

Individual and Injury Characteristics as Risk Factors for Length of Hospital Stay (LOS) among Vehicular Crash Patients in Philippine Tertiary Hospitals

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ABSTRACT

Background. Mobility in the Philippines has increasingly become a major issue, especially with the growing economy of the country. Road transport in the country is still substandard despite a rise in budget for infrastructure and road repair. Hence, there is a need to focus efforts on reducing vehicular crashes.

Objective. This study looked into the length of hospital stay (LOS) and factors affecting LOS among vehicular crash victims brought to the major tertiary hospitals located in the three major metropolitan areas in the Philippines.

Methods. Data gathering and processing of road crash patients brought to the major tertiary hospitals in the Philippines from 2009 to 2020 were done. Descriptive statistics and inferential statistics such as the Kruskal-Wallis H Test and Cox Regression analysis were used.

Results. The average length of hospital stay of the victims is 6.98 days (± 2.26), with 2016 recording the highest LOS (10.44 days) and 2020 the lowest (2.99 days). On the other hand, the median length of hospital stay of road crash victims is 3 days, with the years 2011 to 2014 having the highest median length of hospitalization (6 days), while 2019 had the lowest median length of hospital stay. Using Kruskal-Wallis H Test, length of hospitalization is associated with sex ($H(1) = 300.411, p < 0.001$), marital status ($H(1) = 51.696, p < 0.001$), context of mechanism of injury ($H(7) = 346.046, p < 0.001$), victim type ($H(2) = 92.091, p < 0.001$), vehicle type ($H(9) = 288.188, p < 0.001$), body parts injured ($p < 0.0001$), the number of injured body parts ($H(5) = 960.7598, p < 0.0001$) and type of injury ($H(2) = 570.9585, p < 0.0001$), patient classification ($H(1) = 63.12, p < 0.0001$), consult type ($H(1) = 785.55, p < 0.0001$), GCS ($H(4) = 643.87, p < 0.0001$), vital statistics ($p < 0.0001$), and patient outcomes ($H(6) = 2197.243, p < 0.0001$). On the other hand, Cox Regression Analysis shows that patients who suffered head and neck, face, chest, and abdomen injuries have significantly increased odds of death occurring in a shorter length of hospital stay.

Conclusion. The study showed the length of hospital stay over the years for road crash victims, and risk factors included risky behavior, vehicle type, type of injury, among others. There is a need to look at post-crash response as a strategy to reduce road injuries and related fatalities.

Keywords: road safety, road crashes, length of hospital stay, road crash injuries, road crash fatalities



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INTRODUCTION

The Philippines is an archipelago, and transport is important as it links people and economic centers. Roads are the most predominant transport system as it accounts for 98% of passenger traffic and more than half of cargo traffic. In urban areas, vehicles such as jeepneys, taxis, tricycles, and pedicabs are mainly used on the road. Roads, being the most dominant transport system, have been seen to have an increasing number of vehicular accidents due to their poor quality.¹ In addition to unsafe roads, the WHO also recognized distracted driving, noncompliance with the use of motorcycle helmets, seatbelts and child restraints, drunk-driving and use of drugs, and unsafe vehicles as factors for road crash accidents.²

Between 20 and 50 million people suffer non-fatal injuries from road crashes, and these accidents claim lives. About 1.35 million people die every year from road accidents worldwide, and the most affected include the vulnerable road users: pedestrians, cyclists, motorcyclist and motorcyclists.² In the Philippines, approximately 12,690 fatal road accidents happen every year, and that translates to 35 fatal accidents per day.³

Road traffic accidents are recorded higher in developing countries. Road accidents pose economic burdens, in general. For the national economy, road traffic accidents cost up to 3% of the GDP loss yearly. For the victim's side, it poses a burden through hospital care costs and decreased productivity and, worse, even death.²

The Decade of Action for Road Safety (2011-2020), established in the UN General Assembly Resolution 64/255, had five (5) pillars to "accelerate coordinated international action" in the reduction of road accident-related fatalities and injuries. The 5 pillars include: 1) Road Safety Management; 2) Safer Roads and Mobility; 3) Safer Vehicles; 4) Safer Road Users; and 5) Post-Crash Response. Pillar 5 focuses on the provision of the key elements of post-crash support from the scene, treatment facilities and/or hospitals, and up until follow-up: emergency care and rehabilitation for injury, mental health care, legal support, and data on crashes and injuries.⁴

Injuries and outcomes from road traffic accidents affect the length of hospital stay (LOS) of a patient. Some studies show that severe injuries result in longer length of hospital stay and that road crashes involving trucks, buses, and cars result in higher injury severity score (ISS) and increased hospital stay.⁵⁻⁷

As evidenced by a study about the social and economic burden of road traffic injuries in the Philippines, the estimated cost of death and injuries in 2014 (latest data) due to accidents on the road resulted in PhP 1.213 B in medical costs alone, not to mention the costs for lost productivity due to illnesses and injuries that amount to PhP 26.519 B.⁸

This study looked into the length of hospital stay of road crash patients brought to the major tertiary hospitals

in the three major metropolitan regions of the Philippines from 2009 to 2020, as well as the factors affecting hospital stay. The specific objectives are: 1) to determine the length of hospital stay of patients brought to the major tertiary hospitals in the Philippines; and 2) to look at risk factors such as demographic and clinical variables, patient history, risky behaviours, among others, to the length of hospital stay.

