

## Mortality by Traffic Accident in Mahajanga, Concerned and Predisposing Factors

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### Abstract

Road accidents currently represent one of the most serious problems for the community on a national and global scale. They are the leading cause of death for children and young people aged 5 to 29, and the number of road deaths continues to rise.

This is a cross-sectional study carried out in Mahajanga over a period of 2 years, during the years 2016 and 2017. The aim is to identify the deceased victims, and determine the factors favoring fatal road accidents in the Boeny region. Of 1209 victims of traffic accidents during this period, 69 had died, with a mortality rate of 5, 70%. They had an average age of 29.49 years, predominantly male (78.2%). Pedestrians (n = 33; 47.82%) and motorcyclists (n = 17; 24.63%) were the most affected. Most accidents occurred in built-up areas (63.8%), but those outside built-up areas were the most serious. In 98.55% of cases, these accidents were related to human factors, occurring during the day between 6 a.m. and 5 p.m. (60.8%). The vehicle- pedestrian (43.48%) and vehicle-vehicle (21.74%) type collision were the most encountered mechanism, involving mainly motorcycle (31.88%), minibus (23.19%) and off-road cars (20.29%). In 40.6% of the cases, the victims died on the spot, 18.8% during their transport to the hospital, and 40.6% after their arrival at the hospital. The lesions that caused these deaths were dominated by severe polytrauma (88.4%) and severe head trauma (31.8%).

The education of road users, the establishment of a good road safety policy and the adoption of responsible behavior with strict respect for the highway code among vehicle drivers will help to reduce this scourge.

**Keywords:** Mortality; Road Accident; Developing Countries; Urban Environment; Contributing Factors; Road Safety

### Introduction

In 2017, road accidents were the ninth leading cause of death worldwide, all age groups combined, responsible for 1.2 million fatalities and non-fatal injuries affecting up to 50 million people. The World Health Organization aimed to reduce the number of road deaths and injuries by 50% by the end of 2020 [1]. This is a real public health problem.

The new report of the World Health Organization (WHO) in 2018 indicates that the number of road deaths continues to increase and reaches 1.35 million per year, thus constituting the main cause of death among children and young people. young people aged 5 to 29 [2]. The risk of dying in a road accident remains three times higher in low-income countries compared to high-income ones. Worldwide, pedestrians and cyclists account for 26% of people killed on the roads, a proportion that reaches 44% in Africa and 36% in

the Eastern Mediterranean [2]. According to World Bank data, the average mortality rate of 26.69 deaths per 100,000 inhabitants related to road accidents is the highest in Africa.

In Madagascar, this rate is 29.2 per 100,000 inhabitants [3]. Mahajanga, a coastal town of 244,000 inhabitants in the North-West of Madagascar, is a favorite destination for vacationers, especially by land [4]. It is subdivided into four regions (Boeny, Melaky, Sofia, Betsiboka) [5]. Road accidents sometimes cause several victims and account for many deaths [6,7]. This study aims to identify the deceased victims, and determine the circumstances of occurrence, of road accidents in the Boeny region between 2016 and 2017.

**Methodology**

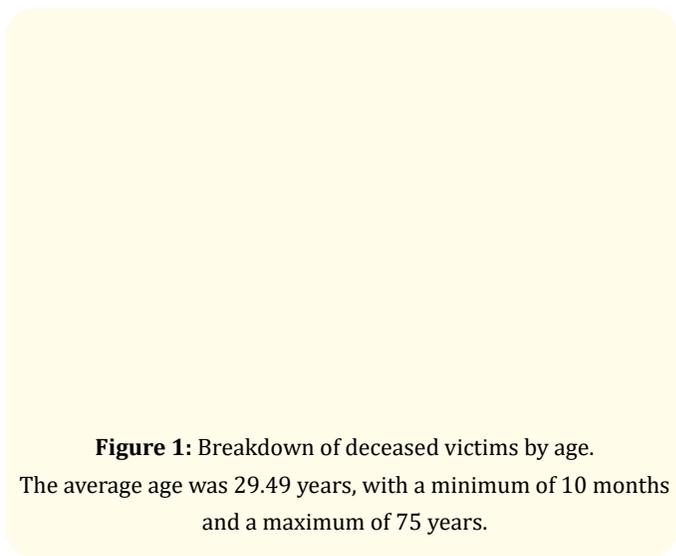
We carried out a retrospective, descriptive and cross-sectional study of 2 years, during the years 2016 and 2017. The data were collected from the documents of the Emergency Department of the University Hospital Professor Zafisaona Gabriel (CHU PZAGA) Mahajanga, of the Municipal Office of Hygiene (BMH) of Mahajanga and the Road Safety Brigade of the Boeny Region on the axis of national road number 4. All victims of traffic accidents recorded in the Boeny Region, in urban areas and outside agglomeration constituted our study population. The inclusion criteria were: victims who died as a result of traffic accidents identified at the CHU PZAGA Mahajanga, at the BMH and at the Road Safety Brigade of the Boeny Region during this period, without distinction of age, type, place or manner of occurrence of death. Deceased cases with unusable records were excluded. Text and graphics were entered and produced using Microsoft Office Word and Excel 2016 software. For data processing and statistical analysis, we used SPSS® version 25.0 software. The results were represented in absolute value and in percentage. Pearson’s Chi-square test was used to test the correlation with a significance level (p value) of less than 0.05.

