Epidemiological profile of pedestrian-motor vehicle trauma in the metropolitan area of Guadalajara

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ABSTRACT

Background: According to ENSANUT, 60% of deaths are caused by road traffic injuries and affect the most vulnerable road users such as pedestrians, cyclists, and motorcyclists. Of this percentage, 45% were pedestrians. **Objective:** The objective of this study was to define the epidemiological profile of pedestrian-motor vehicle trauma in the Metropolitan Area of Guadalajara. **Materials and Methods:** A cross-sectional study was conducted on pedestrians injured in car collisions who were referred to a third-level public hospital from 2014 to 2015. The variables comprised the municipality where the event occurred, demographic characteristics, substance abuse, medication, the use of devices while crossing the street, and severity of injury. The information was analyzed using percentages, standard deviation, and χ^2 for comparison-related factors according to the injury severity, considering $p < 0.05$ as statistically significant. **Results:** The total number of injured pedestrians was 397. The municipalities with the highest number of injured pedestrians were Guadalajara (41.3%) and Zapopan (29.7%). Males were the most affected (80.4%), with most incidents affecting those in the age group of 18–39 years old (34.5%). Roughly 65% of cases occurred at night and on Fridays, Saturdays, and Sundays. The most common injuries were fractures and injuries to the extremities and head, with 27% of injured pedestrians showing severe injuries. **Conclusion:** Although we did not find any statistical significance, the information gathered from this study indicates a need to implement preventive strategies about vial education and the improvement of signals and protective elements on the streets to aid vehicle and pedestrian flow and control or reduce the number of injured pedestrians.

KEY WORDS: Epidemiologic factors; Injuries; Motor vehicle; Pedestrians; Traffic accident

INTRODUCTION

Traffic accidents are a public health problem and rank among the 10 principal causes of mortality worldwide.[1-5] According to the World Health Organization, each year, 1.25 million people die as a result of road traffic injuries. Between 20 and 50 million people present non-fatal injuries that are serious enough to cause a permanent disability.[6] Regarding this health problem, Mexico ranks 7th in the world and 3rd in Latin America.[7]

According to the data obtained from the National Survey of Health and Nutrition (ENSANUT) 2012, 60% of deaths by road traffic injuries affected the most vulnerable road users such as pedestrians, cyclists, and motorcyclists. Of this percentage, 45% were pedestrians.[8]

Road traffic injuries are caused by the interaction of three factors: Humans, vehicles, and the environment.[9] Among these, the subfactors include driver and pedestrian behavior,[10] vehicle type, speed, hour of the day, day, conditions, and infrastructure of the street, among other factors.[11,12] With regard to the increase in road traffic events and the greatest impact on pedestrian health, the purpose of this study was to determine the epidemiologic profile of pedestrian-vehicle trauma in the Metropolitan Area of Guadalajara (MAG).

MATERIALS AND METHODS

This is a cross-sectional study that included pedestrians injured in traffic events at the MAG. These patients were attended to at Civil Hospital of Guadalajara "Fray Antonio Alcalde" from 2014 to 2015. The sample size was calculated with a prevalence of 32% of the pedestrians injured in Jalisco state, according to the National Council of Population and Apartment (CONAPO, 2010). We used the Velasco formula[13] to estimate the proportions with a confidence interval of 95%, a power of 80%, and a 0.05 precision rate for a total sample size of 397 persons, all of whom were >18 years old.

In this study, we considered the anonymity of the people who participated in the study. All the aspects of the research were explained and informed to the participants including the freedom to reject to continue in the study at any moment. According to the Regulation of the General Health Law in the Field of Health Research,[14] in Mexico, this study is classified as being without risk since it only collects retrospective information about the traffic event. This information was delivered to all participants in a written form. It is important to mention that this investigation was approved by the Ethics Committee of Civil Hospital of Guadalajara "Fray Antonio Alcalde."

The information was obtained through a survey that included the following variables: The municipality where the traffic event occurred; age; sex; schooling; occupation; marital status; consumption of substances (medicines, alcohol, and drugs); whether they had a disability; use of any audio device (cellular, headphones, video games, etc.,); injury severity by scale of Illescas[15] (mild injury <15 point, moderate injury from 16 to 24 points, and severe injury >25 points); type of vehicle; place; event day; type of street; and vehicular flow. For the statistical analysis, we used Epi Info version 7 and SPSS version 17.0. We obtained the necessary averages, frequencies, percentages, standard deviation, and bivariate analysis with χ^2 or Fisher's exact test, considering $p < 0.05$.

RESULTS

From 2014 to 2015, 397 injury pedestrians were attended to at a third-level hospital due to vehicular traffic events that occurred in the MAG. The most frequent events were observed in the municipalities of Guadalajara (41.3%) and Zapopan (29.7%) [Table 1].

