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Effect of Road Conditions and Number of Passengers on Severity of Trauma

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I. Introduction

Road traffic injuries (RTIs) are included under unintentional injuries. The definition of road traffic fatality varies in different countries and is defined as 'any person killed immediately or dying within 30 days as a result of an injury or accident' (Mohan et al, 2006). According to WHO, RTIs are the sixth leading cause of death in India with a greater share of hospitalizations, deaths, disabilities and socioeconomic losses in young and middle-age populations (Ministry of Health and Family Welfare, 2004).

The Abbreviated Injury Scale (AIS) was first introduced in 1969 as an anatomic scoring system to categorise automobile victims for epidemiological purposes (Marcin and Pollack, 2002). It underwent revision in 1990, and body regions for the AIS were identified as follows: head, face, neck, thorax, abdomen and pelvic content, spine, upper extremities, lower extremities, and unspecified. In this revised version, external injuries are dispersed across body regions, and the AIS provide a reasonably accurate way of ranking the severity of injury by body regions.

With the AIS, injuries are ranked on an ordinal scale ranging from 1 to 6, with 1 being considered a minor injury or least severe, 5 being a severe injury or survival uncertain, and 6 being an un-survivable injury (Stevenson et al, 2001). An AIS score ≥ 3 is considered serious. The AIS correlates well with the degree of injury but suffers as a prognostic tool because it does not take physiologic derangements or chronic health into account.

II. Material And Methods

Study design: Prospective Observational Study (cross-sectional)

Study setting: Patients coming to the OPD and trauma centre of CSMMU, Lucknow were included in the study.

Study subjects: Injured patients from Lucknow and adjoining areas. This represents the target population since ninety percent of adult injured patients admitted to CSMMU Trauma Centre are direct admissions.

Sampling Frame: Injured patients admitted to CSMMU trauma centre, ninety percent of which are direct admissions and ten percent are referred patients. Patients who meet the inclusion criteria shall be consecutively recruited to ensure random selection.

Inclusion/Exclusion criteria

Patients admitted in CSMMU trauma centre, suffered injuries due to road traffic accidents were included in the study. An injury on road without involvement of vehicle (Persons slipping & falling on the road & sustaining injury), injury involving a stationary vehicle (e.g. Persons getting injured while washing or loading a vehicle), brought dead due to RTA, patients not giving informed consent(in coma ,unconscious, for more than 3 days post injury & unable to understand or reply due to shock), patient referred to CSMMU trauma centre after being treated elsewhere for more than 3 days, burn patients and patients under 12 yrs of age were excluded from the study. Accident victims were allocated into two groups, ie, those with severe injuries to the extremities or pelvis (Abbreviated Injury Scale [AIS] 3–4) and those without injuries or with minor injuries to the extremities (AIS 0–2).

Analysis: The analysis was carried out by using SPSS 16.0 version (Chicago, Inc., USA). The univariate and multivariate logistic regression analysis was carried out to find the strength of the association between road conditions and severity of AIS. The p-value<0.05 was considered significant.

III. Results

Majority (78.6%) of the accidents happened on plane road. The percentage of other road condition was almost less than 5%. The percentage of AIS 3-4 was 84.5% and AIS 0-2 was 15.5% among the patients who got accident on plane roads. The risk of AIS 3-4 was 14.77 times significantly higher among the patients who got accident on plane roads compared with poor road conditions (OR=14.77, 95%CI= 7.73-28.21, p=0.0001). The percentage of AIS 3-4 was higher in all the road conditions than AIS 0-2. It was also observed that the risk of AIS 3-4 was significantly higher among the patients who accident on slippery road, pot holed, Kharanja, under construction, dust and sand than poor road conditions (Table-1).