**Results**

During our study period from 2016 to 2017, we recorded 711 traffic accidents, of which 62 were fatal, i.e. 8.72% of accidents.

**Profile of deceased victims**

The total number of victims was 1,209, of whom 69 died, or 5.70%. According to gender, the death concerned 15 women (21.70%) and 54 men (78.20%), sex ratio of 3.6.



**Place of occurrence of the accidents**

Fatal accidents occurred in built-up areas for 44 victims (63.80%) and outside built-up areas for 25 victims (36.20%).

	In urban areas Number (%)	Extra urban areas Number (%)	Total
Pedestrian	27 (61,36)	6 (24)	33
Motorcyclist	14 (31,82)	3 (12)	17
Passenger	3 (6,82)	9 (36)	12
Driver	0	7 (28)	7
Total	44 (100)	25 (100)	69

**Table 1:** Distribution of deceased victims according to the place of occurrence of the fatal accident P = 0,001.

**Accident occurrence times**

	In urban areas Number (%)	Extra urban areas Number (%)	Total
[6 à 12 h ]	7 (15,91)	14 (56)	21
[12 à 18 h ]	17 (38,69)	4 (16)	21
[18 à 00 h ]	12 (29,27)	3 (12)	15
[00 à 6 h ]	8 (18,18)	4 (16)	12
Total	44 (100)	25 (100)	69

**Table 2:** Correlation between times and place of occurrence of fatal accidents P = 0,005.

**Direct and indirect causes of accidents**

	In urban areas Number (%)	Extra urban areas Number (%)
Speeding	13 (29,55)	12 (48)
Driving while intoxicated	13 (29,55)	0 (0)
Pedestrian drunkenness	3 (6,82)	0 (0)
Driver inattention	5 (11,36)	9 (36)
Carelessness of road users	9 (20,45)	2 (8)
Technical failure	0 (0)	2 (8)
Infrastructure	1 (2,27)	0 (0)
Total	44 (100)	25 (100)

**Table 3:** Correlation between causes and place of occurrence of fatal accidents P = 0,038.

	Number	Percentage (%)
Pedestrian-vehicle*	30	43,48%
Vehicle-vehicle	16	3,19
Vehicle-Obstacle	17	24,64
Fall into the void	5	7,25
Rolled over	1	1,45
Total	69	100,0

**Table 4:** Mechanisms of the fatal accident.

Pedestrian-vehicle\*= car-pedestrian, motorcycle-pedestrian, TucTuc-pedestrian.

	Number	Percentage (%)
Moto	22	31,88
Minibus	16	23,19
Car 4x4	14	20,29
TruckCamion	10	14,49
Light vehicle	8	11,59
Taxi-TucTuc	7	10,14
Bus	2	2,90
Ox cart	1	1,44

**Table 5:** Breakdown by type of vehicle involved.

**First aid to victims**

Of the 69 deceased victims, 28 died at the scene of the accident, compared to 44 transported to a care center.

