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EVALUATION OF THE BURDEN OF PEDESTRIANS' INJURIES IN QATAR FROM ROAD TRAFFIC ACCIDENTS IN TERMS OF HEALTH CARE RESOURCES AND COST

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AUTHORS' CONTRIBUTIONS

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ABSTRACT

Background: Road traffic injures is a significant public health issue which increase the global concern after being the tenth leading causes of death worldwide. The major victims from this issue are road users which include drivers, passengers, cyclists and pedestrians. According to Qatar National Road Safety Strategy, every year around 220 people lose their lives and a further 550 victims are seriously injured due to road traffic accidents (National Road Safety Strategy, 2013-2022). However, pedestrians' fatal injuries constitute about twelve percent of the total death rate.

Objective: To investigate the health care resources and costs burden of pedestrian injuries from Road Traffic Accidents (RTAs) in Qatar during 2009 to 2011 and to estimate the injury severity score and mortality rates among these patients in order to provide evidence on the burden of managing pedestrians' injuries in Qatar.

Methods: A retrospective cross sectional analysis of data collected from Hamad General Hospital trauma registry between January 2009 and December 2011. We used a cost model for various healthcare services used by the HMC Finance Department. Resource use and cost data are produced across various injury severity scores and years. Since this study is investigating and analyzing pedestrians' injury resources and costs, the injury severity score is chosen as the main variable reflecting the total cost, length of stay (LOS) cost, intensive care unit (ICU) cost, ward unit cost, total procedure cost, total diagnostic cost, and blood unit cost. The frequency of sex, nationality 1 (Arab – Non-Arab – Qatari), nationality 2 (Nepal, India, Pakistan, Bangladesh, Philippines, and others), and year were analyzed. Data were analyzed using SPSS program.

Results: The discoveries of this report could be determined as the following; the majority of pedestrians' injury was males and the highest rate of admission was in year 2011. It can be noticed that there are significant differences in diagnosis cost due to years with p-value <0.0001. The injury severity score had a strong relationship with the total cost, length of stay (LOS), total procedure cost, total diagnostic cost, and blood unit cost. Thus, there are significant differences between groups of total procedure cost, LOS cost, blood unit cost, and total cost due to ISS with p-value <0.0001. The injury severity score had a strong relationship with the total cost, length of stay (LOS), total procedure cost, total diagnostic cost, and blood unit cost.

Conclusion: This report offers evidence on healthcare resources and costs burden of pedestrians' injuries over three years period in Qatar. It gives indication on how to better manage these patients in terms of healthcare resource allocations, and can be used in future planning by policy makers.

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Keywords: Pedestrians; economic; injuries; cost; Qatar; accidents; road; safety.

1. INTRODUCTION

Road traffic injures is a significant public health issue which increases the global concern after being the tenth leading causes of death worldwide [1]. The major victims from this issue are road users which include drivers, passengers, cyclists and pedestrians. World Health Organization reviewed a fact sheet on November 2016 reported that around 20 to 50 million of people are suffering from non-fatal injuries (World Health Organization, 2016). In addition, Pedestrian injuries are raising public health threats around the world; especially the global economic burden of car collisions and pedestrian injuries are totals $500 billion. From a global perspective, this public health concern is more evident in developing nations [2-4]. In particular, developed countries including state of Qatar, are now experiencing burden of road safety crisis. In Qatar, road traffic crashes is the second leading cause of death resulted from fatal injuries. According to Qatar National Road Safety Strategy, every year around 220 people lose their lives and a further 550 victims are seriously injured due to road traffic accidents [5]. These figures are responsible for approximately 18% of the total mortality rate in Qatar. However, pedestrians' fatal injuries constitute about twelve percent of the total death rate.

In the state of Qatar, expatriate workers constitute the majority of population and the major victims of pedestrians too. According to Hamad Medical Corporation, 92% of pedestrian victims are from Pakistan, India, Bangladesh, Sri Lanka and Nepal (Hamad Medical Corporation, 2015). Also, Dr. Rafael J. Consunji, the Director of Injury Prevention in Hamad Medical Corporation (HMC) reported that most pedestrian accidents occurred during the weekend especially Thursdays evening (Hamad Medical Corporation, 2015). Moreover, it appears to be that most of the pedestrian accidents occur during late afternoon and early morning of the day. Furthermore, fifty-six percent of pedestrians died due to night road accidents and nineteen percent of road accidents during 2012 and 2013 happened in the Industrial Area at night. However, 71% of the pedestrians expired at the accident location (Hamad Medical Corporation, 2015). These figures and information of pedestrian's victims of workers shows poor socio-economic status and cultural barrier in communication. Moreover, these injuries make economic burden to the healthcare system in Qatar [6,7].

Thus, the objectives of this report are:

1. To investigate the health care resources and costs pedestrian injuries from Road Traffic Accidents in Qatar during 2009 to 2011.
2. To investigate injury severity score (ISS) and mortality rate among these patients.

