



The Open Public Health Journal

Content list available at: <https://openpublichealthjournal.com>



RESEARCH ARTICLE

Epidemiological Profile of Injured Motorcyclists in Road Traffic Accident Treated in a Third-Level Hospital

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Abstract:

Background

In Mexico, motorcycle use is increasingly prevalent owing to the availability and low fuel consumption of the vehicle. With the increasing number of motorcycle users, the rate of injuries and mortality due to road traffic accidents has also increased.

Objective

The study aimed to describe the epidemiological profile of injured motorcyclists treated in a third-level hospital, who were involved in traffic accidents in Guadalajara's Metropolitan Area and Zapotlanejo municipality.

Methods

We realized a logistic regression model, where we included all variables with $p \leq 0.25$, they had three or less response options became in dummy variables for facilitate the analysis and we took as confounders factors either variables that modify up to 10% the value of Odd Ratio.

Results

In our study, we examined 180 injured motorcyclists. The factors that increases risk of severe injury at Metropolitan Zone of Guadalajara and Zapotlanejo's town were as follows: the motorcycle was not functioning properly prior to the incident (OR 76.89, 2.08-2839.25), the motorcyclist consider had committed any traffic infraction at the time of the event (OR 6.88, 1.30-36.26), the injured live in Metropolitan Zone of Guadalajara (OR 7.58, 1.15-50.17), driving a motorcycle when the driver did not know if the vehicle was "salvage" or not (OR 113.84, 9.13-1419.96) and as protectors factors, we found that a person drove a motorcycle with brand not Italika (OR 0.06, 0.008-0.41) and the road traffic occurred by line road or intersection "+" (OR 0.10, 0.02-0.61).

Conclusion

This information allowed to observe that exist elements of motorcyclist, and the motorcycle and environment that increases or reduced severity injuries in this group, most important when they did not have a health insurance.

Keywords: Epidemiological profile, Motorcyclist, Injuries, Road traffic accidents, Protective devices, Risk factors.

Article History

Received: July 04, 2019

Revised: October 04, 2019

Accepted: November 14, 2019

1. INTRODUCTION

In Mexico, over the past decade, there has been a steady increase in both the incidence and mortality rates of road traffic accidents involving motorcyclists [1]. The disproportionate growth in the number of cars does not correlate with the rate of adjustments and urban infrastructure development, nor with the

planning and implementation of programs for urban mobility and efficient public transport to allow the safe and satisfactory passage of all road users. Additionally, the perspective of mobility aims toward the use of other less polluting and more economical modes of transportation that can reduce travel times for users and their families. As it has been happening in Jalisco since 2004, when the bikeway and the recreative way were established [2].

The motorcycle-riding three specific features (*i.e.*, the

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motorcycle itself, the environment, and the rider) that comprise a system, where, if any of these elements experience any failure in performance, a road accident may occur. In Mexico, the mortality rate of motorcycle riders has increased substantially. From 1998 to 2009, the number of traffic accidents involving a motorcycle increased by 337.8% [3]. According to the National Institute of Statistics, Geography, and Informatics (INEGI), the state of Jalisco is no exception since it has the highest number of motorcycles in the country. The National Center of Accident Prevention (CENAPRA) confirmed this statistic and further stated that the state had a 421% increase in the number of motorcycles from 2001 to 2004 [1], and this tendency has continued [4].

Against this background, in 2010, the Mexican Initiative of Road Security (IMESEVI) was established, proposing an intervention to diminish accident mortality by 50%. With this objective, IMESEVI established the application and monitoring of preventive measures for different road users. In the case of motorcyclists, only the security helmet was enforced [5, 6]. However, this preventive measure is not the only one for this group; it is necessary to identify other features of motorcyclists to address the increasing rate of motorcycle accidents.

Therefore, it is important to describe the characteristics of the subject, vehicle, environment, and security equipment characteristics identified in other studies about motorcycle road users. This information can provide an epidemiological characteristics of injured motorcyclists in one of the biggest metropolitan areas in Mexico. The aim of this study was to analyze factors associated to the severity of injury of motorcyclists injured in road traffic accidents treated in a third-level hospital.