The average age of injured pedestrians was 39.6 years old. The most affected age group ranged from 18 to 29 (34.5%) and 30 to 39 years old (22.9%). In terms of sex, men were

Table 1: Municipalities where pedestrians injured in vehicle traffic events were presented in the MAG in 2014–2015

Municipalities of MAG	*n* (%)
Guadalajara	164 (41.3)
Zapopan	118 (29.7)
Tlaquepaque	52 (13.1)
Tlajomulco de Zúñiga	34 (8.6)
Tonalá	15 (3.8)
El Salto	14 (3.5)

MAG: Metropolitan Area of Guadalajara

Table 2: Sociodemographic characteristics of injured pedestrians by vehicle traffic events between 2014 and 2015

Sociodemographic characteristics	*n* (%)
Age group	
18–29 years old	137 (34.5)
30–39 years oldc	91 (22.9)
40–49 years old	62 (15.6)
50–59 years old	40 (10.1)
60>	67 (16.9)
Sex	
Woman	78 (19.6)
Man	319 (80.4)
Marital status	
Married	130 (32.70)
Divorced	10 (2.50)
Separated	3 (0.80)
Single	175 (44.10)
Free union	64 (16.10)
Widowed	15 (3.80)
Schooling	
Elementary school	125 (31.5)
Secondary education	144 (36.3)
High school	104 (26.2)
Degree	24 (6.0)
Occupation	
Employee	100 (24.9)
Shopkeeper	70 (17.6)
Laborer	47 (11.8)
Unemployed	42 (10.6)
Homemaker	35 (8.8)
Student	29 (7.3)
Salesperson	25 (6.3)
Bricklayer	20 (5.0)
Retired or Pensioned	9 (2.3)
Others occupations*	22 (5.8)

*Others occupations (tinsmith, stylist, mechanic, carpenter, etc.)

the most affected group (84%). Single (44.1%) and married (32.7%) were the most frequent marital status. Regarding education, 67.8% had a secondary school education or less. The principal occupations were employee (23.2%), shopkeeper (17.6%), and laborer (11.8%) [Table 2].

The injuries presented were fractures and other injuries in the lower extremities (87.6%) and head (65%). The Injury Severity Score showed that 27% of pedestrians had severe injuries [Table 3].

As presented in Table 4, most of the traffic events occurred between 18:00 and 23:59 h (39.5%) and on weekends (65.6%). With regard to environmental characteristics, 72.3% occurred in the street, while 27.7% of accidents occurred in avenues, of which two of three occurred in a single direction of vehicular flow. The most common type of vehicle involved in the reported crashes was sedan (37.8%) followed by pickup or van (14.6%). Of the total number of pedestrians involved in crashes, 4% were drunk 6 h before the traffic event, 13.4% had taken medication, and 6.5% had used an electronic device (headphones, cell phone, iPod, etc.) [Tables 4 and 5].

No statistically significant differences were found regarding the association between the sociodemographic, environmental, and vehicle characteristics regarding the severity injury score (severe injury vs. mild/moderate injury) [Table 5].

DISCUSSION

The epidemiologic profile of injury pedestrians involved in traffic events in the MAG predominantly comprises men between 18 and 39 years old, people with a secondary education or lower, and, in general, individuals without partners according to the Civil Registry, and those who were economically active. For more than a third of injured pedestrians, the traffic events mainly occurred after 18:00 hours and before midnight, mainly between Friday and Sunday and in one-way streets. The most frequent location of injuries was the extremities followed by head injuries. Of the total of injured pedestrians that required medical attention, the injuries were generally considered mild in accordance with the Injury Severity Score of Illescas.[14]

With regard to other studies, we found an agreement in terms of the most frequently reported age group. In this study, this age group was reported 57.4% less than the studies by Ávila,[9] Granillo,[16] Vargas and Solano,[3] and Hasani *et al*.,[17] who reported between a range of 59% and 73%. Likewise, men were the affected group, which was similar to the results found in reports by the General Hospital of Queretaro in Mexico (77.8%),[16] Health Science Center of University of Arizona (72%),[18] Shahid Rajaee Hospital (61.4%),[19] Forensic Organization from Iran (73.2%),[17] Guru Gobind

Singh Hospital (87%),[20] and Center City Hospital in Sydney (64.4%).[21] Regarding marital status, we found a difference to Hasani *et al*.,[17] report, whose study indicated that the majority of injured pedestrians were married. This was in contrast to our results, which showed that people without a partner were the most affected, according to the Civil Registry.