1.1 Overview: Road Traffic Safety Regulation

Qatar is one of the countries which maintain carefully traffic safety laws for all road users due to high incidence rate of road traffic accidents each year. The government has promoted National Road Safety Strategy 2013-2022 to decrease the people suffering from road traffic crashes and raise the level of traffic law obligation among the public [2]. The main vision of the National Road Safety Strategy (NRSS) is ensuring "safe road transport system that protects all road users from death and serious injury"[1]. This strategy is formed by Ministry of interior and with help of "Public Works Authority" (Ashghal) in order to improve road safety in Qatar within the next 5 years and lays the foundations for a safe road transport system that will benefit future generations. The Committee of National Road Safety Strategy (NRSS) is looking at the implementation of the strategy within the Road Safety Action Plan 2013-2017. Pedestrian's safety is one of the National Road Safety Strategy (NRSS) considerations due to suffering from severe injuries resulted from road accident. Statistics from Ministry Of Interior MOI had shown that from 2008 to 2010, about 33% of all road fatalities injuries and 29% of all serious injuries involved pedestrians (Ministry Of Interior, 2011). One of National Road Safety Strategy (NRSS) facilities was presented effective campaigns in different languages Arabic, English, Hindi and Tamil to orient the public about pedestrian's safety law and raise the level of awareness among the drivers.

National Road Safety Strategy 2013-2022 has been Actions for pedestrian safety to decrease the incidence rate of fetal and severe injuries and maintain road safety. Pedestrians safety actions include conduct effective campaigns on pedestrian safety, teach children and young students in schools and colleges about safe road use and improve the design and shape. Also, add consistent and complete footpaths and crossings zebra lines for pedestrians. In addition, encourage to use high visibility reflective clothing color or bags for pedestrians using the roads at night. By the other hand, road traffic law in Qatar initiates

[1] *National Road Safety Strategy 2011-2016.*

violations relating to the safety of pedestrians as shown in the Table1.

Traffic-related pedestrian injuries (TRPI) are powerless against street clients. However, Road traffic injuries (RTIs) are a critical general wellbeing test and anticipated to be the fifth driving patron to the worldwide weight of sickness by 2030. More than 90% of lethal accidents happen in low and middle-income nations with generous results, especially for defenseless street clients, for example, pedestrians, cyclists, and riders of mechanized bikes [8]. In this research, we aim to identify and analyze the economic burden of pedestrian injuries for all aged groups in Qatar during 2009 to 2011. To this end, we attempted an orderly audit of the published literature of studies researching the weight of and modifiable hazard elements for RTIs in created and creating nations. These reviews are mostly focused on health impact and here we found the gap in these studies that they didn't identify the healthcare resources cost burden of pedestrian's lives.

1.2 Economic Cost of Pedestrian Injuries

In Stockholm city during 2008, a study analyzed pedestrian's injuries cost at zebra crossings; in order to decrease the incidence rates and economic cost [9. In this study, data were collected from different sources such as Swedish Civil Contingencies Agency, traffic office police and hospitals. The sample size was 166 including 90 women and 76 man of pedestrians injured during 2008. Researchers used cost of Illness method to measure the cost of accident, hospitalization and administration cost. However, material costs were not included due to lack of data on pedestrian injuries. The results were clearly highlighted that around 73 including 39 women and 34 men pedestrians injured occurred at zebra crossings which involve 20 severe injuries cases and 53 minor injuries cases. The Majority of injuries (43%) occurred among winter and dark seasons from November to February. Also, the highest rate of injuries (41%) happened during late afternoon and evening time between 1500 – 1900 h. In addition, the highest attribution (38%) of severe injuries was for the young people aged (20 – 29 years) and (20%) for elderly people above (60 years). The estimated cost of the severe injured pedestrians was 9.2 million SEK and 1.6 million SEK for the cost for minor injuries. Thus, the results of the study concluded that Injuries place the society significant amounts of money every year and recommended place speed bumps and adjacent lights to zebra crossings where the most pedestrian injuries incidence occur.

In their study of [10] which was conducted in New South Wales in Australia to estimate the cost of injury recovery for pedestrian resulted from vehicle collisions. It has used data from hospitals separation records for people who were injured and hospitalized in New South Wales among 2002 to 2011. In this study, personal injury recovers cost (PIRC) equation used the key demographic and injury characteristics. This equation helped the economic cost burden of traffic injury of a total 9,781 pedestrians who were injured to be calculated. The economic evaluation of the study includes individual recovery costs associated with severe brain injury. However, the costs associated with property damage, vehicle repair or rescue services were not included. The results highlighted that brain injury cases were 22.6% of the total injury recovery costs which estimated about 2.4$ billion in personal injury recovery costs. However, the annual recovery cost was $243 million. A single injury recovery cost was ($153,682). Additionally, results shown Males had a total injury recovery cost 1.7 times higher than females. Thus, median injury recovery cost dropped with increasing age.

In United States, many studies have been conducted to evaluate the economic burden of pedestrian injuries. This study was aimed to measure the economic cost of pedestrian and pedal cyclist injuries in the United States and the range of motor vehicle associated with the age group during 2000. Huge data were be utilized from Traffic Safety Facts in National Highway Traffic Safety Administration and Fatality Analysis Reporting center. A total number of 203,260 pedestrian injuries sever cases recorded in United States within 2000. Cross-sectional analysis was used to analyze data for medical care costs, wage work losses and household, ages and severity. The results of the study presented those children under age five experience higher costs than their elders and younger ages from 5-14 face greater annual risks if they are walking or driving their own pedaled vehicles. However, the total estimated Costs of pedestrian and pedal cycle injuries in 2000 was $40 billion including 51.7% of medical cost.