MATERIALS AND METHODS

In the early stages of the study, coordination with the tertiary hospitals in the three major regions (Metro Manila, Metro Cebu, and Metro Davao) in the country was done. Table 1 shows the list of participating hospitals from the three regions.

The researchers secured ethical clearance from the Department of Health-Single Joint Research Ethics Board (DOH-SJREB). This guarantees that the researchers involved in the study followed ethical practices and ensured that the confidentiality of patients whose data were included in the study was preserved. Research assistants who have health training, such as nurses, were assigned to encode data from the clinical abstracts to a pre-designed template in Excel. The hospital administrators reserve the power to revoke access from the research assistants. This prevents unauthorized access to the database beyond the scope of the study.

The researchers only had access to road crash patients. The research assistants manually track, cross-check, and clean the data. The research assistants also exercise intellectual judgement, if possible, to encode the proper information in cases where data is missing or is a special case. Data from the same name but different hospital numbers are treated as separate cases if the time between consults is more than three months. Data with the same hospital number but a different name is considered separate cases if the history and diagnosis seem independent, and a new pseudo-hospital number is

Table 1. Participating Hospitals and Number of Road Crash Patient Data Gathered

Hospital name	Number of Patient Data Gathered	Percent
	18,333	45.5
<i>East Avenue Medical Center</i>	6,790	16.9
<i>Jose R. Reyes Memorial Medical Center</i>	2,119	5.3
<i>Philippine General Hospital</i>	7,483	18.6
<i>Philippine Orthopedic Center</i>	2,466	6.1
<i>Southern Philippines Medical Center</i>	53	0.1
<i>Talisay District Hospital</i>	2,439	6.1
<i>Vicente Sotto Memorial Medical Center</i>	603	1.4
<i>Missing</i>	2	0.0
Total	40,286	100

Table 2. Association of Socio-demographic Variables and Length of Hospitalization of Road Crash Patients Admitted in the Major Tertiary Hospitals in the Philippines

Variables	N	Mean Rank	Kruskal Wallis Chi-Square	p-value
Sex				
Male	26,912	17845.61	300.411	<0.0001
Female	7,785	15632.27		
Marital Status				
Single	16,162	12869.96	51.696	<0.0001
Married	10,105	13556.30		

assigned. Expert opinion is also taken into account during periodic meetings for the project.

Study Design and Samples

This is a review of the database of the participating hospitals with patient records on road crashes and vehicular accidents covering years from 2009–2020. All available records of road crash patients were included and encoded. The participating hospitals are shown in Table 2.

Demographic variables (age, sex, region, province, city, admission date, service, consult type, patient classification, and length of hospital stay), history of the patient (Mechanism of Injury (MOI), Place of Injury (POI), Date of Injury (DOI), and Time of Injury (TOI), and body parts injured), risk factors (alcohol and drug intake, seatbelt and helmet use) and clinical variables (blood pressure levels, heart rate, respiratory rate, and Glasgow Coma Score) served as the independent variables in analyzing the length of hospital stay of patients.

Hospital stay is a count variable that indicates the number of days the patient was admitted to the hospital before being discharged or dying. Since the length of hospitalization is a heavily right-skewed distribution, the Kruskal-Wallis H

test was used to look for a significant relationship between demographics, patient history, clinical variables, and risk factors. Kruskal-Wallis H test is a non-parametric analog of the t-test; hence, significant differences between groups are determined through comparison of the average rank of each member of a group, or “Mean Rank.”

Survival Analysis using Length of Hospitalization and Patient Outcomes was done using Cox Regression Analysis. Cox regression is a survival analysis technique, and as such, it analyzes the time until an occurrence of an event. The technique has been used in studies such as Ravangard et al. and Thai et al., who used the method to analyze the length of hospital stay of patients.^{9,10} Here, Cox Regression was used to analyze the length of hospital stay of patients leading to death, recovery, and unchanged patient outcome. The result of Cox regression is the “Hazard Ratio.” Hazard ratio quantifies the degree of difference between the groups but does not indicate what the absolute difference in duration of the illness is. For the Inferential Statistics, the significance level is always set at 95%. The expected outcome of analysis is to identify the risk factors for length of hospitalization, specifically individual and injury characteristics.

The study is limited by samples taken from older years since the data collectors encoded more recent data. Due to the COVID-19 pandemic, data collection was halted in some hospitals; hence, there was oversampling for 2018 and 2019 and undersampling for previous years.

RESULTS

Socio-demographic Profile

The average and median length of hospitalization is on a continuous decline from 2009 to 2020.

The average length of hospital stay of the victims is 6.98 (± 2.26). The lowest mean LOS was recorded in 2020 (2.99 days), while the highest was in 2016 (10.44 days) (Figure 1).

