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Logistic Regression Modelling of Traumatic Injuries at the Accident and Emergency Unit; Komfo Anokye Teaching Hospital, Kumasi – Ghana

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Abstract

This study analyzes traumatic injuries at the Komfo Anokye Teaching Hospital's (KATH) Accident and Emergency Unit (AEU) in Kumasi, the capital of Ashanti Region of Ghana. Secondary data was used for this work. Data was extracted from the Trauma Database (Trauma Registry) and a total of 3903 cases were recorded. The variables extracted from the database include; patient's age, gender, occupation, mechanism of injury and place of injury (location). The analysis showed that, out of the 3903 patients selected for the study approximately 63% of the cases were classified as blunt trauma. Males were most frequently injured representing 71.3%. Also, the most frequently injured age group was 15 to 55 years representing 69.0%. The most frequent cause of injuries, accounting for 45.2% of all injuries, was motor vehicle collisions. The variables associated with the type of trauma (penetrating) are gender, mechanism of injury, place of injury and occupation.

Keywords: traumatic injuries, accident, type of trauma, mechanism of injury

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INTRODUCTION

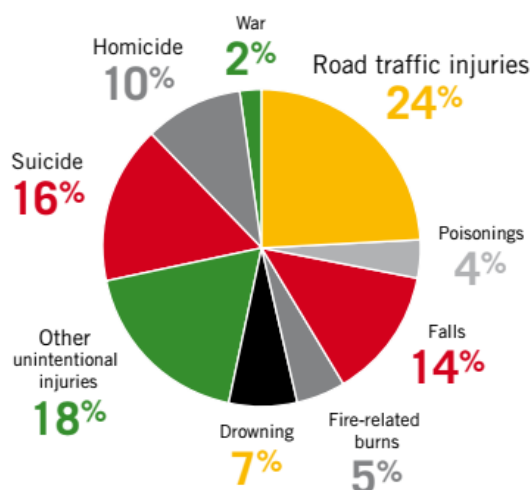
Significant percentage of the worldwide burden of sickness is as a result of Traumatic injuries and this causes 9% of all deaths worldwide (WHO, 2002). Traumatic injuries is the third most prevalent cause of mortality overall and the most common cause of death for people under the age of 45 (Imam, 2021).

Trauma starts as a result of energy from an outside origin gets into the body. Both blunt and sharp motions can transmit kinetic energy. In addition to blunt and sharp processes, thermal energy can also exist. It might appear as cold, heat, or a chemical agent that generates the cold or heat. Blast injuries and other mass casualty incidents caused by improvised explosive devices are more likely in warlike settings (IED). Some research have asserted that the leading cause of mortality among people age from 1 to 44 years is trauma through which most of the injuries can be avoided ((Imam, 2021); Roudsari et al, 2005). A report by the U.S. transportation department in July 2020 revealed that Motor Vehicle clashes/collision (MVC) was the frequently source of death in 2016 and 2017. Also, majority of trauma deaths for the age bracket 1 to 65 are associated with MVC while falls accounts for those above 65 years (Centers for Disease Control and Prevention (CDC)).

In many low-income countries as well as some middle-income countries, traumatic injuries stand tall when it comes to mortality factors among working age individuals, representing a sizable illness load on emerging nations. Injuries account for one-third of the frequent cause of mortality among young adults (15-29) (Casey et al. (2012). Five of the top 15 causes of death in adults between the ages of 15 and 29. Injury related deaths in emerging nations are higher compared to deaths relating to heart diseases (Mathers, 2008). Injuries from MVC is the first biggest result of disability and one of the most common cause of mortality (Suliman, et al., 2022).

Since emergency care capacity is limited, it is difficult to determine how cost-effective injury deterrence and urgent medical attention are in these contexts of low resources (Hsia, Razzak, Tsai & Hirshon, 2010). Notwithstanding the disproportionately high rates of injury-related deaths and impairments in low-and-middle-income countries, the prevalence of illness brought on by these occurrences has been significantly underreported in the literature on emergency care (Foran et al, 2011). Additionally, Hyder asserted that there are inconsistency in injury reporting and this has resulted in large underestimations of morbidity and death in these environments (Hyder, 2013). Poor reporting methods and the inability to pay for a doctor's visit after an accident are probably major causes of this problem. Few studies have been conducted to identify the processes of damage as well as the types of injury incurred in these occurrences in emerging nations, notably in Africa.

The WHO claim that about 5.8 million lives are lost annually as a result of injury. This accounts for 9% of all lives lost globally; 32% more than the number of mortalities associated with malaria, tuberculosis, and HIV/AIDS altogether (WHO 2014) This was confirmed by the study of James et al. (2020); Global injury morbidity and mortality from 1990 to 2017. The causes of injury deaths in the world per the 2014 report is summarized in the figure below.