Table 1. Road traffic law related to pedestrian's safety in Qatar

Type of Violation	Fine Amount	Points
Drivers speed at pedestrian crossings lines	QR.300	Nil
If pedestrian does not take necessary precaution while crossing the main road.	QR.200	Nil
If the pedestrian does not follow the traffic signs and signal for directives while crossing the road	QR.500	Nil
If the driver park motor or wait at assigned places for pedestrian crossings area.	QR.300	3

Another paper of [11] similarly was conducted in San Francisco. It was the first study had examined direct cost in details and mentioned how it applies to particular regions in a city. The purpose of this paper was to describe the pedestrian injured population associated hospital actual costs in San Francisco hospitals. The unique point in this paper is reporting the cost rather than charging data. The Data of 3,598 pedestrians injured cases were collected from several sources such as hospital billing information system, patient medical records, and trauma centers and police reports during 2004 – 2008. However, the analysis of injury cost according to body regions affected was replaced with a geographic analysis cost. The study results highlighted the economic burden of pedestrian injuries during the five years period amounted to $171 million. In addition, total cost medical care in one year was $74.3 million. These costs are underrated as they do not cover indirect costs, such as those incurred after discharge. The major challenges in this paper of mapping cost by collision location were the lack of available data to match incidents identified by the Trauma Registry to police reports.

From a general wellbeing point of view, a cost-benefit analysis investigation of utilizing bicycle/pedestrian trails in Lincoln, Nebraska, to decrease human services costs related with inertia was directed. Information was gotten from the city 1998 Recreational Trails Census Report and the writing. Per capita yearly cost of utilizing the trails was U.S.$209.28 ($59.28 development and upkeep, $150 of hardware and travel). Per capita yearly direct health advantage of utilizing the trails was $564.41. The money saving advantage proportion was 2.94, which implies that each $1 interest in trails for physical movement prompted $2.94 in direct health advantage. The sensitivity analyses demonstrated the proportions extended from 1.65 to 13.40. In this manner, building trails is cost useful from a general wellbeing viewpoint. The most sensitive parameter influencing the money saving advantage proportions were gear and travel costs; in any case, even for the most astounding cost, each $1 interest in trails brought about a more prominent return in direct health advantage [12].

In Sydney, a study of Small et al [13] examined the differences between pedestrian and motor vehicle in terms of demographics, injury profile, outcomes, and cost. The population included in this study was who injured in years 2002 – 2004 and admitted as inpatients. The highest injuries were related to men more than women with the main age of 46. In addition to that, most of injuries which happen in the city of Sydney were on Friday during autumn season. The type of injuries that the study showed is muscle-skeletal, head, and external injuries and the percentage of them as a following are: 34.3%, 31.8%, and 20.2%. Furthermore, approximately half of patients had alcohol consuming positive with 0.22% concentration which classifying as a bad outcome in terms of hospital, intensive care unit, morbidity, and mortality. Moreover, 13.4 was the average day of length of stay and costing a$16320 per each admission. Sixteen patients out of one hundred and eighteen were died and the highest rate was among elderly group (22.7%).

In Iran, a study of (2014) analyzed the costs of RCTs in Iran, using the data about the number of morbidities and mortalities from two national databases designed at the Centre for Disaster Management and Medical Emergencies (CDMME) and the Legal Medicine Organizations (LMO) between 20 March 2009 and 20 March 2010. The medical costs and severity of injures were obtained by selecting 400 medical records randomly from two large trauma centers in Tehran providence. In addition, data about rehabilitation costs, productions lost, administrative cost, property cost and intangible cost were reviewed by the reviewer of the current evidence with consultant of experts. Costs were estimated by using standard human capital method. Costs include administrative, medical and funeral costs, production lost, property damage and intangible costs. The total death from RTCs is 22,974. The total costs of RTCs were approximately 72,465 billion Rials (around 7.2 billion US Dollars), which attribute to 2.19% of Iran's Gross Domestic production. Direct costs were around 3,516 billion Rials which is 48.6% of the total costs. Moreover, cost of production lost were approximately around 24,785 billion Rials which accountable for 34.2% of the total cost. 12,513 billion Rials was attributed for intangible costs which is around 17.2 of the total coats. The economic burden of road traffic crashes in Iran has been substantial and significant drain on healthcare resources.

In Vietnam, study estimated the costs of road traffic injuries and examined the factors associated with increased costs in Vietnam. A prospective cohort study was conducted to analyze the impact of injuries in Vietnam. Eligible participants who had road traffic injuries were admitted to the Thai Binh General Hospital. Costs were obtained from hospitalization which includes direct medical, direct non-medical and indirect costs incurred by participants and their care givers. Generalized linear models were used to analyze factors associated with increased costs including demographic and injury context characteristics. The average cost of hospitalization costs from road traffic crashes per patient and their family is US$363 or it attribute to 6 months of average salary. The study found that income, severity of injury, principle site of injury and length of stay were significant factors of increased costs. However, age, gender, occupation and type of road user were not statistically significant. Injury characteristics and income were controlled and found that participants with principal injuries to the lower extremities had a cost 1.28 (95% CI 1.07 to 1.54) times higher than those with principal injuries to the face. Motorcyclists with head injury tend to had increased costs comparing with riders without helmet (1.41 times higher, 95% CI 1.17 to 1.71).