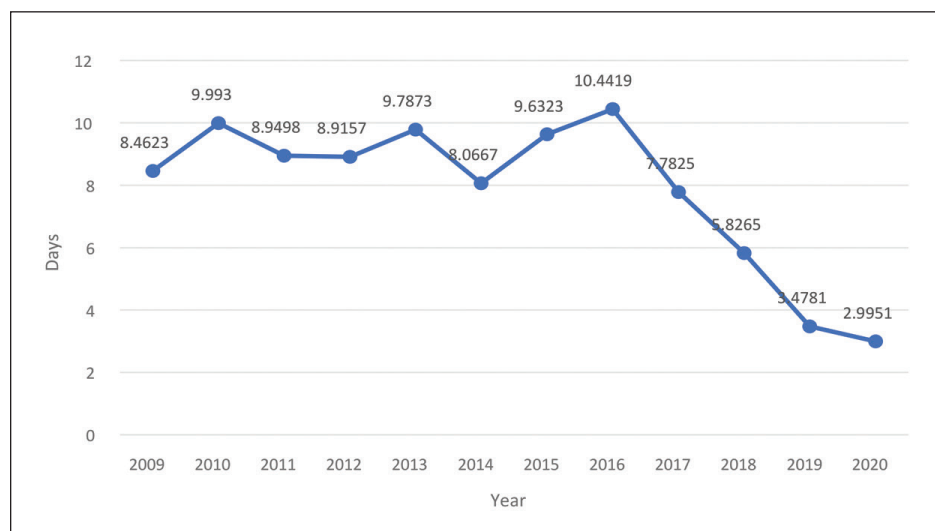


Figure 1. Mean length of hospitalization of road crash victims brought to the participating major tertiary hospitals in the Philippines (2009–2020).

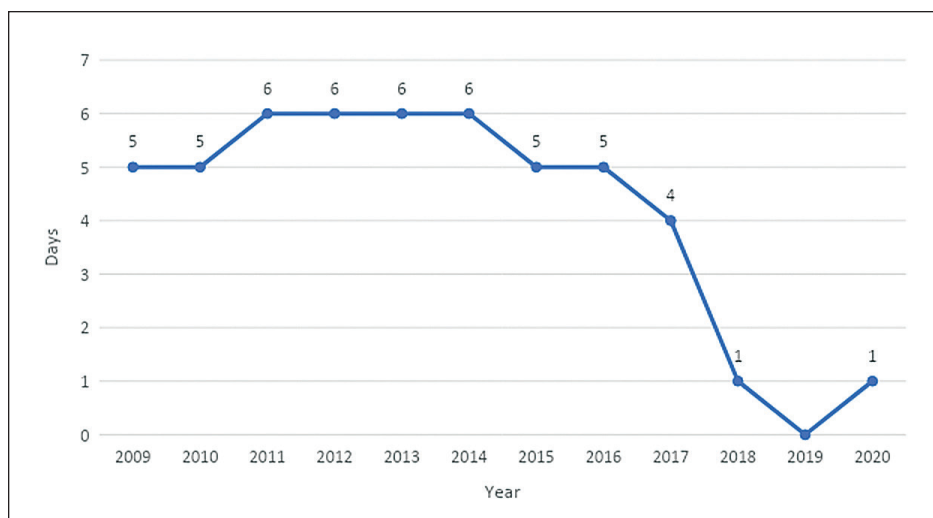


Figure 2. Median length of hospitalization of road crash victims brought to the participating major tertiary hospitals in the Philippines (2009-2020).

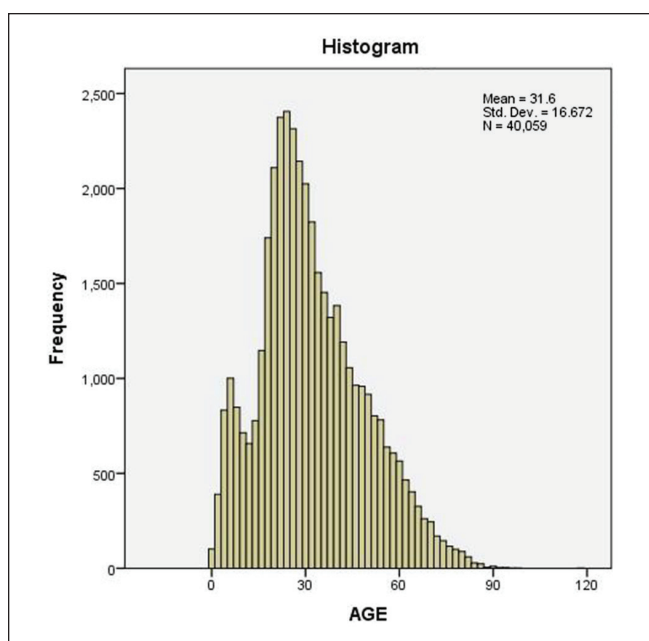


Figure 3. Distribution of patients by age.

The overall median length of hospital stay of road crash victims is 3 days. The years 2011 to 2014 recorded the highest median length of hospitalization (6 days), while 2019 recorded the lowest median length of hospital stay (Figure 2).

The average age of the road crash victims admitted to the major tertiary hospitals is 31.6 years (± 16.67). The distribution is bimodal, with the first peak at 5-year-olds, and the highest peak at 22-year-olds (Figure 3).

