External cause injuries in the emergency department of a hospital over a five-year period

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Abstract

Background: In the State of Mexico there are no investigations that provide information for decision-making and administration of resources related to the care of externally-caused injuries (ECI). **Objective:** To describe ECIs seen in an emergency department over a 5-year period. **Method:** A retrospective study was designed with patients admitted to emergency department (2010-2015) with ECI diagnosis. Descriptive and cluster analyses were performed. **Results:** At the emergency department, 16.59% of emergency care was related to ECI. A total of 16,567 patients of 14 to 99 years of age (average = 37.7; SD = 17.28) were included; 69.2% were males. ECIs occurred mainly in public places (26.3%) and at home (23.7%). The main causes were aggression outside the home (32.7%), on average at 34 years of age, falls (25%) on average at 45 years, and motor vehicle accidents (9.7%) on average at 33 years. The cluster analysis identified four groups: aggression outside the home 32.7% (5,417), traumatic contacts, 26.30% (4,363), road traffic accidents 15.9% (2,640) and falls 25% (4,147). **Conclusions:** Motor vehicle accident-related ECIs showed the most severe consequences.

KEY WORDS: Externally caused injuries. Emergency departments. Road traffic accidents. Home accidents.

Introduction

External cause injuries (ECI) are currently acknowledged to constitute a public health problem. They can be caused by road traffic accidents, falls, assault and domestic violence, among others. They have been reported to account for up to 26.3 % of emergency departments demand and are considered to be the fourth cause of death in the American continent.^{1,2} They are also responsible of death and disability, in addition to representing a high cost for society, patients and institutions.¹⁻⁴

Motor vehicle accidents-derived ECIs are highly relevant. The World Health Organization (WHO) estimates they represent the leading cause of death among young people of 15 to 29 years of age.^{5,6} In Spain, approximately 10 % of hospitalizations between 2004 and 2008

were calculated to derive from ECIs associated with the use of motor vehicles.⁷ One study carried out in Colombia found that, between January 2004 and December 2007, there were 12 148 patients with ECI, out of which 37.1 % were younger than 18 years; when the injury occurred in the street, 29 % of injured were pedestrians, 44.3 % were drivers and 24.1 %, passengers. Intentional injuries were also shown to account for 24.5 % of total cases attended to.³

In Mexico, ECIs are among the 10 leading causes of death. Only regarding transport accidents, the report on the road safety¹⁸ situation indicates that in 2014 there were 15 886 deaths within the national territory; in addition, 2012 National Public Health and Nutrition Survey (ENSANUT – *Encuesta Nacional de Salud Pública y Nutrición*)⁹ data show that 320 496 people were hospitalized in 2011 with injuries caused by traffic

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accidents, which accounts for 7.2 % of total hospitalizations that year. This type of injuries occur more often in young subjects, the injured remains hospitalized between 5 and 6 days and in 43 % it takes an average of one year reincorporating to working activities.^{4,10}

ECIs are also related to violence and aggression: in Colombia, the problem of pregnant women deaths due to homicides, suicides and accidents has become evident; however, there are only few studies on the subject.¹¹ Mexico is also facing the problem of violence, since the homicide rate increased from 9.7 per 100 000 population in 2005 to 23 homicides per 100 000 population in 2010.¹²

In Latin America, alcohol consumption is associated with 33 % of intentional and 26 % non-intentional accidents, as well as with 24 % of homicides, 11 % of suicides and 20 % of traffic accidents.¹³

In this study, describing ECI characteristics is sought based on 2010 to 2015 records of Centro Medico Lic. Adolfo López Mateos Emergency Department, in Toluca, State of Mexico, the population of which was 16 187 608 inhabitants in 2015.¹⁴

Method

After ethical approval, a retrospective study was carried out with the referred emergency department electronic record as source of information. Patients diagnosed with ECI (ICD-10), of either gender, from 14 to 99 years of age, attended to between September 1, 2010 and May 31, 2015, were included. The records were categorized based on ICD-10 codes and grouped as described in the work by Ávila-Burgos et al.¹ The database was divided according to age groups as defined by the National Institute of Statistics and Geography (INEGI – *Instituto Nacional de Estadística y Geografía*).¹⁵

The original database comprises 110 809 services provided by the emergency department within the aforementioned period, out of which 16.59 % (n = 18,378) were ECI-associated cases; from these, incomplete records and those containing non-plausible data were excluded. The final sample contained 16 567 ECI records.