Table 3: Injury type and Injury Severity Score of injury pedestrians by vehicle traffic events in the MAG during 2014–2015

Injury characteristics	*n* (%)
Injury type*	
Fractures/extremity injuries	348 (87.6)
Head injury/traumatic brain injury	260 (65)
Luxation/sprain	198 (49.8)
Traumas and contusions	154 (38.7)
Wounds	75 (18.8)
Injury severity score	
Mild	197 (49.6)
Moderate	93 (23.4)
Severe	107 (27)

*Injury pedestrians could have more than one injury,
MAG: Metropolitan Area of Guadalajara

Table 4: Pedestrian-motor vehicle crash characteristics in the MAG, 2014–2015

Characteristics	*n* (%)
Hour of occurrence (h)	
00:00–05:59	31 (7.8)
06:00–11:59	115 (29)
12:00–17:59	94 (23.7)
18:00–23:59	157 (39.5)
Day of occurrence	
Monday	48 (12.1)
Tuesday	22 (5.5)
Wednesday	19 (4.8)
Thursday	47 (11.8)
Friday	100 (25.2)
Saturday	85 (21.4)
Sunday	76 (19.1)
Vehicle involved	
Sedan	150 (37.8)
Van or pickup	58 (14.6)
Non-specific	189 (47.6)
Type of road	
Street	287 (72.3)
Avenue	110 (27.7)
Vehicular flow	
One direction	266 (67)
Double direction	131 (33)

MAG: Metropolitan Area of Guadalajara

Table 5: Sociodemographic, environmental, and vehicle characteristics related to the Injury Severity Score of injured pedestrians in the MAG between 2014 and 2015

Characteristics	Severe injury (>25 points)	Mild/moderate injury (<25 points)	*P*
Sex			
Woman	58	20	0.77
Man	232	87	
Day of the week that occurred the traffic event			
Monday to Thursday	104	32	*P*=0.27
Friday to Sunday	186	75	
Type of road			
Street	213	74	*P*=0.40
Avenue	77	33	
Vehicular flow			
One direction	200	66	0.17
Double direction	90	41	
Consumption of alcohol before crash			
No	278	103	>0.99*
Yes	12	4	
Consumption of any medication before crash			
No	254	90	0.37
Yes	36	17	
The traffic crash occurred on the work route			
No	247	87	0.35
Yes	43	20	
Use of any electronic device at the moment of traffic crash			
No	247	87	0.35
Yes	43	20	
Type of vehicle involved in the traffic crash			
Sedan	107	43	0.65
Van/pickup	47	11	

*Fisher's exact test, MAG: Metropolitan area of Guadalajara

The occurrence of traffic events was more frequent at weekends, which is similar to the results reported by the General Hospital of Queretaro, Mexico (40.6%),[16] but contrary to information provided by Saint Vincent Hospital,[21] where Friday was the most frequent day (40% approx.). Daytime was found to be the most common time for crashes, which is similar to the results found by Hasani *et al*.,[17] and Small *et al*.,[21] but different to Granillo[16]. In this study, on average, most events happened at night.

Regarding the vehicular flow in one direction and the occurrence of traffic events where injured pedestrians were involved, this could be explained by Echeverry *et al*.,[22] and Odero *et al*.,[23] because they refer to pedestrian crossing as careless on streets where the vehicular flow is only in one direction and can infer that the speed of the vehicle could be minor, although these circumstances could change and contribute to the accident.

In this study, one of four injured pedestrians presented severe injuries, which concurred with other studies implemented in Medellin, Colombia.[24] The anatomic regions most

commonly affected were the extremities and head, which concur with the findings of Brainard *et al*.,[18] Ghaem *et al*.,[19] Reith *et al*.,[25] Small *et al*.,[21] and Kong *et al*.,[26] though this is contrary to Hasani *et al*.,[17] who reported head injuries as more common than extremities.

The strengths of this study are that it provides information on the three elements that constitute a traffic event: Pedestrian, vehicle, and occurrence location. This information allows the characterization of the most vulnerable people on public roads whose possibility of dying is greater depending on the severity of the injuries. In this study, the information came from people who attended a third-level public hospital. This group either had no insurance or a popular insurance that did not cover traffic crashes; therefore, this article provides information on this population who has informal work or is employed without health benefits.

The limitations of the study were that there was probably an information bias. In some of the cases, the injured pedestrian was unable to answer the survey due to his/her health condition after the crash. The person who answered the

survey was a relative, and consequently, the family members could not have been sufficiently informed about the traffic event.

Recommendations

A way to reduce the number of traffic accidents at night could be addressed by enforcing the use of reflective clothing, improving public lighting in dark areas, enhancing safety in the streets to prevent delinquency, and strengthening the use of the pedestrian crossing or footbridge by road safety education.

This topic must be addressed by public institutions, researchers, the government, and the society to design preventive actions that include people, environment, and vehicles to enhance traffic flow for all road users.

CONCLUSION

In the MAG, pedestrians are frequently knocked down; hence, this epidemiological profile is similar to other countries and contexts, where the vehicular fleet, urban infrastructure, and behavior of road users are associated with the probability of being involved in a traffic crash. In light of this, it is important to analyze all the elements involved to plan strategies to strengthen road safety and reduce the morbidity and mortality rate.

It is important to mention that, in this study, we did not find any statistical significance with regard to Injury Severity Score; however, our outcomes were similar to other countries, cities, or hospitals. This study was an initial study of the epidemiologic features of one the most vulnerable populations in the MAG. The population in this study had unfavorable social characteristics and had no health insurance; therefore, it is also worth investigating other risk factors such as economic impact or the long-term physical damages of being involved in traffic accidents in the MAG.

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