2. METHODS

This was a cross-sectional and analytical study on injured motorcyclists in the GMA and Zapotlanejo municipality in Jalisco State, Mexico. Subjects were treated in the “Fray Antonio Alcalde” Civil Hospital of Guadalajara between the period of November 2012 to May 2014. We calculated the sample size on the basis of road traffic accidents reported in 2014 in the Metropolitan Area, accounting for 94,241 road users, of which 2,313 were motorcyclists involved in a traffic accident, thus showing a frequency of 3%. With this data and a confidence interval of 99.99%, we obtained a minimum sample of 176 motorcyclists.

The inclusion criteria were as follows: being a motorcyclist or a passenger of any age or sex injured in a road traffic accident inside GMA or in Zapotlanejo municipality. We included Zapotlanejo municipality in the criteria owing to the number of patients attending this hospital for medical attention and its proximity to the Metropolitan Area. Regarding the inclusion of underage subjects, we explained to them the purpose of the study and asked them if they wanted to participate. If underage subjects accepted, we proceeded to ask the person responsible for the minor for his/her authorization and to sign the consent form to begin data collection.

The exclusion criteria were as follows: motorcyclists injured in sporting events, using a motorcycle of more than two wheels, subjects injured outside the GMA and Zapotlanejo municipality in Jalisco state, motorcyclists with an injury that impeded them answering the questionnaire, not having relatives to answer for them, subjects not willing to participate, or not signing the consent form. Elimination criteria were incomplete questionnaires (on more than 20%) and people's unwillingness to answering the questions.

We designed the questionnaire after conducting a literature review of risk factors of non-intentional events that occur when a person drives a motorcycle. We included the following data: a) injured patients' personal data (name, age, sex, home municipality, home state, address and phone or cell phone number, education, previous illness to the accident, occupation); b) motorcyclists' data (time riding in months or years, days and hours of the week that rides, motorcycle insurance, motorcyclist or driver license); c) data related to road traffic accidents (event description, date, time and weather conditions of the accident, street, intersections, neighborhood and municipality, type of road, object or subject that he/she crashed with, type of accident, site on the road of the accident, riding under the influence of alcohol or drugs, motorcycle lights); d) data regarding personal protective equipment (wearing a helmet, having it fixed, type of helmet, its condition, color, brand, and certification; wearing a reflective vest, jacket, gloves, and boots for motorcycle); e) data of motorcycles (type of motorcycle, brand, model, engine size, registry, and functioning); and f) the severity of the injury, evaluated using the Injury Severity Score (ISS; 2008) [7]. We divided the last section (f) into six anatomical regions: head, face, thorax, abdomen or pelvic contents, extremities or pelvic girdle, and skin. The evaluation of the ISS was done as follows: first, we selected the three regions with the greatest severity; then, each of the region numbers was squared, and finally, added together. Each region was given a score ranging from 1 to 6, where 1 point indicated minor severity and 6 points indicated maximum severity or injury incompatible with life. The scores ranged from 1 to 75 points.

We conducted statistical analysis with descriptive data statistics in proportions and confidence intervals of 95%. For the bivariate analysis, severity was classified into two categories: moderate and severe level. We calculated X^2 for variables that had normality and the Fisher's exact test for those variables without the above criterion, considering a $p < 0.05$ value as statistically significant. After that, variables with $p < 0.25$ values were included in the Logistic Regression Model.

3. RESULTS

During this time period, 180 motorcyclists were injured. Of this number, the majority were male (91.7%), with an average age of 26.3 (SD 10.61), residents of GMA (73.9%), and with basic education (72.8%). More than one quarter used to work in the commerce industry as employees or sales agents (27.1%) and only 7.8% of the motorcyclists had a chronic illness before to occur the road traffic accident. Table 1).