For the socio-demographics of the road crash patients, those within the productive-aged group are the most affected. Road users aged 20 to 29 comprise the majority (28.3%) of the total road crash victims, followed by those aged 30 to 39 (19.6%). The least involved in road crashes are those aged 60 and above (6.8%). Males (77.10%) are more primarily

affected than females (22.90%). For marital status, single patients constitute more than half (62.56%) of the total road crash victims, while married patients are 37.44% of the total patients.

For the victim types, 58.5% of the reported victim types are composed of Drivers. This is followed by Pedestrians at 22.4% and then Passengers at 19.1%. The most common vehicle type is motorcycle (81.6%, 58.3%), across all three victim types. In line with this, the most common context of mechanism of injury of the road crash patients was Slipped/Lost balance/Lost control/Slid (40.87%). This is followed by Fell off/Thrown off (30.87%) and Others (22.41%).

Physical Health Profile of Patients upon Admission

For the risk factors, it can be observed that the majority of the crash victims have poor behavioral road practices. For instance, seatbelt and helmet usage are low, being only reported in the charts of 15 and 1,048 patients, respectively. Alcohol and drug intake, on the other hand, are reported in the charts of 3,175 and 7 patients, respectively. Fatigue riding is reported by 19 patients. These can possibly be under-reported due to the huge missing data on risk factors. The majority of the patients are also classified as charity (95.5%) patients and consulted as emergency cases (93.7%).

In addition, the vital statistics of the majority of the road crash patients are within normal range for blood pressure (BP) [57.6%], systolic blood pressure (SBP) [67.1%], diastolic blood pressure (DBP) [75.8%], and heart rate (HR) [79.3%]. For the respiratory rate (RR), half of the patients (42.2%) exhibited abnormally high RR compared to normal levels. For the outcomes, the majority (74.4%) recovered or improved, while 15.3% of the patients died.

The most common injury prevalent among the road crash patients is external injury (73.7%). This is followed by injuries to the extremity (53.4%), head and neck (41.1%), face (23.2%), and chest (18.4%). In line with this, the majority of the patients (79.9%) did not suffer brain injury (79.9%) while

7.2% suffered severe brain injuries. Multiple injuries are also prevalent among 42.2% of the total patients.

Expected Outcome of the Statistical Analysis

Kruskal-Wallis H Test was used to determine the factors contributing to the length of hospital stay. LOS was greater for males ($p < 0.001$), married ($p < 0.001$), and drivers ($p < 0.001$) (Table 2).

For context of mechanism of injury, the longest length of hospital stay is for those who burst a tire, while the shortest is for those who swerved ($p < 0.001$). Similarly, patients with longer hospital stays are those who are victims of trucks across all three victim types, while victims of taxis had a shorter length of hospital stay ($p < 0.001$) (Table 3).

Significant association with length of hospitalization was also found for alcohol intake, fatigue, and seatbelt use. Length of hospital stay is longer for those who are alcohol intoxicated ($p < 0.0001$), fatigued ($p = 0.02$), and those who used seatbelts ($p = 0.01$). The latter is an unusual finding as it would be assumed that LOS would be higher for victims who did not wear seatbelts (Table 4).

Patient classification ($H(1) = 63.12$, $p < 0.0001$) and consult type ($H(1) = 785.55$, $p < 0.0001$) are significantly associated with length of hospitalization. For patient classification, paying patients have significantly longer length of hospital stay. For consult type, emergency patients have a significantly length of hospital stay.

Table 3. Association of Context of Mechanism of Injury, Victim Type, and Vehicle Type to Length of Hospitalization of Road Crash Patients Admitted in the Major Tertiary Hospitals in the Philippines

Variables	N	Mean Rank	Kruskal Wallis Chi-Square	p-value
Context of Mechanism of Injury				
Slipped/Lost balance/Lost control/Slid	3,407	4021.674	346.064	<0.0001
Fell off/Thrown off	2,692	4741.122		
Avoided pedestrian	117	2869.427		
Avoided animal	105	4187.114		
Avoided object	54	3696.056		
Burst tire	29	5315.983		
Swerved	207	2515.024		
Others	1,775	3972.967		
Victim Type				
Driver	9,142	7977.991	92.091	<0.0001
Passenger	2,949	7388.721		
Pedestrian	3,315	7226.544		
Vehicle Type (Driver or Passenger)				
Cycle-Pedicab, Bicycle, Side Car	551	5911.576	228.1883	<0.0001
Motorcycle	10,138	6289.127		
Tricycle	545	6121.836		
Car	345	5085.217		
Jeepney, Owner-type jeepney	230	4804.457		
Taxi	41	2980.427		
Bus	170	3894.350		
Van	96	6611.526		
Truck	147	7520.993		
Others	61	5292.959		
Vehicle Type (Pedestrian)				
Cycle-Pedicab, Bicycle, Side Car	88	1088.972	73.07902	<0.0001
Motorcycle	1,771	1524.201		
Tricycle	217	1395.756		
Car	440	1421.980		
Jeepney, Owner-type jeepney	113	1509.885		
Taxi	40	1125.763		
Bus	55	1255.564		
Van	99	1484.162		
Truck	82	1835.634		
Heavy Equipment	10	2381.600		
Others	46	1449.783		