Another study in New Zealand, the hospital inpatients costs of injury treatment were recruited from Dunedin Hospital by using Resource Utilization System. Data were used to estimate inpatients costs caused by road traffic crashes. The study found that injuries were more expensive to treat than non-injurers ($3,115 vs. $2,749 per case). The average cost of treating a patient varied depending on road user group, nature and severity of injury. Pedestrians were twice costly comparing to motor vehicle occupants. Internal injuries were 4.5 times more expensive to treat than intracranial injuries. In addition, critical injuries were 15 times more expensive to treat than minor injuries. Pedestrians treatment cost were higher than other type of road user. National pedestrians contribute for 18% of the total cost and they accounted for 10% of all road user hospitalization. The highest cost was attributed to internal injuries which account for 16% and the cases were 7% followed by severe and critical injuries combined which accounted for 19% of total costs and attributed to 6% of total cases. Total national costs were attributed by occupants 43%, moderate injuries 37% and lower limb fracture 24%. The study showed that between 43.0$ million and 47.4$ million were approximately the annual inpatients treatment cost. Moreover, the national cost of treating the late effect of road traffic crashes was approximately 9.1 $ million.

1.3 Severity of Injuries for Pedestrian

In five European countries, an investigation of [14] analyzed seriousness and result of TBI (traumatic brain injuries) brought about by street auto collisions in various sorts of street clients in five European nations. The statistic, seriousness and result measures of 683 people with RTA-related TBI from Austria, Slovakia, Bosnia, Croatia and Macedonia were broke down. Five sorts of street users (car drivers, car passengers, motorcyclists, bicyclists and pedestrians) were thought about utilizing univariate and multivariate factual techniques. Short-term result [intensive care unit (ICU) survival] and last accessible long-term result of patients were evaluated. In their informational collection, 44% of TBI were road traffic related. The median age of patients was 32.5 years, being the most minimal (25 years) in car passengers. The most serious and broad wounds were accounted for pedestrians. People on foot had the most minimal rate of ICU survival (60%) and ideal long-term result (46%). Drivers had the most noteworthy ICU survival (73%) and car passengers had the best long-term result (59% good). No distinctions in the result were found between nations with various economy levels. TBI are fundamentally connected with RTA and in this way, handling them together could be more compelling. The population at most astounding danger of RTA-related TBI is youthful guys (in their sample middle age: 32.5 years). Pedestrians have the most extreme TBI with the most noticeably bad result. Both groups ought to be a need for general wellbeing activity or action.

In their cross-sectional study Aliyeh, et al [15] were researching the monetary weight of street auto collisions (RTAs) in patients admitted to a solitary focus in south eastern Iran. This cross-sectional review was directed in Amir-Al-Momenin clinic of Zabol associated with Zabol University of Medical Sciences amid a 12-month time frame from April 2012 to April 2013. All the RTAs patients who were admitted to our crisis division were incorporated. The immediate costs of healing facility care were recorded by their medicinal outlines and the accountant enlistment data. Information are displayed by various RTAs qualities. General 1155 patients were incorporated into the present review with mean age of 36.7 ± 5.14 years among whom there were 673(58.3%) men and 482 (41.7%) ladies. The yearly frequency of RTAs was ascertained to be 288 for every 100,000 population. The RTAs monetary weight in their inside was 589,448.49 USD which represented 10.4% of aggregate healing center costs amid their review period. The cash spend on RTAs in their middle was 130 circumstances more than gross national salary per capita. Cost of every patient in

street traffic was 15 times more than cost of a normal patient of the doctor's facility in different areas. With extensive high proportion of accidents in Zabol, proper mediation is required for controlling and forestalling RTAs keeping in mind the end goal to decrease its wounds, affect and the related financial or economic weight.

In their case control investigation of individual and ecological hazard components for youngster person on foot RTIs in San Juan de Mira Flores, Lima, Peru´. The examination of individual hazard variables included 100 instances of genuine walker RTIs and 200 age and sexual orientation coordinated controls. Statistic, financial, and harm information were gathered. The natural hazard considers think about assessed vehicle and person on foot development and framework at the destinations in which 40 of the above case RTIs happened and 80 control locales. Likewise, Tyke passerby street movement wounds (RTIs) are an imperative reason for death and inability in poorer countries, be that as it may, RTI aversion procedures in those nations draw upon studies led in wealthier nations. This examination explored individual and ecological hazard components for tyke walker RTIs pertinent to an urban, creating world setting. After alteration, variables related with expanded danger of kid person on foot RTIs included high vehicle volume (OR 7.88, 95%CI 1.97–31.52), truant path divisions (OR 6.59, 95% CI 1.65–26.26), high vehicle speed (OR 5.35, 95%CI 1.55– 18.54), high road merchant thickness (OR 1.25, 95%CI 1.01–1.55), and more youngsters living in the home (OR 1.25, 95%CI 1.00– 1.56). Defensive components included more hours/day spent in school (OR 0.52, 95%CI 0.33–0.82) and years of family home in a similar home (OR 0.97, 95%CI 0.95–0.99).

2. METHODOLOGY

A cross-sectional retrospective analysis of data collected from the HMC trauma registry between January 2009 and December 2011. Trauma registry data set demographic variables such as age, gender, nationality 1 (Arab – Non-Arab – Qatari), nationality 2 (Nepal, India, Pakistan, Bangladesh, Philippines, and others). Also, injury severity score (ISS), hospital length of stay (LOS), intensive care unit (ICU), emergency medical services (EMS) and cost of procedures, were analyzed. We used a cost model used by the HMC Finance Department to cost healthcare services used, such as LOS, Trauma unit, tests and investigations, surgical procedures, blood units, etc. The HMC cost model does not include costs of some of the procedures done at the HMC Trauma Center, e.g. Tracheostomy and Thoracotomy. For costing these two procedures, we applied a cost model used in the United Arab Emirates (UAE) [16]. This has been done after consultation with the respective consultant at the HMC Trauma Center, and considering the similarities in healthcare settings between two neighboring countries. Data were presented as mean, 95% confidence interval (CI) for diagnosis cost, procedure cost, LOS cost, and blood unit cost. The demographic variables were presented as frequencies and percentages. We provide our results by year and by categories of injury severity scores (ISS).