Table 1. Socio-demographic characteristics of the studied group.

| - | | Injury severity score | | OR (CI 95%) | p |
|--|--------|-----------------------|------------|-------------------|------|
| | | ≥25 points | ≤24 points | | |
| Sex | Male | 45 | 120 | 2.43 (0.59-16.42) | 0.24 |
| | Female | 2 | 13 | | |
| Home municipality | | | | | |
| Outside of Zona Metropolitana de Guadalajara | | 10 | 17 | 1.84 (0.75-4.36) | 0.16 |
| Inside of Zona Metropolitana de Guadalajara | | 37 | 116 | | |
| Education | | | | | |
| Junior high school or less | | 32 | 99 | 0.76 (0.37-1.59) | 0.40 |
| Higher than junior high school | | 15 | 34 | | |
| Occupation* | | | | | |
| Professionals and technicians | | 5 | 15 | 3.08 (0.53-25.69) | 0.24 |
| Traders, sales employee and sales agents | | 12 | 37 | 3.08 (0.62-15.2) | 0.20 |
| Service and security personnel | | 2 | 11 | 1.73 (0.21-14.05) | 0.62 |
| Agriculture, livestock, forestry, hunting and fishing activities worker | | 3 | 4 | 7.12 (0.88-57.54) | 0.08 |
| Craft workers | | 7 | 14 | 4.75 (0.85-26.43) | 0.13 |
| Machine operators, industrial workers, assemblers and professional drivers | | 10 | 21 | 4.52 (0.88-23.32) | 0.09 |
| Activities and support workers | | 6 | 12 | 4.75 (0.82-27.49) | 0.11 |
| Unemployed and domestic workers | | 2 | 19 | | |
| Previous illness to the road traffic accident | | | | | |
| Yes | | 5 | 9 | 1.64 (0.52-5.17) | 0.39 |
| No | | 42 | 124 | | |
| *Fisher's Exact Test | | | | | |

Regarding the specific details of accidents, almost half of the accidents (48.9%) occurred between 18:00 and 23:59 hours and during the night (51.7%). Of this percentile, 22.2% of the subjects believed they infringed the traffic rule, 56.1% had their lights on while riding, and 87.2% of the accidents occurred inside the GMA. The object of collision was a car,

pickup, or van (57.2%), and in 40% of the accidents, the motorcyclists experienced a side impact in collector (20.0%) and main roads (19.4%), with cross-intersections (40.6%) being the most common place for traffic accidents. Of these motorcyclists, 26.1% were riding being drunk and 5.6% were on drugs (Table 2).

Table 2. Road traffic accident data according to injury severity score.

| - | Injury Severity Score | | OR (CI 95%) | p |
|---|-----------------------|------------|-------------------|--------------------|
| | ≥25 points | ≤24 points | | |
| Time of the accident | | | | |
| 18:00-05:59 hours | 29 | 85 | 0.91 (0.46-1.81) | 0.79 |
| 06:00-17:59 hours | 18 | 48 | | |
| Weather conditions | | | | |
| Sunny | 23 | 52 | 1.13 (0.31-4.13) | >0.99 [▲] |
| At night | 20 | 73 | | |
| Other weather condition | 4 | 8 | | |
| Think they infringed a road rule | | | | |
| Yes | 13 | 27 | 0.62 (0.31-1.24) | 0.19 |
| No | 30 | 104 | | |
| The municipality of the accident | | | | |
| Guadalajara, Tlaquepaque, Tonalá, Zapopan | 36 | 96 | 0.79 (0.37-1.72) | 0.56 |
| Other municipality | 11 | 37 | | |
| Collision with object or individual* | | | | |
| Pedestrian or animal | 1 | 2 | 1.74 (0.15-20.05) | 0.54 [▲] |
| 2 or 3 wheeled motor vehicle | 2 | 5 | 1.39 (0.25-7.65) | 0.65 [▲] |
| Car, pickup or van | 23 | 80 | 3.48 (1.18-10.28) | 0.02 |
| Heavy transport vehicle or bus | 8 | 8 | | |
| Fixed or parked object | 3 | 3 | | |

(Table 2) contd....