Table 4. Association of Risk Factors and Length of Hospitalization of Road Crash Patients Admitted in the Major Tertiary Hospitals in the Philippines

Risk Factors	N	Mean Rank	Kruskal Wallis Chi-Square	Asymptomatic Significance
Alcohol Intake				
No	5,641	3761.59	870.64	<0.0001
Yes	2,978	5348.81		
Drug Intake				
No	5,604	2805.00	0.58	0.45
Yes	6	3270.42		
Fatigue				
No	3,287	1651.15	5.18	0.02
Yes	19	2060.68		
Seatbelt Use				
No	3,140	1574.85	6.34	0.01
Yes	13	2097.38		
Helmet Use				
No	1,874	1402.16	0	0.98
Yes	929	1401.68		

Vital signs of patients upon admission are also significantly associated with their length of hospitalization ($p < 0.0001$). Patients with abnormal BP have a significantly shorter LOS. Patients with abnormally low SBP have significantly shorter LOS. Those with abnormally high SBP also have shorter LOS compared to normal SBP. Patients with abnormal DBP have significantly lower LOS, as do patients with abnormal HR and abnormally low RR (Table 5).

The Glasgow Coma Score of patients is also significantly associated with their length of hospitalization. Patients with moderate brain injury (GCS 9-12) have the longest length of hospital stay, while patients with severe brain injury (GCS 8 and below) have the shortest length of hospital stay.

There is a significant association between length of hospitalization and body parts injured ($p < 0.0001$). Kruskal-Wallis H test showed that the length of hospital stay for patients who suffered head and neck, face, chest, abdomen, and extremity injuries is significantly longer than that of their counterparts. Moreover, the length of hospital stay of patients who suffered external injuries is significantly shorter than that of those who did not suffer from the said injury.

There is also a significant association between the number of body parts injured and length of hospitalization ($H(5) = 960.7598, p < 0.0001$). The longest hospitalization belongs to those with 2 body parts injured, while the shortest belongs

Table 5. Association of Clinical Data and Length of Hospitalization of Road Crash Patients Admitted in the Major Tertiary Hospitals in the Philippines

Variables	N	Mean Rank	Chi-Square	Asymptomatic Significance
Patient Classification				
Charity	32,356	16866.81	63.12	<0.0001
Paying	1,560	18860.16		
Consult Type				
Emergency	31,099	16895.07	785.55	<0.0001
Elective	1,959	10726.06		
Blood Pressure (BP)				
Within normal ranges	16,178	15296.60	931.7302	<0.0001
Abnormal	11,900	12330.47		
Systolic Blood Pressure (SBP)				
Abnormally Low	327	6923.263	633.3489	<0.0001
Normal	18,817	14742.36		
Abnormally High	8,887	12739.02		
Diastolic Blood Pressure (DBP)				
Abnormally Low	1,129	12661.33	433.0668	<0.0001
Normal	21,247	14583.53		
Abnormally High	5,665	12182.15		
Heart Rate (HR)				
Abnormally Low	493	11370.60	243.5350	<0.0001
Normal	22,331	14460.44		
Abnormally High	5,351	12784.06		
Respiratory Rate (RR)				
Abnormally Low	227	5390.69	509.5222	<0.0001
Normal	11,738	13089.58		
Abnormally High	15,826	14616.11		

to those with 6 body parts injured. Similarly, the length of hospitalization is significantly longer for those who suffered multiple injuries than their counterparts who did not.

Patient outcomes are significantly associated with length of hospitalization ($H(6) = 2197.243, p < 0.0001$). Patients who recovered and patients who died generally had the longest length of hospitalization, while patients who were “Absconded” or “Discharged” had the shortest length of hospitalization. Admitted road traffic accident victims who

were discharged with an unchanged status, transferred, or home against medical advice had a significantly shorter LOS than those who improved/died (Table 6).

Cox Regression Survival Analysis

Cox regression was used to model length of hospital stay leading to death, recovery, or unchanged patient outcome. Cox regression is a survival analysis technique, and as such, it analyzes the time until an event. The technique has been used

Table 6. Association of Body Injury Type and Length of Hospitalization of Road Crash Patients Admitted in the Major Tertiary Hospitals in the Philippines

Variables	N	Mean Rank	Chi-Square	Asymptomatic Significance
Glasgow Coma Score (GCS)				
No Brain Injury	21,180	13356.15	643.87	<0.0001
Minimal Brain Injury	2,505	15331.15		
Moderate Brain Injury	1,325	17086.85		
Severe Brain Injury	2,074	11020.81		
Head and Neck Injury				
No	11,594	9178.73	1592.567	<0.0001
Yes	9,807	12500.65		
Face Injury				
No	11,805	7308.19	1151.47	<0.0001
Yes	4,250	10027.37		
Chest Injury				
No	12,513	7432.39	775.3777	<0.0001
Yes	3,365	9825.22		
Abdomen Injury				
No	13,005	7055.61	824.5672	<0.0001
Yes	1,833	10001.27		
Extremity Injury				
No	9,014	7015.71	5483.923	<0.0001
Yes	12,076	13180.27		
External Injury				
No	5,679	11254.65	159.5858	<0.0001
Yes	15,162	10108.75		
Sum of Body Parts Injured				
1	17,916	13872.77	960.7598	<0.0001
2	8,920	17096.94		
3	2,746	16773.55		
4	592	16304.47		
5	74	14144.97		
6	14	7218.714		
Multiple Injuries				
No	17,995	14441.91	688.6924	<0.0001
Yes	13,148	17118.70		
Patient Outcomes				
Recovered/ Improved	2,4974	17983.53	2197.243	<0.0001
Died	5,128	17282.62		
Unchanged	439	11473.55		
Transferred	772	11507.61		
HAMA	1,994	13518.97		
Absconded	218	5075.711		
Discharged	607	4586.125		