2.1 Data

This study was done to investigate and analyze the health care resources and costs burden of pedestrian injuries from Road Traffic Accidents (RTAs) and to estimate the injury severity score and mortality rates among these patients. Pedestrian injures is a highlighted problem in Qatar and there is a study done with the same data that we used but in terms of health outcomes. The data that we use in our study do not include individual patient level of EMS therefore we cannot cost EMS on patient level. In order to cost EMS on patient level, we estimate it based on the literature which shows that 86% patients used EMS for trauma road traffic accident related to trauma services [17]. Then we calculated the total cost based on this estimation and we know that the number of patients that used the EMS is 517 out of 601. Therefore, EMS cost becomes a fixed cost for all patients.

2.2 Data Collection

A retrospective cross-sectional analysis of data collected from Hamad General Hospital trauma registry between January 2009 and December 2011. A frequency tables were generated to find out resources used for the selected variables using SPSS. Descriptive analysis was performed to find out the cost of pedestrian injuries across selected characteristics. Data was distributed by years and Injury Severity Scores (ISS). Graphical analysis using the pie and bar diagrams was conducted by using SPSS.

3. RESULTS

Our finding was related to our research questions that influence our study. Data were collected to investigate and analyze the health care resources and costs burden of pedestrian injuries from Road Traffic Accidents (RTAs) in Qatar during 2009 to 2011 and to estimate the injury severity score and mortality rates among these patients across different variables namely; procedure cost, diagnosis cost, blood unit cost, and

LOS cost. The total population size is 601, including both male and female. In this study, we only focused on the variables that we were interested in that are serving our study questions. Furthermore, we kept the missing data and we reported them.

3.1 Demographic Variables from 2009 to 2011

From the table above, it can be seen that 556 cases of males with percentage of (92.5%). 44 cases of females with percentage of (7.3%). According to the nationality 1 most cases of non-Arab with percentage of (70.9%). Followed by Arab (Non-Qatari) with percentage of (16.3%) and (7.5%) of Qataris (Fig. 1). It can be seen that, most cases of pedestrians from Nepal with percentage of 24.1%. Followed by India with percentage of (16.1%), (8.3%) goes for Pakistan. (5.7%), (3.8%) and (3.7%) go for Bangladesh, Srilanka and Phillipines respectively. (9.2%) from other countries not mentioned. The table shows that 202 cases in 2009 with (33.6%). In 2010 the cases decrease to 182 with (30.3%) then the cases raised in 2011 with (36.1%) and 217 cases (Fig. 2).

Table 2. Cross-sectional study population characteristics

	Frequency	Percent (%)
Gender		
Male	556	92.5
Female	44	7.3
Nationality 1		
Arab (Non Qatari)	98	16.3
Non-Arab	426	70.9
Qatari	45	7.5
Nationality 2		
Nepal	145	34.0
India	97	22.8
Pakistan	50	11.7
Bangladesh	34	8.0
Phillipines	22	5.2
Srilanka	23	5.4
Others	55	12.9
Year		
2009	202	33.6
2010	182	30.3
2011	217	36.1