Injury makes up a bigger share of the causes of mortality and years of life lost in emerging nations (James et al., 2020). It is critical that health services change to accommodate the rising cost of damage.

It is predicted that comprehensive surveillance systems will aid in determining the burden of acute medical diagnoses and injuries. Such monitoring systems that enable academics and decision-makers to track trends across time do not yet exist in Ghana. For instance, only a tiny portion of pedestrian injuries are recorded in police data, not all victims of injuries obtain proper medical attention, and a number of other important statistics are not accurately recorded.

Setting up systems in the hospital to collect data on injuries, as advised by the WHO may help us comprehend injuries in emerging nations more thoroughly (WHO, 2004). This study analyzes traumatic injuries by determining the variables associated with the types of traumatic injuries at the Accident and Emergency Unit of the Komfo Anokye Teaching Hospital (KATH), Kumasi. Specifically, it assesses the various mechanisms of traumatic injuries as well as the association between mechanisms of traumatic injuries and other variables.

METHODOLOGY

Setting and Data

This study used data that was extracted from the Trauma Database (Trauma Registry) of the AEU of KATH. The AEU serves the 1.4 million residents of Kumasi and the surroundings and an additional 3 million people as far as emergency care is concern (GSS, 2013). KATH is the second largest hospital in Ghana under the auspices of Ministry of Health (MoH) and has a bed capacity of 1000. The ultra-modern AEC was constructed in 2009 and has a bed capacity of 120. KATH is accessible to about 80% of the population of Ghana.

The study used data on a total of 3903 cases recorded from the patients' folders. It was made up of the patient's age, gender, occupation, region of injury, Mechanism of injury and the Place of injury. Statistical package for social scientists (SPSS version 22) was employed for the analysis of data. The response variable was the type of trauma which we defined as either blunt or penetrating. The independent variables included patient's age, gender, region of injury, occupation, Mechanism of injury and the Place of injury.

Statistical Model

The study used the model described in Equation 1.

$$\theta = \log\left(\frac{\pi}{1-\pi}\right) = X\beta + \varepsilon \tag{1}$$

where θ connects the linear equation to $\log\left(\frac{\pi}{1-\pi}\right)$. π is the likelihood of obtaining penetrating trauma. X and β are the set of independent variables and regression parameters respectively. Lastly, usual residual or error term is represented by ε . The Likelihood Ratio Test of the hypothesis $H_o : c(\beta) = 0$, which compares the entire model versus the model that contains only the intercept, yields the overall goodness of fit (Hilbe & Greene, 2008). An event's odd is its likelihood relative to both its likelihood of occurring and its likelihood of not occurring, as well as its likely frequency. In this study, the likelihood that a patient would sustain a penetrating injury is compared to the likelihood that they will sustain a blunt injury. This indicates that the logistic regression's outcome variables should be discrete and dichotomous. Due to the dichotomous nature of the response variable; either penetrating or blunt, logistic regression was determined to be appropriate for application.

Goodness of fit test

We can easily compute the Deviance, Wald and Likelihood ratio when making simple inference about coefficients in a given model. The likelihood ratio statistic was considered the best choice for testing the hypothesis $H_o : c(\beta) = 0$. It is given by

$$\chi^2 [i] = 2(\log L_a - \log L_0) \tag{2}$$

where $\log L_a$ is the log-likelihood computed using the full estimator, $\log L_0$ is the complement computed using the restricted estimator and the associated degrees of freedom i , which represent the number of restrictions. The significance of Wald statistic was used to assess the significance of the predictor variables. The Wald statistic $W_i = \left(\frac{\beta_i}{SE(\beta_i)}\right)^2$ is the squared proportion of regression coefficient to its standard error which is asymptotically chi-square in distribution.

RESULTS

We fitted a logistic regression model similar to the work of Fosu, Frimpong and Arthur (2014) to the data extracted. According to Table 1, out of the 3904 cases recorded, 63.3% were classified as blunt whilst 36.7% were penetrating. That is, almost 4 out of every 10 trauma cases selected results is penetrating. Again, males with penetrating trauma (39.6%) exceed that of females (29.6%). Majority of the trauma cases (45.2%) were as a result Moving Vehicle Collision/Clash, 23.8% were due to Homicide/Suicide/Assault, 3.8% were as a result of Burns while 10.7% were associated to other mechanisms of injury. Majority (76.2%) of the Homicide/Suicide/Assault injuries resulted in penetrating trauma. Also, 95.7% of the Bites/Animals resulted in penetrating trauma. More than 40% (42.8%) of the penetrating trauma was as a result of MVC.

Table 1: Cross Tabulation of type of Trauma against patients’ gender, age, mechanism of injury, place of injury and occupation.

