1.57	[0.39 - 6.26]
Systolic blood pressure < 90 mmHg	2.00	0.80	0.02	7.39	[1.70 - 31.60]
Systolic blood pressure 80 - 140 mmHg	-	-	-	-	-
Systolic blood pressure > 140 mmHg	1.80	0.85	0.03	6.05	[1.15 - 31.98]
Diastolic blood pressure 60 - 80 mmHg	-	-	-	-	-
Diastolic blood pressure < 60 mmHg	1.20	0.90	0.18	3.32	[0.45 - 25.24]
Diastolic blood pressure > 80 mmHg	0.70	0.60	0.28	2.02	[0.55 - 7.45]

4. Discussion

This study was conducted to determine the mortality rate of severe motorcycle

trauma patients, and it is very high in this series, at 71.8%. Analysis of the data collected in this study on severe trauma patients admitted to six care centres between 2021 and 2023 reveals several factors influencing patient prognosis, including age, head injury, oxygen saturation, ISS, and Glasgow Coma Scale (GCS).

Severe motorcycle trauma affects young patients, as noted by others [6], therefore of an economically productive age, male [6] [12], and often married, thus responsible for families, and unfortunately, they will die seven times out of ten. This high mortality rate can also be explained by the fact that there is no pre-hospital care, with patients being taken to any health facility, sometimes with no equipment or skills at all for these types of patients. As a result, the majority of patients arrived at the hospitals concerned after having passed through a small outlying centre—a factor that increases mortality. It should be pointed out that the current government has introduced universal health cover, a major innovation, but it does not yet cover trauma victims and is limited to pregnant women. What's more, there is no level one trauma centre in Kinshasa. The Brazilian study [13] also found a male predominance, with a mean age of 31 years, corroborating the results of this study. This reflects the seriousness of this problem and its economic consequences for the country. Indeed, not only is the care of severely injured people very expensive for families, but also the victims are those who work to feed their families, and the fact that they are sick is doubly detrimental for them, for the family and for society. And we have not followed the distant future of survivors in terms of after-effects which are often serious. In the literature review published by Chamaphom [14], the trauma, whether mild, serious or fatal, concerned more young people under 30 years of age than those over 50 years of age. In the Madougou study [6], the injury mechanism was often a motorcycle-on-motorcycle collision as in our study and head and lower limb injuries were as frequent as in our study. Rearderson in Tanzania [15] also noted that the accident mechanism was a motorcycle-on-motorcycle collision in 35%, a figure close to our results (40%). Other authors have reported the predominance of motorcycle versus vehicle collisions, reflecting the diversity of mechanisms predominating according to the studies. A Kenyan study [16] found that victims were often unmarried, unlike our results, with 50% of married people suggesting that motorcyclists in our context are responsible for families who struggle to feed their families.

The mortality rate in this series is the highest of all the series in the literature; 5.2% in Benin [6], 4.6% in Senegal [9], 5.2% in the James study [5]. However, it should be emphasized that their studies involved all trauma patients, while ours only focused on severe trauma patients. Thus, 4 out of ten patients had several injuries, reflecting the severity of the trauma, just as the Guinean study also found that 43% of patients had at least two injuries [17]. Authors have reported higher mortality among helmet wearers, 0% to 2.8%, compared to 10 to 14.8% among non-helmet wearers [18]. In the Ethiopian study [19], the victims were the driver in 42%, the pedestrian in 35.5% and the passenger in 25%, corroborating the re-

sults of our study for the predominance of the driver, but the passenger was often the victim in our series because the motorcycle is used essentially as a means of transport and the driver is therefore always accompanied by passengers. Cranioencephalic lesions predominated in this study, unlike the Brazilian study, which accounted for only 3% of the cases. This difference was likely due to the sample size of 62 patients [13]. However, other studies [20] [21] have found a predominance of cranioencephalic lesions, consistent with the results of our study. Wade's study [9], which examined all types of trauma, found a predominance of skin lesions and fractures of the lower and upper limbs. The victims were mainly drivers (56%), as in our study.