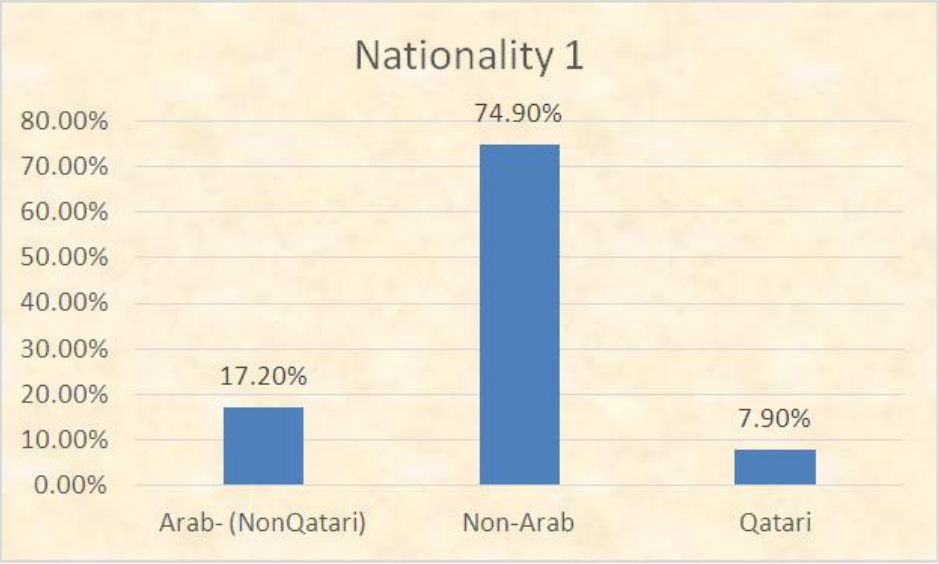

Fig. 1. Nationality1 of pedestrian injury

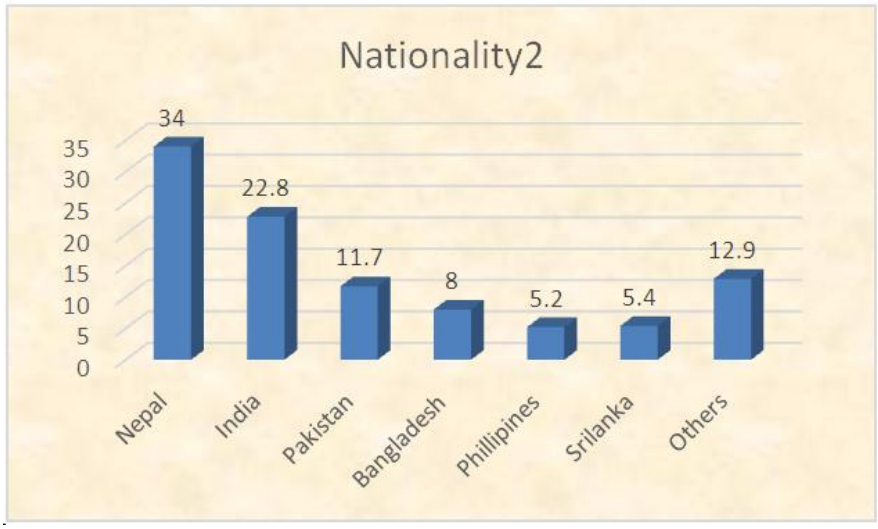

Fig. 2. Nationality2 of pedestrian injury

Table 3. Mortality rate of pedestrians' injury

Outcome	Frequency	Percentage (%)
Alive	509	84.7
Dead	92	15.3

3.2 Resources

3.2.1 Days and blood unit

It can be seen from the previous table that the average ICU days is 2.95 with percentage of 95% CI: 2.20 to 3.70 and SD 9.33. The average Ward unit days is 12.21 with 95% CI: 10.19 to 14.22 and SD 25.18. The average of LOS days is 15.83 and we are confident with percentage of 95%: 12.84 to 17.48 and SD 28.95. The average of blood unit is 0.63 with percentage of 95% CI: 0.40 to 0.85 and SD 2.82.

3.2.2 Procedures

The statistics table above presents the procedures of pedestrians' injury of 558 patients where 13 patients were missing. However, it illustrates that 180 cases have Intubated ETT with percentage of (30.6%). Second, there were 38 cases have undergone to the procedure of Ex Lap with percentage of (6.5%). Third, only 6 cases have undergone to the procedure of Thoracotomy with percentage of 1% which represent the lowest percentage among all procedures. Furthermore, there were 50 cases have undergone to the procedure of Chest Tube Insertion with percentage of (8.5%). Also, there were 13 cases have undergone to the procedure of Tracheostomy with percentage of (2.2%).Finally, 144 cases have undergone to the procedure of ORIF with percentage of (24.5%).

3.3 Diagnostic

The table above present the diagnostic of pedestrians' injury of 558 patients where 13 patients were missing. first, 396 cases have undergone to a CT Head diagnosis with percentage of (67.3%). Second, 239 cases have undergone to a CT Chest diagnosis with percentage of (40.6%). Also, 384 cases have undergone to a CT Abd with percentage of (65.3%). Moreover, 188 cases have undergone to an X-Ray Chest with percentage of (32%). Finally, 180 cases have undergone to an X-Ray Pelvis with percentage of (30.6%).

Table 4. Resources used by pedestrian injury

	Mean	SD	95% CI
ICU days	2.95	9.332	2.20 – 3.70
Ward unit days	12.21	25.178	10.19 - 14.22
LOS days	15.16	28.952	12.84 – 17.48
Blood Unit	0.63	2.820	0.40 – 0.85

Table 5. Procedures distribution of pedestrian injury

Procedure	Frequency	Percentage
Intubated ETT	180	30.6%
Procedure (Ex Lap) [1]	38	6.5%
Procedure (Thoracotomy) [5]	6	1.0%
Procedure (Chest Tube Insertion) [10]	50	8.5%
Procedure (Tracheostomy) [13]	13	2.2%
Procedure (ORIF) [15]	144	24.5%

Table 6. Diagnostic distribution of pedestrian injury

Diagnostic	Frequency	Percentage
CT Head	396	67.3%
CT Chest	239	40.6%
CT Abd	384	65.3%
X-ray Chest	188	32.0%
X-ray Pelvis	180	30.6%

Table 7. Years- specific differences in diagnostic, procedures, and length of stay (LOS) costs and total cost

	2009	2010	2011	F-value	P-value
Total Diagnostic cost	1254.36 QR	1470.44 QR	1731.84 QR	11.45	<0.0001
Total Procedure cost	1969.55 QR	2059.67 QR	1807.79 QR	0.40	0.691
Length of stay (LOS) cost	60035.51 QR	51919.31 QR	45824.15 QR	1.05	0.351
Total Cost	**64857.86** QR	**57131.42** QR	**51412.88** QR	**0.923**	**0.398**