	Number	Percentage (%)
Polytrauma		
Trauma (cranial + abdominal + limbs)	61	88,40
Trauma (cranial + maxillofacial)	39	
Trauma (cranial + thoracic)	21	
	1	
Lower limb trauma	3	4,3
Abdominal trauma	2	2,9
Upper limb trauma	2	2,9
Chest trauma	1	1,5
Total	69	100,0

**Table 6:** Distribution according to the injuries observed on the victims.

	Number	Percentage (%)
Taxi Tuc-tuc	21	51,22
Particular vehicle	6	14,64
Public transport vehicle (mini-bus, bus, Taxi-brousse)	14	34,14
Total	41	100,0

**Table 7:** Means used for the transport of the 41 victims out of 69 (28 deaths on the spot).

	In urban areas Number (%)	Extra urban areas Number (%)
On the spot	15 (34,1)	13 (52)
On the road to the hospital	7 (15,9)	6 (24)
Less than 24 hours after arrival at the hospital	12 (27,3)	2 (8)
During hospitalization (24 hours and more)	10 (22,7)	4 (16)
Total	44 (100)	25 (100)

**Table 8:** Correlation between death and place of accident P = 0,002.

## Discussion

### Overall frequency of death by traffic accident

In our study, over the two years, we identified 711 traffic accidents, of which 62 were fatal (8.72%). The total number of victims was 1209 of which 69 died, or 5.70%.

In 2015, the WHO report indicated that 79 countries saw a decline in the absolute number of road traffic casualties and 68 countries saw an increase. If some countries have been particularly successful in reducing the number of road deaths, it is because they have improved their legislation and its enforcement and made roads and vehicles safer. "Traffic accidents cause unacceptable damage - especially among poor people in poor countries" explained then Dr Margaret Chan, Director-General of the WHO [8].

Our result with the frequency of 5.70%, recalls the overall rate of mortality by traffic accident of 29.2 per 100,000 inhabitants in Madagascar [3]. In reality, low- and middle-income countries pay the heaviest price, in which 90% of road traffic deaths occur despite having only 54% of the vehicles on the road worldwide [8]. An Algerian study in 2012 found 27,728 victims of traffic accidents in the Eastern Region, of which 1,676 had died, i.e. 6.04% [9]. In 2017, in Ghana, 35% of all injury related collisions were fatal [10]. Indeed, a systematic review of African studies reports this African particularity of high death frequency in traffic accidents [11].

### Profile of victims

The age range of 15 to 35 years constituted half ( $n = 35$ ; 50.72%) of the deceased victims; the average age was 29.49 years and the extremes of 10 months and 75 years. Children under fifteen ( $n = 13$ ; 18.84%) and elderly subjects ( $n = 3$ ; 4.34%) were also collected among those killed. A clear male predominance was observed [15 women (21.70%) against 54 men (78.20%)], revealing a sex ratio of 3.6. They were mainly pedestrians ( $n = 33$ ; 47.82%) and motorcyclists ( $n = 17$ ; 24.63%).

In Mahajanga, in 2013 for example, among 5412 live births, 18.6% (i.e. 1005 births) were from single mothers [12]. Thus, from adolescence, human contact and consequently the use of roads and means of transport increase. This situation constitutes daily exposure in a population with a high proportion of young people, as in several developing countries. And entry into the professional environment is done very early in order to meet family needs, so pedestrians are the most exposed.

A study of road fatality prevention shows that pedestrian injuries cause 23% of road traffic collision mortality worldwide. Forty five percent of these deaths occur in low-income countries compared with 29% and 18% in middle-and high-income countries [13]. In Ghana, pedestrians were 3 times more likely to die compared with drivers/riders. Though males were 6 times more likely to die than females overall, females were more likely to die as pedestrians (90% of all female casualty deaths) and males were more likely to die as riders/drivers (78% of all male casualty deaths). Children under 10 years and those aged 60 years and above were independently 2 times more likely to die in traffic collisions [10].

In a study at Bangui University Hospital, 94 deaths were recorded out of a total of 1173 patients admitted, i.e. a mortality rate of 8%. Among these deaths, they found 83 men (88.3%) and 11 women (11.7%). The average age of the victims was 36.7 years ( $\pm 3$ ). The youngest was 15 and the oldest was 63. The most affected age groups were those from 15 to 29 years (38.3%) and 30 to 44 years (36.2%) [14].

According to the WHO, road accidents are the leading cause of death for children and young people between the ages of five and 29. From a young age, men are more likely than women to be involved in a road accident. Almost three-quarters (73%) of traffic fatalities are men under 25, who are almost three times more likely to be killed in a car accident than young women [8]. Several studies, from developed and developing countries, agree on the fact that children and young people, pedestrians and men are most at risk of being killed in a traffic accident [15-18].

### Place of occurrence of the accidents

In our study, accidents occurred in the city in the majority of cases with 63.8%, against 36.2% of cases outside urban areas.