Descriptive statistics, frequencies, chi-square tests and ANOVA were used, as well as a multivariate cluster analysis that included quantitative and qualitative variables, which is why the IBM two-step algorithm included in the SPSS software was chosen.¹⁶

Results

A total of 16 567 records were included, with patients of 14 to 99 years of age (average of 37.70 ± 17.28 years),

Table 1. Sociodemographic characteristics of the study population

	Females		Males		χ^2 (p)
	n	%	n	%	
Age					
5-14	6	0.12	16	0.14	857.36 (0.00)
15-24	958	18.76	3531	30.81	
25-34	1122	21.97	3109	27.13	
35-44	880	17.23	2103	18.35	
45-64	1223	23.95	2049	17.88	
≥65	918	17.98	652	5.69	
Marital status					
Married	2203	43.69	5166	45.39	891.27 (0.00)
Divorced	3	0.06	2	0.02	
Separated	166	3.29	137	1.20	
Single	1691	33.54	4680	41.12	
Cohabiting	420	8.33	1229	10.80	
Widowed	559	11.09	167	1.47	
Level of education					
None	576	12.01	727	6.54	251.69 (0.00)
Primary school	814	16.97	1672	15.03	
Secondary school	620	12.92	2140	19.24	
High school	360	7.50	883	7.94	
Higher education	346	7.21	531	4.77	
Other	2081	43.38	5168	46.47	

out of which 69.2 % (n = 11,460) were males. Disability was observed in 0.60 % (n = 100), whereas 1.45 % (n = 74) of women were pregnant. Sociodemographic characteristics are described in table 1.

Age-based reasons for hospitalization are shown in figure 1. Significant differences were found between patients who required hospitalization and those who didn't for falls ($F = 97.254$, $p = 0.000$), traffic accidents ($F = 7.257$, $p = 0.007$), interpersonal aggression at home ($F = 9.889$, $p = 0.002$) and assault away from home ($F = 4.702$, $p = 0.030$).

Of the records, 98.12 % (n = 16 256) corresponded to patients residing within the State of Mexico, 83.17 % (n = 13 780) in urban areas and 14.55 % (n = 2 412) in rural areas; in 2.36 % (n = 375) this was not recorded. The Toluca municipality had the highest frequency, 45.67 % (n = 7 567), out of which 96.99 % (n = 7,339) was at its urban area, with the locality with the highest assiduity being Toluca de Lerdo with 83.73 % (n = 6 145), followed by San Pablo Autopan with 4.03 % (n = 296), San Mateo Otzacatipan with 2.59 % (n = 190) and San Andrés Cuexcontitlán with 1.89 % (n = 139). In the rural area, Xicaltepec Tepaltitlán (Ejido San Lorenzo) stands out with 24.34 % (n = 55), as well as Ejido Santa Cruz Atzacapozaltongo with 12.39 % (n = 28), San Diego Linares with 7.96 % (n = 18) and Tecaxic with 6.64 % (n = 15).

ECI-related diagnoses were grouped into 8 categories, with predominance of head and neck trauma with

Figure 1. Distribution of injuries by age and hospitalization requirement.

33.11 % (n = 5485), followed by upper limb trauma with 29.25 % (n = 4846) and lower limb trauma with 15.87 % (n = 2630). Table 2 shows diagnostic groups frequency and their respective need for hospitalization.

The most recurrent external cause group was interpersonal aggression away from home with 32.72 % (n = 5420), followed by falls with 24.98 % (n = 4139). The external causes that reported the lowest frequencies were self-inflicted injuries with 0.06 % (n = 10) and interpersonal aggression at home with 3.76 % (n = 623). Traffic accidents, involving motor and non-motor vehicles accounted for 9.68 % (n = 1604), while the group named other external causes of injuries (transport accidents, gunshot and explosions, foreign body, bites or stings, choking, burns, exposure to natural phenomena, accidental poisoning and over-exertion) was 18.11 % (n = 3000). Female patients had the highest prevalence in the 45 to 64 years age group, where falls at home were the most recurrent causes of injury. Table 3 shows external causes' distribution by age group; in order to facilitate the reading of the table, it was reduced to 3 groups instead of the 6 defined by INEGI.

The procedure recorded in more occasions was consultation, described as global, in 95.13 % (n = 15 760). Of the remaining 4.87 % (n = 807), electrographic monitoring showed the highest frequency with 28.87 % (n = 233).