	Type of Trauma		Total
	Blunt	Penetrating/Sharp	
Gender			
Male	1680 (60.4%)	1101 (39.6%)	2781
Female	790 (70.4%)	332 (29.6%)	1122
Total	2470 (63.3%)	1433 (36.7%)	3903
Mechanisms of Injury			
MVC	1148 (65.2%)	614 (34.8%)	1762
Fall	804 (86.5%)	126 (13.5%)	930
Homicide/Suicide/Assault	148 (23.8%)	474 (76.2%)	622
Burns	147 (99.3%)	1 (0.7%)	148
Bites/Animals	1 (4.3%)	22 (95.7%)	23
Others	219 (52.6%)	197 (47.4%)	416
Total	2467	1434	3901
Age			
Below 15yrs	560 (74.9%)	188 (25.1%)	748
15-24yrs	406 (58.1%)	293 (41.9%)	699
25-54yrs	1134 (57.9%)	825 (42.1%)	1959
55-64yrs	141 (71.2%)	57 (28.8%)	198
Above 64yrs	197 (78.8%)	53 (21.2%)	250
Total	2438	1416	3854
Place of Injury			
Home	761(66.1%)	391 (33.9%)	1152
Road	1285 (64.2%)	716 (35.8%)	2001
Work/Industry	193 (49.2%)	199 (50.8%)	392
School	64 (88.9%)	8 (11.1%)	72
Others	160 (59.7%)	108 (40.3%)	268
Total	2463	1422	3885
Occupation			
Managers	9 (56.3%)	7 (43.7%)	16
Professionals	98 (68.1%)	46 (31.9%)	144
Technicians	79 (53.7%)	68 (46.3%)	147
Clerical Support	4 (80%)	1 (20%)	5
Service and Sales	499 (58.4%)	355 (41.6%)	854
Agric	215 (62.3%)	130 (37.7%)	345
Craft Related	240 (55.3%)	194 (44.7%)	434
Machine Operators	161 (53.3%)	141 (46.7%)	302
Elementary occupation	82 (53.9%)	70 (46.1%)	152
Force Works	5 (71.4%)	2 (28.6%)	7

Others	979 (71.9%)	383 (28.1%)	1362
Total	2371	1397	3768

Majority of injuries (69.0%) are associated with the age group 15 to 54 years. Among the penetrating trauma group, 79.0% fall within this category. Also, more than half (51.5%) of the cases occurred on our roads. This may be due to road accident or injury obtained by a pedestrian while using the road. Approximately 4 out of every 10 injury cases recorded on our roads led to penetrating trauma. The home is also one injury prone area contributing to 29.7% of the total cases. 33.9% of the cases from the home resulted in penetrating trauma. Again, more than one half (50.5%) of the cases recorded from the work place or industries resulted in penetrating trauma. Among the various occupations, sales and service (22.7%), craft (11.5%) Agric (9.2%) and machine operators (8.0%) were much recorded.

On the mechanisms of injury according to Figure 2, MVC is the leading cause of injury constituting 45.16%. Fall contributes to 23.8% while Homicide/Suicide/Assault/Stabbing contributes to 16.0%. Burns and Bites/Animals together contribute to 4.4%. All other mechanisms of injury constitute 10.7%.

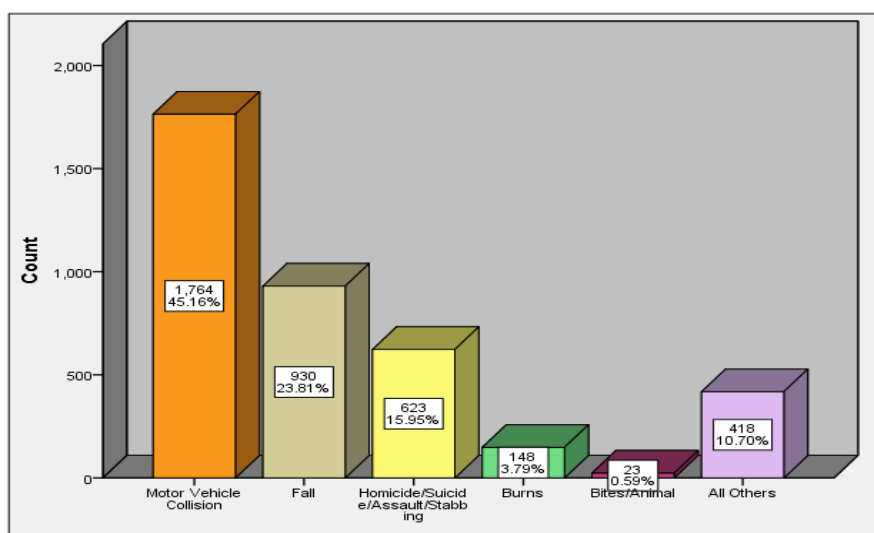


Figure 2: Mechanisms of Injury

The Pearson Chi-Square presented in Table 2 exhibited a significant association between the type of trauma and the variables (gender, mechanism of injury, age, place of injury and occupation) at the 1% significant level ($p < 0.001$).