The same is true in Ivory Coast, the majority of accidents (i.e. 93.4%) occurred in urban areas with 2/3 of cases in Abidjan [19]. Indeed, according to the literature, the majority of traffic accidents occur in urban areas due to the high density of urban road traffic in relation to the growing increase in the car fleet and the proliferation of high-speed vehicles [20].

In the Rhône, France, for the period 2012 to 2016, nearly half of the deaths occurred in urban areas. Nevertheless, even if they are less numerous, fatal accidents outside built-up areas are often more serious [21].

In Mahajanga this is probably related to excessive speed on poor roads, not suitable for high speeds, associated with overloading conditions of poorly maintained vehicles. In short, half of traffic accidents outside urban areas were fatal immediately (13/25; 52%), compared to 15/44 (34.1%) in urban areas. We found a significant association between severity and location of the accident ( $p = 0.002$ ) (Table 8).

In France, the Institute for the Study of Road Accidents in 2012 [18] and the National Interministerial Observatory for Road Safety in 2018 [22], report the vast majority, respectively 76.07% and 71%, of fatal accidents in non-conurbation areas, while the hospitalized injured were mainly found in conurbation.

### Accident occurrence times

Here, more than half of traffic accidents occurred during the day, between 6 a.m. and 5 p.m., with a rate of 60.8%. These results could be explained by the fact that the time slot, 6 a.m. to 5 p.m., corresponds to the period when all activities are at their maximum and moving from one service to another is more accentuated; therefore this is the period with the highest risk of road traffic accidents. At the same time, in Mahajanga, due to low night lighting in some areas, the day is more conducive to activities requiring travel.

Our results are comparable to those found in several studies, including a Central African study where more than half of the injuries occurred during the day between 6 a.m. and 6 p.m. (64.9%); and 35.1% between 6 p.m. and 6 a.m. [14]. The same for Modarres, accidents occurred much more in the afternoon shift, between 1:30 p.m. and 7:00 p.m. [23]. Indeed, according to an Ethiopian study, driving on daylight increased human fatal accident by 2.36 times ( $p$ -value = 0.030) as compared to driving at night [24]. According to James Damsere-Derry, among the 1,149 injury related casualties recorded, two-thirds (60%) occurred during the day whilst the remaining 40% took place during the night. However, in terms of injury severity, there was a higher number of casualty fatalities at night (40% of all casualties at night) compared to daytime (31% of all casualties during the day) [10].

Conversely, in Kenya and in the Sultanate of Oman, the most of car accidents happened in the night [25,26]. Accidents are then favored by poor public lighting, to which is added the defective lighting of many vehicles and moreover on certain roads, it is very difficult to distinguish pedestrians, cyclists, or animals moving on the lower side.

### Direct and indirect causes of accidents

In our study, it was revealed that 98.55% of road accidents were related to the human factor, dominated by speeding (36.23%), driver inattention (20.29%), driving while intoxicated (18.84%), and recklessness of road users (15.94%). Drivers, whether two-wheelers or motorized vehicles, were incriminated in 76.9% of accidents.

In France, drivers (motorists, utility vehicle drivers, moped and motorcyclists) were most often presumed responsible in fatal accidents where they were involved in more than 63% of cases [18].

Drivers' with lack of sufficient driving experience caused to increase the chance of the occurrence of fatal accidents as compared to those with long years of driving experiences. This may be because lower driving experience drivers usually involve in driving faster than the recommended limits [24]. Drivers' educational level had been played a crucial role in a road traffic accident. And it was a direct cause to increase death prevalence by 1.89 times ( $p$ -value = 0.042) as compared to drivers with grade 12 and above educational levels [26]. The presence of passengers similar in age to the young driver increases the risk of crashing. The gender of both the driver and the passengers plays an important role in the driver's crash risk and driving behaviour in this effect [26].

Alcohol increases the crash risk for all drivers [2,8]. One study suggested that where alcohol or drug use was reported as a factor, adolescent drivers were 3.3 times more likely to sustain a severe injury [27].

In Algeria, in the study by Azzedine, *et al.* [9], the direct causes of traffic accidents were linked to the human being up to 90.64%, to the means of transport (5.09%) and to the environment with 4.27%. The behavior of the human being which was at the origin of the traffic accidents was mainly manifested by excess speed with high rates of 24.63%, dangerous overtaking (9.26%), the no use of pedestrian crossings (6.02%), failure to respect the safety distance (5.59%), driver inattention (5%) and loss of control of the vehicle (4.37%).