Association was also found with the resulting consequence ($\chi^2 = 1437.72$, $p = 0.000$), diagnosis ($\chi^2 = 976.22$, $p = 0.000$), patient destination ($\chi^2 = 880.00$, $p = 0.000$), area of care ($\chi^2 = 447.48$, $p = 0.000$) and external cause group ($\chi^2 = 942.26$, $p = 0.000$) variables.

Only in 3.97 % (n = 658) of cases was the administered medication recorded: omeprazole was the most widely used with 18.54 % (n = 122), followed by ketorolac tromethamine injectable solution or vials with 12.77 % (n = 84) and midazolam 15 mg injectable solution with 12.61 % (n = 83).

The main place of ECI occurrence was the street with 26.33 % (n = 4362), followed by home with 23.67 % (3922). Association was found with patient gender ($\chi^2 = 1384.76$, $p = 0.000$): females had the highest frequency of injuries at home with 52.37 % (n = 2054) and males in the street with 75.26 % (n = 3283).

The area of care is associated with patient destination ($\chi^2 = 6781.57$, $p = 0.000$). Subsequent hospitalization was required by 83.67 % (n = 1680) of patients admitted to the resuscitation area and by 78.19 % (n = 993) of those admitted to an observation area. Of those attended to in private practices, 52.24 % (n = 3846) were discharged home and of those who were managed in the trauma area, 43.99 % (n = 2607) were referred to outpatient care; 6.01 % (n = 24) of those involved in motor vehicle accidents were reported as deceases.

Table 2. Hospital requirements according to presenting injuries

	Not Hospitalized		Hospitalized		χ^2 (p)
	n	%	n	%	
Diagnosis					
Head and neck trauma	3291	60.00	2194	40.00	479.40
Upper limb trauma	3369	69.52	1477	30.48	(0.000)
Chest, abdomen and pelvis trauma	954	46.58	1094	53.42	
Lower limb trauma	1691	64.30	939	35.70	
Burns and corrosions	311	46.84	353	53.16	
Other injuries	357	55.09	291	44.91	
Multiple injuries	42	30.43	96	69.57	
Poisoning	43	39.81	65	60.19	
External cause					
Interpersonal aggressions away from home	3243	59.83	2177	40.17	221.08
Falls	2756	66.59	1383	33.41	(0.000)
Other external causes of injury	1695	56.50	1305	43.50	
Traffic accidents, motor and non-motor vehicles	775	48.32	829	51.68	
Traumatic contacts	1149	64.88	622	35.12	
Interpersonal aggressions at home	434	69.66	189	30.34	
Self-inflicted injuries	6	60.00	4	40.00	
Affected area					
Head	1434	43.49	1863	56.51	1846.72
Lower limbs	1687	54.21	1425	45.79	(0.000)
Upper limbs	2133	72.06	827	27.94	
Chest	540	51.33	512	48.67	
Abdomen	126	26.47	350	73.53	
Face	1311	79.50	338	20.50	
Multiple	129	27.80	335	72.20	
Spine	432	64.57	237	35.43	
Hand	838	80.04	209	19.96	
Neck	549	81.82	122	18.18	
Pelvis	90	49.45	92	50.55	
Other	400	86.77	61	13.23	
Feet	250	81.97	55	18.03	
Back or glutei	60	59.41	41	40.59	
Unknown	36	65.45	19	34.55	
Genital region	24	60.00	16	40.00	
Ocular region	19	73.08	7	26.92	

As for day of occurrence, in 39.76 % (n = 6587) it was recorded to be on weekend. Sunday had the highest prevalence with 21.02 % (n = 3483) and Tuesday the lowest with 11.12 % (n = 1843); 3 % (n = 497) of injuries were recorded on commemorative holidays: National Independence (September 16), Mexican Revolution (November 20), 1917 Constitution (February 5), Labor Day (May 1), Benito Juárez Birthday (March 21), New Year (January 1) and Christmas (December 25).

The cluster analysis indicated a Silhouette coefficient of 0.3 (measure of cohesion and separation of the found groups; the groups must be separated from each other while their elements are cohesive;¹⁷ a 0.2-0.4 value is considered to be acceptable¹⁸). Twenty-two qualitative and one quantitative variable were included; 4 clusters were found. In table 4, the groups that were found and most representative variables are appreciated.^{17,18}

Cluster C1, with 32.70 % (n = 5,417), showed young (average age 34.13 years) males (78.40 %) who attended on their own initiative (65.30 %) with head injuries (21.90 %) resulting from interpersonal aggressions (27.70 %) in the street (39.90 %); 25.70 % were recorded on Sunday and the main consequence was fracture (28.40 %), the area of care was the consultation room (49.60 %) and 40.20 % required hospitalization.