in studies such as Ravangard et al. and Thai et al., who used the method to analyze length of hospital stay of patients.^{9,10}

The hazard ratio quantifies the degree of difference between the groups but does not indicate what the absolute difference in duration of the illness is. (In a race, for example, the hazard ratio gives the probability that A will win but does not tell us by how much.) They wrote: “The hazard ratio is equivalent to the odds that an individual in the group with the higher hazard reaches the endpoint first.”¹¹

Cox Regression on Length of Hospital Stay Leading to Death

There were 7,321 cases involved in the Cox regression analysis, and 567 of these were events that led to the death of the patient. The omnibus test of model coefficients shows a chi-square score of 1031.87 with 10 degrees of freedom and a *p*-value of <0.0001, suggesting that the model is significant.

Analysis showed that head and neck and face increase the expected hazard relative to a one-day increase in length of hospital stay by 42% and 94.8%, respectively. This is also similar to chest and abdomen injuries by 2.004 and 2.688 times, respectively. On the contrary, extremity injury decreases the expected hazard relative to a one-day increase in length of hospital stay by 0.246. For charity and severe injury patients, on the other hand, this increases by 2.6 times and 99.8%, respectively.

The Cox Regression on length of hospital stay leading to death implies that patients who suffered head and neck, face, chest, and abdomen injury have significantly increased odds of death occurring in a shorter length of hospital stay. On the other hand, Cox Regression f showed that patients with severe brain injuries (*p* <0.0001) have lower chances of recovery and a shorter LOS. This is similar for charity and severe brain-injured patients. Meanwhile, extremity injury had significantly decreased odds of death for a longer length of hospital stay (Table 7).

DISCUSSION

The length of hospital stay is an indicator of how effective and efficient the hospital management is.^{12,13} Reduction in hospital stays could contribute positively to patients, such as decreased risk of development of complications, infections, and medication side effects, improvements in the delivery of quality healthcare services, and increased hospital profits through efficient bed management.¹³

The overall median LOS in this study is three days. This is lower than the three-year retrospective study from 2015 to 2017 in Guinea among road traffic accident victims, which showed that the LOS is 5 days (IQR = 1 – 20).¹⁴ Less severe injuries sustained by the victims may be the reason for shorter LOS, as shown in studies among road traffic victims.^{15,16} This may also explain the low rates of hospital deaths observed over the 11-year data in this study, similar to the findings of Kourouma et al in which low death rates were attributed to less severe injuries.¹⁴

Nevertheless, prolonged hospital stay was associated with the development of complications, specifically, a 5% odds of developing complications with every excess day in the hospital despite treatment completion among trauma patients.¹⁷ Berhe et al. also found that longer LOS for severe trauma patients increases the risk of developing complications by 7 times compared to patients with moderate traumas.⁵ Longer LOS poses an economic burden through reduced productivity of the victim as well as increasing hospital costs.⁵

The shorter hospital stay in this study may also be attributed to better hospital management and emergency response as indicated in the Philippine Health Facilities Development Plan for 2017.¹⁸ Moreover, a nationwide emergency hotline for faster emergency response was established in the Philippines in 2018.¹⁹ However, there is still a need to improve issues for overcrowded hospitals, insufficient facilities for hospital care, referral systems, unregulated ambulance systems, and paramedics.¹⁹

Table 7. Length of Hospital Stay Leading to Death

Factors	Parameter Estimate	<i>p</i> -value	Hazard Ratio	95% CI for Hazard Ratio	
				Lower	Upper
<i>Head and Neck Injury</i>	0.357	0.001	1.429	1.153	1.772
<i>Face Injury</i>	0.667	<0.0001	1.948	1.605	2.364
<i>Chest Injury</i>	0.695	<0.0001	2.004	1.62	2.480
<i>Abdomen Injury</i>	0.989	<0.0001	2.688	2.085	3.465
<i>Extremity Injury</i>	-1.404	<0.0001	0.246	0.200	0.302
<i>External Injury</i>	0.100	0.246	1.105	0.933	1.308
<i>Patient Classification</i>	0.955	<0.0001	2.600	1.623	4.164
<i>Minimal Brain Injury</i>	0.199	0.194	1.220	0.904	1.647
<i>Moderate Brain Injury</i>	0.281	0.119	1.324	0.931	1.884
<i>Severe Brain Injury</i>	0.692	<0.0001	1.998	1.482	2.693

Pre-admission data consisted of sociodemographic variables such as age, sex, marital status; context of mechanism of injury, victim type, risk factors, and vehicle type. All these variables, except age, were associated with length of hospital stay. On the other hand, patient classification, consult type, GCS, injuries, and outcomes were variables for hospital data. Associations were found between injuries, patient classification, consult type, GCS, vital statistics, and outcomes and length of hospital stay.