Table 2: Pearson Chi-Square value for selected variables

Variables	Chi-Square Test Value	df	Asymp. Sig. (2-sided)
Gender	34.408 ^a	1	.000
Mechanism of Injury	771.933 ^a	5	.000
Age	107.112 ^a	4	.000
Place of Injury	69.924 ^a	5	.000

Occupation	90.379 ^a	10	.000
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The logistic regression model presented in Table 3 revealed that gender, occupation, mechanism of injury and place of injury are statistically significant predictors of penetrating trauma ($p < .001$).

Table 3: Variables Associated with Type of Trauma – Multiple Logistic regression model

Parameters	B	Std. Error.	Wald	df	Sig.	Exp(B)
Gender	-0.407	0.079	26.319	1	0.000	0.666
Occupation	-0.075	0.012	37.886	1	0.000	0.928
Mechanisms of Trauma	0.173	0.022	63.672	1	0.000	1.189
Place of injury	0.31	0.075	16.896	1	0.000	1.364
Age	-0.115	0.206	2.887	1	0.089	0.891
Constant	0.35	0.012	14.905	1	0.000	1.419

Age was not found to be a significant predictor of penetrating trauma in this model ($p > 0.05$).

Model Summary and Assessment

The model summary result reveals that the model presented in Table 3 is appropriate and fits the data well ($\chi^2(5) = 115.142, p = .000$).

DISCUSSION

Understanding the contributing developments and effects injuries have on individuals, people, nations, the health sector and facilities is essential for the development of pragmatic intervention for reduction in injury rates and also to sustain the health sector. Few methods for improving data collection, main deterrence, as well as outpatient and urgent care treatment have evolved while injuries have grown in standing as the major cause of lost of lives in emerging countries (Hsia R. et al, 2010). The injuries analysis at AEU of KATH in this study shows injury patterns that is both substantial for the population and similar with those in emerging nations. Abbasi et al. reported in their study “patterns of traumatic injuries and injury severity score in a major trauma center”. They concluded that males having higher injury rates comparably to that of women. Also, car accident was the commonest cause of trauma (Abbasi et al. 2013).

In the current study, MVC was the primary cause of injuries among the hospitalized patients. mechanism of injuries in patients presented to the hospital, accounting for 45.2% of all injuries. It accounts for 45.2% the total cases recorded. The result was in line with current study by Suliman et al. (2022) and James et al. (2020) who found MVC and road accidents respectively as the leading cause of death and disability presented to the AEC. Other studies conducted in Tanzania, Ghana, and Uganda, also showed a similar result of 49%, 29%, and 33%, respectively (Forjuoh, 2003; Nantulya & Reich, 2003). According to a study the Ministry of Transport of

Ghana in 2007, the number of vehicles on the road has increased along with motor vehicle collisions (MVCs) and crash deaths. Growing number of vehicles in the context of poor maintenance of the transportation infrastructure, a lack of usage of safety equipment like seatbelts and helmets, combined road use by pedestrians and a lack of pre-hospital and emergency treatment are all possible contributing factors.

Falls were second most common mechanism of traumatic injury (23.84%) in this study followed by assaults (15.94%). In the study "Individual and medical characteristics of adults presenting to an urban emergency department in Ghana" and "Analysis of traumatic injuries presenting to a referral hospital emergency department in Moshi, Tanzania", by Oteng et al. (2015) and Casey et al. (2012) respectively came up with the same conclusion. Falls are the second most common reason for unintentional injury fatalities globally, according to the WHO. The majority of injury-related fatalities in the United States and Canada are caused by falls.

Furthermore, our findings show how injuries significantly affect men who are in their second as well as fourth phases of their life. In this study, men made up 71.3% of the injured patients who went to the emergency unit, and most of them were between the ages of 15 and 55. According to Abbasi et al (2013), injury can have a considerable influence on a person's socioeconomic standing. The frequency of it leads to significant morbidity as well as the possibility of long-term incapacity, and an inability to engage in work or return to previous employment activities (Abbasi et al., 2013). The patient's pre-accident socioeconomic level has previously been proposed as a factor in predicting injury risk in underdeveloped nations.

Finally, the result of the multivariate logistic regression analysis of the variables associated with type of trauma shows that variables observed to be highly significant associated with type of trauma included gender, occupation, place of injury and mechanism of injury.

CONCLUSIONS

The findings led to the conclusion that Motor vehicle collision was the most common mechanism of injury presented to KATH's emergency department. Gender, Mechanism of injury and occupation are the variables associated with the type of trauma.

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