Cluster C2, with 26.30 % (4363), showed young (average age 36.91 years) male patients (73.40 %) who attended on their own initiative (69.30 %) with head injuries (18.70 %) resulting from aggressions inflicted by someone else (8.40 %) at home (32.70 %), with 21.40 % recorded on Sunday and their main consequence were injuries (34.90 %), with the area of care being the consulting room (68.78 %). Forty-four percent of the group was discharged home.

Table 3. External cause of injury and place of occurrence according to age

	Age group						χ^2 (p)
	5-24		25-44		≥ 45		
	n	%	n	%	n	%	
External cause							
Interpersonal aggressions away from home	1737	32.05	2544	46.93	1139	21.01	1284.42 (0.000)
Other causes of injury	840	28.00	1384	46.14	776	25.87	
Falls	730	17.64	1457	35.20	1952	47.16	
Traumatic contacts	541	30.55	793	44.78	437	24.67	
Traffic accidents, motor and non-motor vehicles	515	32.11	785	48.94	304	18.96	
Interpersonal aggressions at home							
Self-inflicted injuries	143	22.95	249	39.97	231	37.08	
Place of occurrence	5	50.00	2	20.00	3	30.00	
Pedestrian public pathway							
Home	1321	30.28	1868	42.82	1173	26.89	1462.46 (0.000)
Motor vehicle	698	17.80	1478	37.69	1746	44.52	
Other place	695	34.68	975	48.66	334	16.67	
Place not specified	617	28.01	1031	46.80	555	25.19	
Recreation and sports	271	31.14	395	45.40	204	23.45	
Workplace	268	47.02	267	46.85	35	6.14	
Institutional residence	265	26.47	497	49.65	239	23.88	
Public motor vehicle	112	17.39	272	42.23	260	40.38	
Commercial and service areas	102	29.48	169	48.85	75	21.67	
Farm	100	31.85	152	48.41	62	19.75	
	62	18.73	110	33.23	159	48.04	

Cluster C3, with 15.90 % (2640) showed young (average age 34.16 years) male patients (71.40 %) who were referred by a state health services unit (47.50 %) with skull fracture (30.20 %) resulting from motor vehicle accidents (47.80 %). This group, with the lowest number of cases, is the one that demands the highest number of hospitalizations (57.40 %) and requires pre-hospital care (63.60 %).

Cluster C4 shows adult patients (average age 45.47 years); in this group, females had the largest presence (48.7 %), as well as injuries sustained at home (47.10 %), including lower limb fractures (35.80 %). Patients were mainly managed in the trauma area (72.60 %), with referral to outpatient services (34.80 %).

Discussion

ECI characterization enables having a better perspective on the demand in emergency departments. Data analyzed in this study show that most patients with ECI are males at productive ages from 14 to 34 years, with a descending trend as age increases. It is important taking into account that Centro Médico Lic. Adolfo López Mateos is for adult patients' care and minors are only accepted in cases of emergency.

In this work, the use of clustering algorithms is proposed in order to group ECIs according to their characteristics. The groups formed using this tool can be

appreciated to be similar to those proposed by Ávila-Burgos et al.¹ and that the results are consistent with those reported in other studies.^{1-3,19,20} This type of techniques provide additional information on the structure of the groups and the behavior of included variables.

Interpersonal aggressions away from home were found to be the most prevalent ECIs, which is in contrast with other studies that conclude that falls are. However, there is agreement on the fact that male patients (15-34 years) are more prone to suffer ECIs and that traffic accidents demand higher use of hospitalization services.^{1,3,20} In this ECI group it was also found that it is common for patients to be referred by a state health services unit and to require pre-hospital care, which can be indicative of the severity of injuries. The characteristics shown by the cluster analysis include the anatomical regions involved, place of occurrence, destination after care and patients' age and gender, among others. The main problem of this tool is the definition of the variables to be analyzed.

Detailed analyses are recommended for each defined group in order to form more specific subgroups. Detailed studies are suggested in order to detect vulnerable groups, such as minors, disabled or older adults, which serve to highlight the importance of injuries in these groups.