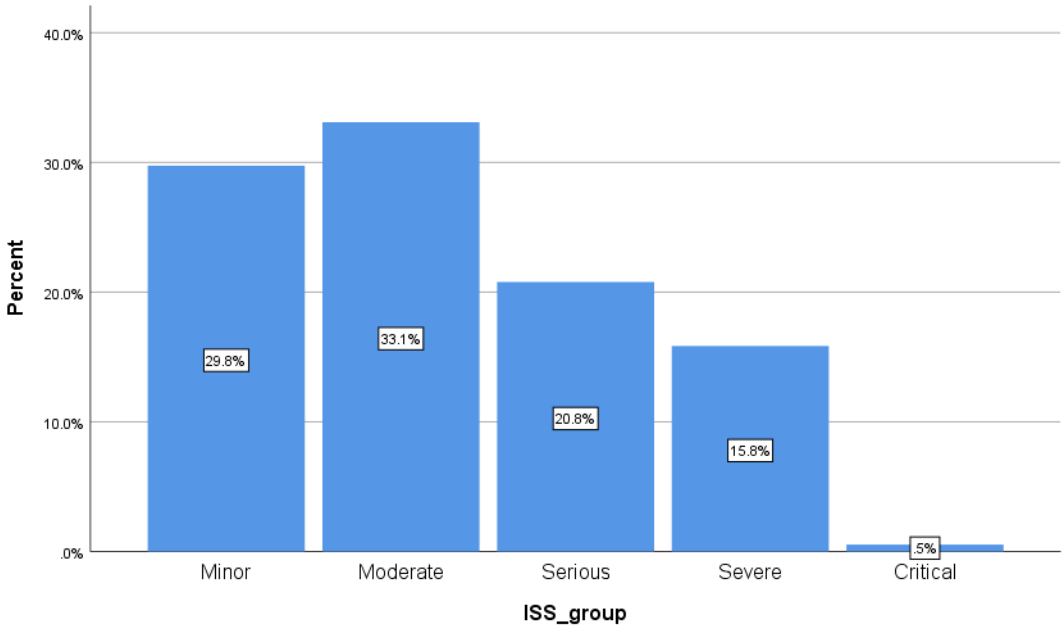

Fig. 3. Frequency percent for ISS group

Table 8. Distribution of the cost by ISS Injury severity score differences in our study's resources

	Minor	Moderate	Serious	Severe	Critical	F-value	P-value
Diagnostic Cost	1316.33 QR	1464.31 QR	1945.34 QR	1679.89 QR	676.67 QR	8.30	<0.0001
Procedure Cost	1569.53 QR	1771.12 QR	2825.00 QR	2195.78 QR	3646.67 QR	3.80	0.005
LOS Cost	34052.96 QR	40385.88 QR	93206.45 QR	73276.78 QR	7285.67 QR	8.04	<0.0001
ICU Cost	1931.54 QR	9269.76 QR	32303.90 QR	38083.50 QR	5265.00 QR	12.52	<0.0001
Ward Cost	32121.43 QR	31116.12 QR	60902.55 QR	35193.28 QR	2020.67 QR	3.40	0.009
B.U Cost	49.23 QR	11.06 QR	762.37 QR	751.11 QR	2773.33 QR	14.50	<0.0001
Total Cost	**38450.05** QR	**45094.37** QR	**100201.16** QR	**79365.56** QR	**15844.33** QR	**8.60**	<0.0001

3.4 Cost of Resources Used

3.4.1 Distribution of the cost by years

According to the table, the diagnostic costs is increasing from 2009 to 2011, where the average cost of 2009 is 1254.36. Moreover, the average cost of 2010 is 1470.44 and the average cost of 2011 is 1731.84. From the ANOVA analysis, it can be noticed that there are significant differences in diagnosis cost due to years, where F-value is 11.45 and p-value is <0.0001. The average cost of 2009 is 1969.55. The average cost of 2010 is 2059.67. Last but not least, the average cost of 2011 is 1807.79. Although there is a reduction in procedure costs over the 3 years, but regarding to ANOVA analysis, it can be seen that there are no significant differences in procedure cost due to years, where F-value is 0.371 and p-value is 0.691. For length of stay cost, it shows that there are 202 cases diagnosed in 2009 with average cost 60035.51. 182 cases in 2010 with average cost 51919.31 followed by 217 cases in 2011 with average cost 45824.15. Although there is a reduction in LOS costs over 3 years, but regarding to ANOVA analysis, it shows that there are no significant differences in LOS cost due to years, where F-value is 1.05 and p-value is 0.351. Furthermore, in state of procedure cost, it shows that the average cost of 2009 is 64857.86. The average cost of 2010 is 57131.42. In 2011 the average cost is 51412.88. Although there is a reduction in total costs over the 3 years, but regarding to ANOVA analysis, it can be noticed that there are no significant differences in total cost due to years, where F-value is 0.923 and significant value is <0398.

Fig. 3 shows the frequency and percentage of injury severity score (ISS). The highest percentage is the moderate (23.1%) and the lowest percentage is the critical (5%). According to Diagnosis cost, it can be seen that the average cost of Minor injured patients is 1316.33 QR. The average cost of the moderate injured patients is 1464.31 QR. The average cost of the serious injured patients is 1945.34 QR. The average cost of the severe injured patients is 1679.89 QR. However, the average cost of Critical injured patients is 676.67 QR. The ANOVA analysis shows that there are significant differences in the average diagnosis cost across various ISS groups (F-value is 8.30, p-value is <0.0001).

For Procedure cost, the average cost of Minor injured patients is 1569.53 QR. The average cost of Moderate injured patients is 1771.12 QR. The average cost of Serious injured patients is 2825 QR. The average cost of severe injured patients is 2195.78 QR. The average cost of Critical injured patients 3646.67 QR. From ANOVA analysis, it can be seen that there are significant differences between groups of total procedure cost due to ISS, where F-value is 3.80 and significant value is <0.0001.