Thus, among the risk factors identified by the WHO, we find in descending order: speeding, driving while intoxicated or under the influence of psychoactive substances, failure to respect or lack of safety provisions (helmet, seat belt, child car seat, etc.), distracted driving due to mobile phone use, dangerous road infrastructure, and non-compliance with the Highway Code [28].

### First aid for victims

Polytrauma was the predominant lesion in our study (n = 61; 88.40%). And among the 41 victims still alive leaving the scene of the accident, 13/41 died en route, 14/41 died less than 24 hours after their admission to the CHU and the 14/41 others died later: beyond the first 24 hours of hospitalization. No victim was conditioned before being brought to the CHU. In addition, medical transport is not an option because it does not exist in Mahajanga.

It is possible, according to some authors, to a large extent to prevent road victims from dying before they arrive at the hospital [29,30]. But in many low-income and middle-income countries, poor public health infrastructure is a major risk factor. In addition, the lack of medical transport, the lack of technical platforms for resuscitation and, above all, the lack of qualified personnel are determining factors of death in hospitals. The implementation of a prevention program involving the road safety services (police and gendarmerie), the public and private media, the Ministry of Transport and the organization of a system of care for patients who are victims of accidents integrating the medicalized collection of the injured, the reinforcement of the technical platform for diagnosis and resuscitation and, finally, the reinforcement of the capacity of the personnel could significantly reduce the occurrence of these accidents and the mortality of the victims in the hospital environment [14].

In most motorized countries, the heavy traffic and the large number of mobile phones mean that, generally, the existing medical services are quickly notified in the event of an accident. However, in low-income countries, the majority of the population does not have access to even the most basic emergency medical services. Most often, it is witnesses, relatives, commercial vehicles or the police who evacuate the injured to hospitals [31].

The means of transport to the hospital in our study were dominated by taxi-TucTuc (n = 21; 51.22%), and public transport (minibus, bus, Taxi-brousse) (n = 14; 34,14%).

According to Abdou Raouf, *et al.* the lack of pre-hospital medical treatment (at the site of the accident and during transport) or even early hospitalization of the comatose, polytrauma injured, in a state of shock, endangered the lives of approximately two out of ten road accident patients in Gabon [32]. A study in Kenya found

that police cars and hospital ambulances evacuated only 5.5% and 2.9% of traffic accident victims, respectively [33].

Finally, the African Development Bank (AfDB) reports on the evaluation of road safety in Africa in 2013, in 75% of the countries studied, that it is voluntary drivers who are responsible for transporting the victims of traffic accidents. road. In the majority of countries, first aid training is not part of the driver training curriculum. The lack of resources is the main obstacle to the establishment of appropriate care for accident victims [34].

At the end of these data, the current technology which has no border seems to be a good option to reduce the number of deaths by traffic accident. As proposed in Atlas Magazine [35] in order to improve road safety, it is possible to integrate "intelligent" systems into vehicles and safety devices (Embedded technologies in automobiles: The Blue hands-free kit -tooth\_The drowsiness detector\_The alcohol ignition interlock device\_The heated road\_The electronic stability control\_The automatic tire monitor) (and Technologies that save motorcyclists' lives: The airbag vest\_Smart helmets). Because it must be recognized that changing the habits and behavior of humans is a more difficult task, because it depends essentially on the human factor (education, will, aptitude, etc.) which is quite unpredictable. This could explain the slowness of the changes of improvement observed by the WHO [2].

### Conclusion

Traffic accidents remain an unresolved public health problem, especially in low-income countries like ours. Indeed, they are now recognized as one of the biggest causes of death in the world and their frequency is increasing in low-income countries, compared to rich countries. While very significant progress has been observed in high-income countries, the situation is worsening in low-income countries. It is as pedestrians that victims are most often killed when they play no "active" role in driving vehicles and are only spectators of their own accidents. Pacifying the public highway by raising the awareness of each of us (parents, drivers, public authorities, etc.) and organizing pre-hospital resuscitation by creating the essential structures of the rescue chain and the care of road accident victims are not only a necessity, but a priority in our country. The improvement of the road network, the implementation of a good road safety policy and the adoption of responsible behavior by vehicle drivers, will make it possible to reduce the consequences of road accidents.

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## Declaration of Conflict of Interest

The authors declare that they have no conflict of interest.

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