In more than one third (37.2%) accidents, the number of passengers were one and in 32.9% of the accidents, the number of passengers were two. 3-6 passengers were in 14.5% accidents and 7-8 were in 12.3% accidents. The AIS 3-4 was in 90.7% patients and AIS 0-2 was in 9.3% in the accidents whom the number of passenger was one. The risk of AIS 3-4 was significantly higher in the accidents whom number of passenger was one compared to the accidents having the number of passenger >8 (OR=3.41, 95%CI=1.33-8.74, p=0.01). The risk of AIS 3-4 was also higher among the accidents having number of passengers 2, 3-6 and 7-8, however, this was statistically not significant (p>0.02) (Table-2).

Most of the accidents happened on major road (59%) followed by state highway (28%). The percentage of other place of accidents were less than 5%. The percentage of AIS 3-4 was higher than AIS 0-2 among the patients who got accident at any location except for cross road. The risk of AIS 3-4 was higher among the patients who got accident at national highway, state highway, major road, junctions than cross road (Table-3).

In the multivariate analysis, the risk of AIS 3-4 was significantly (p<0.05) higher for all the road conditions than poor road condition except for slippery which was significant in the univeratite analysis. The risk AIS 3-4 was found to be significantly higher in accidents having only one passenger than >8 passengers in the multivariate analysis (Adjusted OR=6.24, 95%CI=2.21-17.63). The risk of AIS 3-4 was also higher among the patients who got accident at any location than cross road except for junctions (Table-4).

IV. Discussion

In the present study, majority of the accidents occurred on plane road. In India, such type of roads are not good in condition. Ply-worthy roads are a prerequisite for effective RTA prevention (Verma and Tewari, 2004; Zheng, 2004; Transport and Road Research Laboratory, 2005). So, there is a need of timely road maintenance, proper road engineering with sufficient traffic signs which can go a long way in improving the road worthiness of the roads.

According to a study in Nepal study, 213 (59.16%) of accidents were collision type and 147 (40.83%) were non-collision type. Narrow and defective roads were responsible for 39 (26.53%) of non-collision accidents where as collision types occurred mostly in wide roads i.e. 132 (61.97%) (Mishra et al, 2010).

In this investigation, in more than one third (37.2%) accidents, the number of passengers were one and in 32.9% of the accidents, the number of passengers were two. We observed that the most of the accidents happened on major road (59%) followed by state highway (28%). The percentage of other place of accidents were less than 5% in this study. In our best knowledge, none of the studies have reported such type of data.

A number of scoring systems have been developed to facilitate consistent trauma triage, severity evaluation, management and prognostication (Kobusingye et al, 2002). These include the Injury Severity Score (ISS), Pediatric Trauma Score (PTS), Abbreviated Injury Score (AIS), Revised Trauma Score (RTS) and Trauma score and injury severity score (TRISS) (Brenneman et al, 1998). In the present study, the severity of injury was determined using the Kampala trauma score II (KTS II) whose validity and reliability for use in both adults and children was described elsewhere (Mutooro et al, 2010). This scoring system, compares favorably with other trauma scoring systems such as the Revised Trauma Score (RTS) and Injury Severity Score (ISS) (Brenneman et al, 1998). It is scored based on age, number of serious injuries, systolic blood pressure, respiratory rate and neurologic status on presentation.

In this study, we evaluated the severity of trauma by using AIS. The percentage of AIS 3-4 was higher than AIS 0-2 in this study. It was also observed that there was significant association between AIS and road conditions, number of passengers at the time victim as well as location of the victims. In the multivariate analysis too, these factors were associated with AIS. José et al (2011) evaluated one-month hospital mortality in victims with injuries of the extremities.

A total of 3489 accident victims were evaluated; 3244 (92.98%) did not suffer injuries or had minor injuries of the extremities (AIS 0–2) and 245 (7.02%) had severe injuries (AIS 3–4). Of the 245 patients with AIS 3–4 extremity injuries, 13 (5.31%) patients died, and of those without severe injuries to the extremities, 34 (1.05%) died (Fisher's Exact test P = 0.0000, relative risk 5.063, 95% confidence interval [CI]: 2.707–9.467).