In terms of length of stay (LOS) cost and as the figure above shown that there are 169 Minor injured patients' cases with an average cost 34052.96 QR. 188 cases are Moderate injured patients with an average 40385.88 QR. 118 cases are Serious injured patients with an average cost of 93206.45 QR. 90 cases are Severe injured patients with an average cost of 93206.45 QR. Only 3 cases are Critical injured patients with an average cost of 7285.67 QR. From ANOVA analysis, it can be noticed that there are significant differences between groups of LOS cost due to ISS, where F-value is 8.04 and significant value is <0.0001.

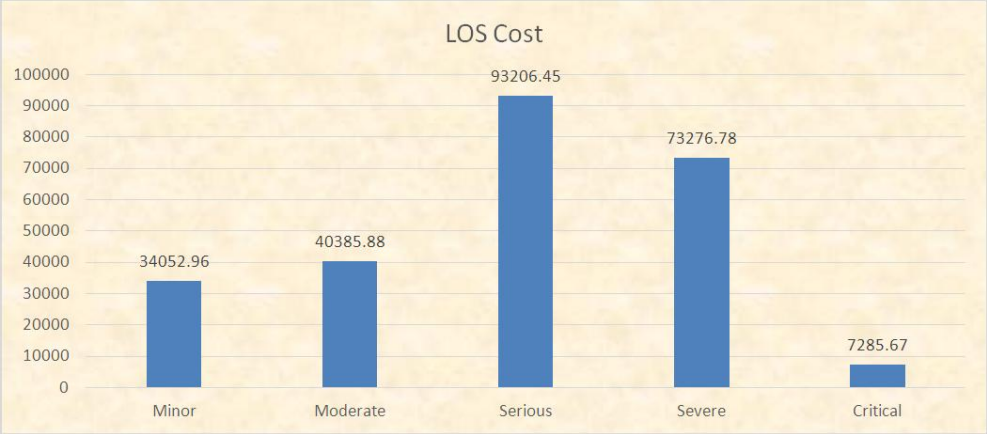

Fig. 4. Pedestrian injury and LOS cost stratified by ISS

For ICU cost, the average cost of Minor injured patients is 1931.54 QR. The average cost of Moderate injured patients is 9269.76 QR. The average cost of Serious injured patients is 32303.9 QR. The average cost of Severe injured patients is 38083 QR. The average cost of Critical injured patients is 5265. From ANOVA analysis, it can be seen that there are significant differences between groups of ICU cost due to ISS, where F-value is 12.52 and significant value is <0.0001.

According to Ward unit cost it can be noticed that the average cost of Minor injured patients is 32121.43 QR. The average cost of Moderate injured patients is 31116.12 QR. The average cost of Serious injured patients is 60902.55 QR. The average cost of Severe injured patients is 35193.28 QR. The average cost of Critical injured patients is 2020.67 QR. From ANOVA analysis, it can be seen that there are significant differences between groups of Ward cost due to ISS, where F-value is 3.40 and significant value is 0.009.

In terms of blood unit cost, the average cost of Minor injured patients is 49.23 QR. The average cost of Moderate injured patients is 11.06 QR. The average cost of Serious injured patients is 762.37 QR. The average cost of Severe injured patients is 751.11 QR. The average cost of Critical injured patients is 2773.33 QR. From ANOVA analysis, it can be seen that there are significant differences between groups of blood unit cost due to ISS, where F-value is 14.50 and significant value is <0.0001.

According to total cost, the average cost of Minor injured patients is 38450.05 QR. The average cost of Moderate injured patients is 45094.37 QR. The average cost of Serious injured patients is 100201.16 QR. The average cost of Severe injured patients is 79365.56 QR. The average cost of Critical injured patients is 15844.33 QR. From ANOVA analysis, it can be seen that there are significant differences between groups of total cost due to ISS, where F-value is 8.60 and significant value is <0.0001.

4. DISCUSSION

We can clearly notice that the mean of length of stay (LOS) and blood unit is very low and that because of the majority of victims of pedestrians' injury were admitted and died at the same day. Although the number of admission patient within three years and in terms of ISS are not changing significantly, but the total cost was drop significantly. That is because of changing happened through ISS. For instance, Serious and severe injuries which have the highest cost are decreased and stick similar in both 2010 and 2011. The severe injuries were become decreased by years. The main strength in our study is the first one in Qatar explored the burden of healthcare resources for pedestrian's injuries cost resulted from traffic accidents. In the term of limitations, missing data for the in-direct cost was a major challenge in the study. The first one is the costing of ambulance services. In fact, we don't have any exact figure of percentage for patients who used EMS services, so we used estimation from another local source to estimate the percentage of patients who used ambulance services. However, we workout the ambulance services cost by using this estimate and we spread the ambulance services cost by dividing the total cost with sample size. The other point in missing data is tracheostomy and thoracotomy procedures cost. Since Hamad Medical Corporation don't hold or provide any unit cost for these procedures, we explored outside source cost from another healthcare settings in UAE. Actually, we estimate tracheostomy and thoracotomy procedures cost from Dubai hospital and used cost model to create our missing costs [17]. Since these costs from different healthcare settings are not directly related to our healthcare settings so this was another limitation of the study.

5. CONCLUSION

This study has shown the economic burden of pedestrian injury in trauma registry at Hamad General Hospital in Qatar. During the data analysis, its proved that our main outcome which is the injury severity score (ISS) reflecting the total cost, length of stay (LOS) cost, intensive care unit (ICU) cost, ward unit cost, total procedure cost, total diagnostic cost, and blood unit cost. Throughout this cross-sectional study, the data of a total of 601 victims of pedestrians' injury with various aged groups and nationalities were analyzed.

CONSENT AND ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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