Interpersonal aggressions at home and self-inflicted injuries had a low prevalence; however, the WHO

Table 4. Groups of external causes found by means of cluster analysis

Variable	C1 32.7% (5417) Aggressions away from home	C2 26.3% (4 363) Traumatic contacts	C3 15.9% (2 640) Traffic accidents	C4 25% (4 147) Falls	χ^2 (p)
Affected area	Head 21.90 %	Head 18.70 %	Head 30.20 %	Lower limbs 35.80 %	3493.67 (< 0.000)
Area of care	Consultation room 49.60 %	Consultation room 68.78 %	Consultation room 32.80 %	Trauma area 72.60 %	4063.24 (< 0.000)
External cause (ICD-10)	W504 27.70 %	W509 8.40 %	V499 26.90 %	W010 35.00 %	99402.00 (< 0.000)
Consequence	Fracture 28.40 %	Injury 34.9 %	Fracture 28.70 %	Fracture 51.60 %	4072.16 (< 0.000)
Diagnosis (ICD-10)	S019 9.90 %	S098 7.70 %	S098 8.30 %	S934 6.30 %	11738.97 (< 0.000)
Place of occurrence	Street (pedestrian) 39.90 %	Home 32.70 %	Motor vehicle 47.80 %	Home 47.10 %	7312.74 (< 0.000)
Pre-hospital care	35.30 %	31.10 %	63.60 %	20.00 %	1024.97 (< 0.000)
Patient destination	Hospitalization 40.20 %	Home 44.00 %	Hospitalization 57.40 %	Outpatient services 34.80 %	1099.21 (< 0.000)
Age	34.13 F = 4.93 ($p < 0.00$)	36.91 F = 1.15 ($p < 0.00$)	34.16 F = 2.28 ($p < 0.00$)	45.47 F = 16.33 ($p < 0.00$)	----
Gender	Male 78.40 %	Male 73.40 %	Male 71.40 %	Male 51.3	1009.55 (< 0.000)

W504=Hit, struck, kicked, twisted, bitten or scratched by another person, streets and highways; W509=Hit, struck, kicked, twisted, bitten or scratched by another person, unspecified place; V499=Car occupant (any) injured in unspecified transit accident; W010=Fall on same level from slipping, tripping an stumbling, household; S019=Head injury, unspecified part; S098=Other head trauma, specified; S934=sprain of ankle.

estimates that 35 % of women in the world have suffered physical and/or sexual violence, most part of which is inflicted by the partner, who is also responsible of 38 % of female homicides committed in the world. The WHO has also established that violence is a risk factor for suicide.²¹ Owing to this, it would be prudent for studies to be carried out focusing on such causes of injury, since with the data analyzed in this work it is not possible to determine if there is some type of concealment or denial of events involving them.

It was possible verifying that for some groups of external causes such as falls, traffic accidents and interpersonal aggressions both at and away from home, age is a factor that influences on the probability of a patient being hospitalized or not. On the other hand, it is important emphasizing that although affected anatomical areas such as the abdomen, pelvis and multiple areas show a low prevalence, they have a high hospitalization percentage.

As for the days of occurrence, it is important taking into account that the information system (IS) marks the day and time of registration. If a patient arrives

close to midnight, it is possible for the registry to be made the next day of the injury occurrence. Therefore, analysis of the day following the registration and capture time would be important.

This and other similar works use information systems' data, which offer advantages in medical care and administration;²² however, it is important to make a reflection regarding their design in order for data validity to be improved. It can be appreciated that those variables that are not mandatory are usually left empty, which causes an underreporting that impacts on subsequent analysis; when there are options such as "others" it would be advisable to specify to which "other" it is being referred to in order for it to provide useful information. It would also be advisable avoiding the use of ambiguous options such as "institutional residence" and "home" for the place of occurrence variable, which may cause confusion. On the other hand, it is necessary for the registration process not to consume too much of the time that is dedicated to patient care. For this, voice recognition systems that enable faster and more accurate data capture have been proposed.²³ It is also desirable that information systems validate data

quality and detect inconsistencies and possible contradiction prior to saving the registries and alert those in charge of capture, thus avoiding information biases. Finally, they must be agile, rapid and simple, so that they don't interfere with patient care time and quality.

The main limitation of the study is that the analyzed database has no record of deaths resulting from ECIs; those that are reported are those occurred in the emergency area.

From the present study, it is concluded that continuous surveillance and a reliable registry are necessary at emergency departments in order to contribute to the prevention of ECIs, by analyzing their tendencies and behavior in specific geographic regions and providing information that leads to the development of public health strategies and policies that decrease inherent risks.

This type of studies is necessary for ECI characteristics to be known at the local level, in order to promote evidence-based decision-making, thus contributing to a better use of resources and to prevention.

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