Males were shown to have longer length of hospital stay than their female counterparts ($H(1) = 300.411, p < 0.001$). This is similar to a study in Southwestern Iran wherein males are 1.18 times more susceptible to having a longer hospital stay than females.¹⁵ In addition, males are more likely to engage in risky road behaviors than females.^{20,21} A study in Oman also showed that injuries are more severe in males than females, and overspeeding is the main cause of fatal injuries for males aged 20-29 years old, hence causing longer length of hospitalization among trauma patients.^{15,22} Also contributing to longer length of hospital stay for males is the increased probability of fatal post-trauma complications such as sepsis and multiple organ dysfunction syndrome (MODS). A clinical study has shown that female hormones decrease the possibility of developing such a prognosis, especially in the early and advanced stages of trauma in female patients.²³

Drivers were most involved in road crash accidents (59%), followed by pedestrians (22%) and passengers (19%). This is similar to studies in Tanzania and Guinea wherein drivers accounted for the majority (38.3%, 50.7%) of victims, followed by passengers (35.4%, 39.5%) and pedestrians (25.5%, 9.8%).^{20,24} For the victim type, drivers had the longest hospital stay. This may be related to risky road behavior among drivers such as non-use of seatbelt and helmet, which can subsequently lengthen hospital stay.^{15,24,25} On the other hand, Shen and Neyens found that non-wearing of seatbelt, drug use, and speeding were associated with longer hospital stay for male and female teen drivers.²⁶ A study in Taiwan also showed that consumption of alcohol or stimulation refreshments before driving and fatigue riding increase length of hospital stay.⁷ Moreso, alcohol and/or drug consumption before driving and fatigue are associated with fatal/extremely severe road accidents.²⁷⁻²⁹

Despite not being associated with length of hospital stay, the greatest number of admissions were between the ages of 20-29 years old (28.3%) and 30-39 years old (19.6%). This is supported by a study by Regev, Rolison, and Moutari that crash risks are higher in the age range of 21-29 years old and the risk decreases with increasing age.³⁰ This may be attributed to the risky behavior engagement of these age groups. A report in the United States (US) in 2017 showed that drivers within the age range of 19-24 (88.4%) to 25-39 (79.2%) years old were most likely to engage in speeding, red light running, or distracted driving.³¹ In addition, males and younger people are the most likely motorcycle riders.²⁰

Motorcycles were the most commonly used vehicle by the admitted road crash victims across all victim types (81.6% for drivers and passengers, 58.3% for pedestrians). This is consistent with studies set in other developing countries.^{24,32,33} The demand and usage of motorcycles in developing countries could be attributed to its cheap price and low maintenance cost as well as their easy mobility in areas with heavy vehicular traffic.³⁴ In addition, the WHO reported that half (57.60%) of the total vehicle registrations in the Philippines in 2016 consisted of motorized 2- and 3-wheelers.³⁵

The vehicle type associated with longer length of hospital stay is trucks ($p < 0.001$). This is similar to a study in Taiwan wherein collisions with trucks lengthen the hospital stay of the involved victims.⁷ Collisions involving trucks cause serious to fatal injuries, which may increase the hospital stay, and severity of injuries is one factor for longer length of hospital stay.^{15,36,37} This may be due to the greater impact force from a truck and lesser ability to stop quickly compared to lighter vehicles.³⁷

The context of mechanism of injury specifically “burst tire” is associated in this Philippine study with length of hospital stay ($p < 0.0001$). Bursting of a tire during high-speed running could result in losing control of the vehicle maneuver and flip-over, resulting in severe injuries.³⁸ Severe injuries can lead to fatality, as shown in the study in Kenya, which shortens the length of hospital stay. In the study of Hamsen et al. in 2020, severely injured patients who died before being discharged from the ICU had shorter length of hospital stay (mean days 6.0 ± 9.4 vs. 10.0 ± 13.4).³⁹

Patient classification, consult type, GCS, injuries, and outcomes were the variables for the hospital data. For length of hospital stay, associations were found with injuries, patient classification, consult type, GCS, vital statistics, and outcomes. 93.7% of the patients were brought to the emergency department, which shows the significance of emergency care in post-crash response.^{15,40}

In a study, emergency admission is associated with longer hospital stay ($p < 0.0001$).⁴¹ In Ethiopia, 38.4% of those admitted in the emergency department had experienced longer stay in the said department.¹² Additional days on LOS among emergency patients may be caused by delays in discharge through discharge incoordination and delays in acquiring physician opinions.