High ISS, low Glasgow Coma Scale (GCS), and poor cardiorespiratory parameters at admission were factors or predictors of death, as Boniface [22] reported that the severity of the lesions was an independent factor in mortality. Hypotension and hypoxia are major secondary cerebral disorders of systemic origin increasing the mortality of traumatic brain injuries which occupied an important place in this series. This observation is justified by the fact that injuries affecting the brain, the circulatory system and the respiratory system directly endanger life. The use of vasopressors, which appears to predict mortality, is in fact a marker of severity, as they are used to treat arterial hypotension or shock. Thus, in the study of Doléagbénu [7], out of 321 patients who suffered cranioencephalic trauma, 181 involved motorcycles. This shows the severity and frequency of motorcycle injuries. In this Togolese series [7], a Glasgow score of less than 9/15 was associated with mortality, corroborating the results of our study. The analysis shows that patients aged 60 and over have a higher risk of mortality, confirming its pejorative role. Other studies, notably that of Boniface [22] carried out in Tanzania, found that mortality concerned the age group of 18 to 40 years. The difference would come from the way in which the age grouping was carried out. The absence of helmets in half of our patients did not paradoxically influence mortality in our series, probably because of the size of the sample.

Indeed, the literature review conducted by Konlan [23] on road traffic accidents in Africa found that not wearing a helmet was significantly associated with mortality ($p = 0.007$). 78% of victims did not wear helmets in the Iamtrakul study [12], results close to those of our study. A typical literature review study conducted in Bogota [24] showed that male gender, married status, high level of education and driving one's own motorcycle were factors associated with wearing a helmet; age had no influence. However, this factor (wearing a helmet) did not emerge as a predictor of mortality in this study, probably because of the sample size. However, in the city of Kinshasa, only the driver wears a helmet and never the passenger. In the Thai study [12], motorcycle accidents, which accounted for 93% of all accidents, were more frequent at night than during the day, a parameter that was not used in our study. Similarly, alcohol consumption, which was present in 33% of accidents in the Thai study, was not used in our study due to the weakness of retrospective studies relying on information found in the files.

In the Guinean study [17], age, sex, and victim category were not predictors of mortality as in our study, except for age, while a low Glasgow Coma Scale score was, corroborating our results. Lack of helmet use, alcohol consumption, driver experience, excessive speed and poor road conditions are risk factors for motorcycle accidents known in the literature but which could not be analysed this study due to the retrospective nature [25]-[27]. However, not wearing a helmet (half in this study), poor road conditions, alcohol consumption and excessive speed are common occurrences in our environment. Our results are similar to those found by Sawadogo [28] Ouagadougou with his MGAP (Mechanism, Glasgow coma scale, Age, arterial Pressure) score is reliable in predicting the mortality of serious injuries.

Limitations and Strengths of the Study

Although this study provides valuable insights into the predictors of mortality in patients with severe motorcycle trauma, it has certain limitations:

Selection bias: The study was conducted on a specific hospital population, which may limit the generalizability of the results to the entire trauma patient population.

Missing data: Missing data in some records may have limited the complete analysis of all potential variables, potentially introducing confounding bias.

Retrospective design: Due to the retrospective design of the study, it is difficult to determine the exact causal impact of certain variables, which limits conclusions regarding causality.

Nevertheless, it retains the strength of being the first study specifically focused on severe motorcycle trauma patients and confirms that this problem is a major public health issue in our city.

5. Conclusions

This study confirmed that severe motorcycle trauma primarily affects young people, with a high mortality rate. The predictors or factors associated with mortality are those described in the literature and linked to the severity of the injury: a low Glasgow Coma Scale (GCS), low blood pressure, low systolic pressure, and low oxygen saturation upon admission, as well as a high ISS.

A prospective study including all major hospitals that receive trauma patients seems necessary to draw generalizable conclusions for the entire city of Kinshasa.

Author Contributions

Alex Kalonji: Study design, data collection, and manuscript writing.

Wilfrid Mbombo: Study design, data collection, and manuscript writing.

Joseph Nsiala: Study design and manuscript writing.

Alhonse Mosolo: data collection and manuscript reading.

Leader Lawanga: Statistical analyses.

All other authors: Manuscript reading.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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