| | | | | |
|--|----|-----|-------------------|-------|
| Without collision with another vehicle | 10 | 33 | 1.05 (0.45-2.46) | 0.90 |
| Type of impact** | | | | |
| Front impact | 20 | 35 | 2.17 (0.98-4.79) | 0.053 |
| Side impact | 15 | 57 | | |
| Rollover | 5 | 27 | 0.70 (0.23-2.14) | 0.53 |
| Rear impact | 5 | 11 | 1.73 (0.52-5.74) | 0.37 |
| Site of the accident *** | | | | |
| Cross-intersection | 23 | 50 | 2.35 (1.01-5.43) | 0.04 |
| Straight track | 10 | 51 | | |
| Other site | 10 | 30 | 1.7 (0.63-4.56) | 0.29 |
| Road type of the accident ***** | | | | |
| Controlled access highways | 10 | 21 | 2.30 (0.71-7.73) | 0.15 |
| Main roads | 6 | 29 | | |
| Collector roads | 8 | 28 | 1.38 (0.42-4.49) | 0.59 |
| Subcollector roads | 6 | 17 | 1.71 (0.47-6.14) | 0.41 |
| Local roads | 11 | 14 | 3.80 (1.17-12.38) | 0.02 |
| Riding under the influence of alcohol **** | | | | |
| Yes | 18 | 29 | 2.35 (1.14-4.84) | 0.02 |
| No | 27 | 102 | | |
| Riding under the influence of drugs **** | | | | |
| Yes | 3 | 7 | 1.27 (0.31-5.12) | 0.74 |
| No | 42 | 124 | | |
| Having lights on ***** | | | | |
| No | 18 | 50 | 1.16 (0.57-2.34) | 0.69 |
| Yes | 24 | 77 | | |

^Fisher's Exact Test, *2 without date, **5 without date, ***6 without date, ****4 without date, *****11 without date, *****30 without date

Regarding the personal protective equipment of the motorcyclists, 42.2% wore a helmet. Of these, only 86.8% had their helmet fixed and 38.2% had a full-face helmet. A high percentage (91.6%) affirmed that their helmet was in good

condition, 30.3% knew they had a certified helmet, and 6.6% knew that the helmet had an expiry date. Regarding other equipment worn that is specifically designed for riding, 6.1% had a jacket, 6.7% wore gloves, and 5.0% wore boots (Table 3).

Table 3. Personal protective equipment according injury severity score.

| - | Injury Severity Score | | OR (CI 95%) | p |
|--------------------|-----------------------|------------|-------------------|--------------------|
| | ≥25 points | ≤24 points | | |
| Wearing a helmet * | | | | |
| No | 30 | 70 | 1.61 (0.80-3.23) | 0.18 |
| Yes | 16 | 60 | | |
| Fixed helmet** | | | | |
| No | 2 | 5 | 1.8 (0.31-10.41) | 0.61 [▲] |
| Si | 12 | 54 | | |
| Type of helmet | | | | |
| Full face | 5 | 24 | | |
| Modular | 1 | 6 | 0.8 (0.08-8.19) | >0.99 [▲] |
| 3-quarter | 4 | 10 | 1.92 (0.43-8.67) | 0.44 [▲] |
| Off-road | 2 | 5 | 1.92 (0.29-12.86) | 0.60 [▲] |
| Skull cap | 3 | 12 | 1.2 (0.25-5.89) | >0.99 [▲] |
| Bike helmet | 0 | 3 | ---- | >0.99 [▲] |
| Helmet condition | | | | |
| Good condition | 15 | 58 | | |
| Bad condition | 0 | 2 | ---- | >0.99 [▲] |
| Certified helmet | | | | |
| Yes | 1 | 6 | | |
| No | 2 | 21 | 0.57 (0.04-7.44) | >0.99 [▲] |

(Table 3) contd....

| | | | | |
|---|----|----|-------------------|-------------------|
| Does not know | 13 | 33 | 2.36 (0.26-21.59) | 0.66 [▲] |
| Helmet expiry date | | | | |
| Does not have it | 3 | 13 | --- | 0.84 |
| Knows it | 0 | 5 | | |
| Ignores it | 13 | 42 | ---- | 0.56 [▲] |
| Wearing a motorcyclist jacket | | | | |
| No | 13 | 56 | 0.31 (0.06-1.56) | 0.19 [▲] |
| Yes | 3 | 4 | | |
| Wearing motorcyclist gloves | | | | |
| No | 13 | 54 | 0.49 (0.11-2.66) | 0.39 [▲] |
| Yes | 3 | 6 | | |
| Wearing motorcyclist boots | | | | |
| No | 14 | 57 | 0.37 (0.06-2.42) | 0.28 [▲] |
| Yes | 2 | 3 | | |
| ▲ Fisher's Exact Test, *4 without date (n=180), **3 without date (n=76) | | | | |

The most commonly used type of motorcycles were scooters (36.1%), and street motorcycles (33.3%). Italika (23.9%) and Honda (21.7%) comprised the majority of the brands owned. Most of the riders owned models that were five or fewer years old (42.2%), 53.8% had an engine size of 150cc or less, most of them had license plates (82.2%) and worked correctly (89.4), and 8.3% of these motorcycles were "salvage" (Table 4).