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Table-1: Distribution of the subjects according to road condition and degree injury to the extremity

Road condition	Total cases		AIS 3-4		AIS 0-2		Unadjusted OR (95%CI)	p-value
	No.	%	No.	%	No.	%		
Plane	683	78.6	577	84.5	106	15.5	14.77 (7.73-28.21)	0.0001*
Slippery	22	2.5	16	72.7	6	27.3	7.23 (2.36-22.19)	0.001*
Pot holed	25	2.9	23	92.0	2	8.0	31.21 (6.49-149.95)	0.0001*
Kharanja	21	2.4	17	81.0	4	19.0	11.53 (3.30-40.25)	0.0001*
Under construction	29	3.3	26	89.7	3	10.3	23.52 (6.14-90.11)	0.0001*
Dust	19	2.2	15	78.9	4	21.1	10.17 (2.88-35.94)	0.0001*
Sand	18	2.1	15	83.3	3	16.7	13.57 (3.40-54.09)	0.0001*
Poor condition	52	6.0	14	26.9	38	73.1	1.00 (Ref)	
Total	869	100.0	703	80.9	166	19.1		

OR-Odds ratio, CI-Confidence interval, *Significant, Ref.-Reference

Table-2: Distribution of the subjects according to no. of passengers and degree of injury to the extremity

No. of passengers	Total cases		AIS 3-4		AIS 0-2		OR (95%CI)	p-value
	No.	%	No.	%	No.	%		
1	323	37.2	293	90.7	30	9.3	3.41 (1.33-8.74)	0.01*
2	286	32.9	234	81.8	52	18.2	1.57 (0.63-3.91)	0.32
3-6	126	14.5	96	76.2	30	23.8	1.12 (0.43-2.90)	0.81
7-8	107	12.3	60	56.1	47	43.9	0.44 (0.17-1.14)	0.09
>8	27	3.1	20	74.1	7	25.9	1.00 (Ref.)	

OR-Odds ratio, CI-Confidence interval, *Significant, Ref.-Reference

Table-3: Distribution of the subjects according to accident location and degree of injury to the extremity

Accident location	Total cases		AIS 3-4		AIS 0-2		OR (95%CI)	p-value
	No.	%	No.	%	No.	%		
National highway	31	3.6	29	93.5	2	6.5	72.50 (13.51-388.89)	0.0001*
State highway	243	28.0	206	84.8	37	15.2	27.83 (10.83-71.53	0.0001*
Major road	513	59.0	425	82.8	88	17.2	24.14 (9.75-59.75)	0.0001*
Street	24	2.8	24	100.0	0	0.0	-	-
Junctions	22	2.5	13	59.1	9	40.9	7.22 (2.13-24.48)	0.002*
Cross road	36	4.1	6	16.7	30	83.3	1.00 (Ref.)	

OR-Odds ratio, CI-Confidence interval, *Significant, Ref.-Reference

Table-4: Results of multivariate logistic regression analysis

Factors	Adjusted OR	95%CI		p-value
Road condition		Lower	Upper	
Plane	6.11	2.49	15.00	0.0001*
Slippery	3.32	0.88	12.41	0.07
Pot holed	16.01	2.83	90.40	0.002*
Kharanja	5.66	1.38	23.20	0.01*
Under construction	12.43	2.76	56.00	0.001*
Dust	4.38	1.03	18.59	0.04*
Sand	5.38	1.16	24.97	0.03*
Poor condition	1.00 (Ref)			
No. of passengers				
1	6.24	2.21	17.63	0.001*
2	2.62	0.96	7.19	0.06
3-6	1.92	0.68	5.45	0.21
7-8	2.23	0.73	6.81	0.15
>8	1.00 (Ref)			
Accident location				
National highway	32.14	4.92	210.00	0.0001*
State highway	8.61	2.67	27.76	0.0001*
Major road	6.02	1.93	18.79	0.002*
Street	-	-	-	-
Junctions	2.238	0.51	9.70	0.28
Cross road	1.00 (Ref)			

OR-Odds ratio, CI-Confidence interval, *Significant, Ref.-Reference