The majority of the patients included in this study in the Philippines were classified as charity patients (95.5%) since all of the covered tertiary hospitals are state-run hospitals. Kruskal-Wallis H Test showed that paying patients had the longest length of hospital stay as compared to charity patients ($p < 0.0001$). This is in contrast to studies in the United States, Iran, and China where patients who belonged to self-payment groups or had no insurance had shorter length of hospital stay.⁴²⁻⁴⁴

Vital signs are important physiologic factors that provide an overview of a patient's condition.⁴⁵ In this study, the vital

signs included were SBP, DBP, HR, and RR. The collected data showed that most of the patients had abnormal vital signs, which is consistent with a study in Indonesia among traffic accident patients.⁴⁰ All of these are associated with shorter length of hospital stay, especially when these vitals are beyond and below normal levels ($p < 0.0001$), attributable to mortality risks. Among trauma patients, the relationship between heart rate and systolic blood pressure was also studied by Bhandarkar et al. Hypotension-bradycardia patients (SBP < 90 mmHg, HR < 60 bpm) had a higher mortality rate of 80%.⁴⁶ Among emergency department patients, 45% of the admitted patients with abnormal vital signs died within the first 48 hours.⁴⁷

Data from the major tertiary hospitals in the Philippines showed that 80% of the patients had no brain injuries (GCS 15), while 7% had severe brain injuries (GCS below 8). Inferences for GCS showed that it is associated with length of hospital stay, specifically for GCS below 8 that indicated severe brain injuries ($p < 0.0001$). In a study by Alshahrani, among motor vehicle accident victims in Saudi Arabia, GCS is a measure of trauma associated with mortality and length of hospital admission, especially when GCS is low.¹⁶ This is further supported by the study of Kisat et al. that critically injured adult trauma patients who died within the first few days of admission had shorter ICU-LOS.⁴⁸

Increased LOS and ICU-LOS were observed with lower GCS scores.^{49,50} Having mild to moderate GCS was associated with time to recovery.⁵¹ In a study, a one-point increase in GCS was associated with a reduction in mortality risk and increased the chance of favorable outcomes.⁵²⁻⁵⁴

This study in the Philippines showed body injuries affect the length of stay in the hospital. Patients with extremity injuries have longer length of hospital stay, followed by head and neck, and face injuries ($p < 0.0001$). Traumatic cases such as upper and lower limb, spine, clavicle, pelvis, and soft tissue injuries do lengthen LOS.⁵⁵ Moreover, bone fractures result in longer length of hospital stay because it takes time to heal, which supports the findings of this study in the Philippines.⁵⁶

Meanwhile, in this Philippine study, patients who have external injuries had the shortest length of hospital stay. A study in Guinea among road traffic victims showed that soft tissue injuries were the most common injuries sustained by the victims.¹⁴ Patients with external injuries such as scratches and slight confusion are easily managed and are suitable for early discharge.¹⁴ In addition to external injuries, patients who suffered chest and abdomen injuries also have shorter length of hospital stay ($p < 0.0001$). A study among blunt chest trauma patients showed that the mortality rate is 50%, hence, shorter length of hospital stay.⁵⁷ Multiple injuries are also associated with increased risk of death among road traffic injury patients.^{24,58,59} These findings are consistent with the results of this study in that multiply-injured patients have shorter length of hospital stay ($p < 0.0001$). Mohtasham-Amiri et al. found that the odds of death when a road traffic accident victim has multiple injuries are 1.2 (95%CI;

$p < 0.001$). Boniface et al. also found that the majority (55.3%) of the severely injured road accident victims have multiple injuries.²⁴

Patient outcomes are also associated with length of hospital stay. Kruskal-Wallis H Test showed that recovered patients had a longer length of hospital stay ($p < 0.0001$), which is similar to the study of Kisat et al.⁴⁸ On the other hand, both recovered and died outcomes had a greater number of LOS than absconded or discharged. For absconded patients, the main reason cited for absconding is financial constraints.⁶⁰ However, these patients are more at risk for readmission, which can further burden the patient financially.⁶¹ In this Philippine study, 75.4% of the road crash patients recovered or improved. Increased recovery outcomes among road crash patients are attributed to timely detection and transport of crash victims, receiving pre-hospital care, and emergency training for healthcare providers.^{62,63}

CONCLUSION

The study showed the length of hospital stay over the years for road crash victims, and risk factors included risky behavior, vehicle type, and type of injury, among others. There is a need to look at post-crash response as a strategy to reduce road injuries and related fatalities. From a statistical point of view, the quality of the results can only be as good as the quality of the data. One major issue with the overall data is that there were missing values.

For vehicle types, it is noted that heavy vehicles such as trucks are involved in crashes, prolonging the length of hospital stay. Head and neck injury, face injury, chest injury, abdomen injury, and extremity injury are also associated with longer length of hospital stay. Hence, there should be efficient management of road use by heavy vehicles, and education among truck drivers on road safety. The age distribution shows which age groups we should take a look into in order to decrease the number of road crash patients. The 20-29 and 30-39 age intervals should be emphasized when creating policies for road safety, as they are the productive ages.

Given the above data results, there is impetus for strengthening the management of overcrowded hospitals and referral systems, and addressing the lack of facilities, paramedics, and unregulated emergency medical systems.¹⁹ The overall goal is to prevent and reduce road crashes and improve crash response when cases arise.

Statement of Authorship

All authors certified fulfillment of ICMJE authorship criteria.

Author Disclosure

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