Regarding the motorcycle features, the majority of the riders (83.3%) used the motorcycle for an average of five or more days a week (63.9%), 11.7% had their vehicles insured, 70.6% had motorcyclist license, and 68.3% also had a driver license. Injuries were mainly on the extremities (77.2%) and head (33.3%). Most of these injuries had a minor severity (57.8%) and a quarter of them (26.1%) were severe. The mean score of the ISS was 11.62 (SD 11.06) (Table 5).

Table 4. Motorcycle data according injury severity score.

| Type of Motorcycle * | Injury Severity Score | | OR (CI 95%) | p |
|---|-----------------------|------------|------------------|-------------------|
| | ≥25 points | ≥25 points | | |
| Scooter | 12 | 53 | | |
| Street motorcycle | 19 | 40 | 2.10 (0.91-4.82) | 0.08 |
| Other motorcycle | 13 | 35 | 1.64 (0.67-4.0) | 0.28 |
| Motorcycle brand** | | | | |
| Honda | 12 | 27 | 2.15 (0.86-5.40) | 0.10 |
| Italika | 14 | 29 | 2.33 (0.96-5.69) | 0.06 |
| Other motorcycle brand | 12 | 58 | | |
| Motorcycle model *** | | | | |
| ≥2010 | 23 | 53 | 1.84 (0.83-4.09) | 0.13 |
| <2009 | 12 | 51 | | |
| Engine size **** | | | | |
| ≤150 cc | 19 | 78 | 1.12 (0.38-3.33) | 0.84 |
| >150 cc | 5 | 23 | | |
| License plate ***** | | | | |
| No | 8 | 15 | 1.79 (0.70-4.58) | 0.22 |
| Yes | 34 | 114 | | |
| Adequate functioning before the accident ***** | | | | |
| No | 1 | 12 | 0.24 (0.03-1.87) | 0.19 [▲] |
| Yes | 42 | 119 | | |
| Knows if the motorcycle is "salvage" | | | | |
| Yes | 6 | 9 | 2.44 (0.80-7.41) | 0.11 |
| No | 29 | 106 | | |
| Ignores it | 12 | 18 | 2.44 (1.05-5.63) | 0.03 |
| ▲ Fisher's Exact Test, *8 without date, **28 without date, ***41 without date, ****55 without date, *****6 without date | | | | |

Table 5. Motorcycle data according to critical status (ISS>15).

| Subject Injured | Severidad de las lesiones | | OR (CI 95%) | p |
|---|---------------------------|------------|------------------|------|
| | >15 points | ≤15 points | | |
| Motorcycle rider | 42 | 108 | 1.94 (0.70-5.42) | 0.20 |
| Passenger | 5 | 25 | | |
| Days on the week for using the motorcycle | | | | |
| 1 to 4 days | 6 | 22 | 1.17 (0.34-3.96) | 0.80 |
| 5 or more days | 34 | 81 | 1.80 (0.72-4.49) | 0.21 |
| No day | 7 | 30 | | |
| Motorcyclist insurance* | | | | |
| No | 34 | 111 | 0.41 (0.16-1.05) | 0.06 |
| Yes | 9 | 12 | | |
| Motorcyclist license** | | | | |
| No | 9 | 34 | 0.71 (0.31-1.63) | 0.42 |
| Yes | 35 | 94 | | |
| Driver license** | | | | |
| No | 12 | 35 | 0.98 (0.45-2.10) | 0.95 |
| Yes | 32 | 91 | | |
| *14 without date, **10 without date | | | | |

Table 6. Logistic Regression Model*.

| | OR | CI 95% |
|---|---------------|---------------------|
| — | | |
| Riding under the influence of alcohol | 1.42 | 0.39-5.26 |
| Weather conditions: On night/Sunny | 0.28 | 0.07-1.17 |
| Weather conditions: On night/Other weather condition | 2.23 | 0.29-17.35 |
| Days on the week for using the motorcycle: 5 or more days / 1 to 4 days | 0.42 | 0.08-2.18 |
| Days on the week for using the motorcycle: No day/1 to 4 days | 3.66 | 0.16-85.39 |
| No adequate functioning before the accident | 76.89 | 2.08-2839.25 |
| Think they infringed a road rule | 6.88 | 1.30-36.26 |
| Motorcycle rider | 0.09 | 0.003-2.21 |
| Motorcycle brand: Italika/Honda | 0.47 | 0.08-2.61 |
| Motorcycle brand: Otra marca/Honda | 0.06 | 0.008-0.41 |
| Motorcycle model | 0.49 | 0.11-2.11 |
| License plate | 1.76 | 0.34-9.13 |
| The injured motorcyclist live in Metropolitan Area of Guadalajara | 7.58 | 1.15-50.17 |
| Knows if the motorcycle is "salvage": Yes/No | 6.60 | 0.41-105.74 |
| Knows if the motorcycle is "salvage": Ignores it/No | 113.84 | 9.13-1419.96 |
| Motorcyclist insurance | 3.80 | 0.65-22.07 |
| Site of the accident: Straight track/ Cross-intersection | 0.10 | 0.02-0.61 |
| Site of the accident: Other site/ Cross-intersection | 0.28 | 0.06-1.30 |
| *n=117, we eliminate incomplete registers to do the logistic regression model | | |

The risk features associated with severe injury were inadequate functioning before the accident; breaking off the traffic laws by the the motorcyclist and the motorcyclist living in the Metropolitan Area of Guadalajara. The features that reduce the risk were driving a motorcycle different to Honda brand and Straight Street (Table 6).

4. DISCUSSION

Most of the injured motorcyclists in GMA were male (91.7%), which is in accordance with other studies [8 - 16]. Additionally, riders were local residents and received their

education in junior high school studies or were less educated (72.7%). In this respect, the hospital reported treating motorcyclists who had completed junior high school studies (57%) and 14% who did not complete their studies [8]. Berrones [15] reported that only 60.1% of the motorcyclists completed junior high school studies or less. This contrasts with what we found in this study, in which 29.4% of them finished junior high school level and 43.3% did not. One-fifth of the subjects was observed working for trade commerce activities, similar to what was reported in Marilia, Brazil [12].

Regarding the motorcyclists who rode under the influence

of alcohol or drugs, we found that 26.1% rode under the influence of alcohol, which is less than what Bahia [9] (49.4%) and Piauí [17] (37.9%) reported in Brazil and greater than what was reported by Berrones [15] in Mexico (6.1%). Drug use in this study was less common (5.6%) than the results found in Zaria, Nigeria [18] (50.3%).

Concerning the time of the accident, in the present study, we found a 51.7% frequency of accidents during night, which is less than what was reported in the District Hospital of Kagundo (85.6%) [19].

Regarding the use of the helmet, in this study, we found this to be 42.2%, which is less than what was reported in Kingston [10] (51.4), Spain [13] (82.8%) and Zhongshan [20] (72.6%); and similar to that of Pelotas, Brazil [14] (40%), and greater than in both Hunan, China [16] (28.7%) and the Australian Capital Territory [21] (34.7%). Overall, in this study, we found that injured motorcyclists were using other personal protective equipment, 6.1% had jackets, 6.7% were found to be wearing gloves, and 5.0% were observed to be wearing boots, in contrast with the findings from the Australian Capital Territory [21] (Jacket (69.7%), Gloves (35.2%) and Boots (32.3%).

Additionally, we found that the majority of motorcycles involved in road traffic accidents were scooters, with an engine size of 150cc or less, and recent models that were legally registered and functioned adequately. This result corresponds to what was reported by the teaching hospital [8]. The type of collision was against a vehicle (66.1%), which is greater than what was reported by the hospital [8] (55.2%) and in Sao Paulo Hospital [11] (45.4%).

The regular use of the motorcycle was five days or more (63.9%), which is similar to what was reported by Chang's [16] (73.5%) (2016) study in the Hunan province, China.

We found that motorcyclists' injuries were more prevalent in the extremities (77.2%), as was the case in Bahia [9] (87.65%), Maringa [22] (58.9%), and in the State of Piauí [17] (51.4%) in Brazil, in contrast to what was found in Connecticut [23] (28.6%) and at the Hospital of Clinics [24] (41.7%). The severity of injuries calculated with the ISS had a mean value of 11.62, which is greater than what was reported in Connecticut [23] (9.7) and on the University Hospital of the West Indies [10] (9.0).

In the case of presenting all the factors in the same motorcyclist involved in the traffic event, the risk of being injured with a degree of severity classified as "severe" (ISS >= 25 points) would be 2777 times higher compared to another motorcyclist damaged with a lower degree of severity (ISS <= 24 points). These agree with the General Systems Theory's postulates [25] and Multicausality [26], where an event is due to the conjunction of various elements, when any of them fails, it causes, as in the case of the present work, a traffic accident where a motorcyclist will be inflicted "severe" injuries (ISS >= 25 points). Furthermore, through the probabilistic model, we can estimate the causal association, which is not possible to determine with only the multicausal model [26].

According to the review of the literature conducted previously, the factors associated with the severity of the

lesions and those of protection found in this study do not coincide with what was previously reported, with the exception of the site where the road accident occurred, although the analysis of this factor in other studies was carried out on different timings than in this analysis. That is, according to the three different moments highlighted by William Haddon, in the Haddon's matrix, a traffic event or other external cause of injury can be analyzed. In that sense, the study carried out by Kim K and Cols [27]. reported the straight track as a risk factor (OR 1.37, 1.15-1.63) in the occurrence of the transit events, on the contrary, Li M and Cols [28]. suggested that the straight track is a factor that reduces the risk (OR 0.917, 0.858-0.981) of dying as a result of a road accident.

Considering the factors associated with the severity of injuries, it is suggested that the motorcycle brand is also a factor that reduces the risk of serious injuries by accidents, this could be explained by the sales rate of these vehicles with respect to the brand. The Italika motorcycle brand is the best-selling in Mexico, followed by Honda and Yamaha [29]. This could explain the result that the use of a motorcycle of the Honda brand or another motorcycle brand except Italika reduces the probability of being severely injured after a traffic event, this is because the population of motorcyclists participating in the study mainly drives two-wheeled motorized vehicles of the Italika brand.

A study conducted in Taiwan [30] found that young adult riders using Sanyan (OR= 1.64, 1.21-2.22) and Yamaha (OR= 1.39, 1.07-1.88) motorcycles had a greater level of severity of injuries than the ones using Kymco motorcycles. Another study in this country [31] including junior college students reported that using Sanyang (RH 0.88, 0.78-0.99) or any other brand (RH 0.66, 0.47-0.93) is safer than Yamaha. On the other side, the persons who break traffic laws have an increased risk (RH 1.54, 1.38-1.72) with respect to others [31].

Among the strengths, this study adds further information, which was not being considered in official registries and other studies, that is important in terms of injury prevention and promoting the personal protective equipment to reduce motorcycle injury severity. This information includes factors such as identifying the helmet features, including its certification and expiry date; if the motorcycle had already been involved in another road traffic accident (as salvage type, which are repaired imported motorcycles that have been crashed); having infringed a road rule; and not having insurance and/or a license. Also, the subjects of our study were characterized by not having social security; hence, they paid for their medical attention.

The limitations of this study are that we interviewed the subjects after the accident, which, as a consequence, could cause amnesia episodes or a lack of awareness as to what happened secondary to trauma, and the relatives of the subjects could have had little or no information about how the accident occurred.

CONCLUSION

In conclusion, due to road traffic accidents, injured motorcyclists are one of the most vulnerable people travelling by road, not only because they often lack the necessary

equipment to reduce the risk of having severe injuries, but also because of their predisposing factors. In this study, we explored features that were previously been considered; consequently, it could be useful to analyze other perspectives to reduce morbidity, mortality, and the accident rate among this population.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The Research And Ethics Teaching Committee Of The Old Civil Hospital Of Guadalajara "Fray Antonio Alcalde" approved the study with Registration no. 068/12.

HUMAN AND ANIMAL RIGHTS

Not applicable.

CONSENT FOR PUBLICATION

Informed consent was obtained from the participants prior to data collection.

AVAILABILITY OF DATA AND MATERIALS

Not applicable.

FUNDING

None.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

ACKNOWLEDGEMENTS

Declared none.

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