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Assessing Road Users' Accidental Risk – A Case Study on Kolkata City

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Abstract: The present study assesses the road users' accidental risk in Kolkata. In other words, this study examines the all road users' and pedestrians accidental risks with probabilities for the period between 2009 and 2012. Road accidents have been enlarged extensively in Kolkata City owing to the remarkable growth of urban populations and the number of motor vehicles. This study is based on secondary data obtained from Kolkata Traffic Police Reviews and the analysis has been made with the application of statistical tests. The empirical results indicate that the degree of accidental risk for all road users' and pedestrians have been fluctuated under study and at the same time the risk is different for unlike kinds of motor vehicles.
Keywords: Road accidents, all road users', pedestrians, accidental risk, motor vehicles, Kolkata.
JEL Codes: I00, I1, I3, M1

INTRODUCTION

Road accidents that are by and large accidental and unnecessary are a widespread risk in daily life to facilitate can take place to just about one and all, wherever. The road accident problem is more and more fetching a risk to civic health and state progress in a lot of developing countries. Road accidents give to scarcity by causing fatalities, injuries, disabilities, pain, mislaid of efficiency and objects spoils[1]. Road accidental deaths and injuries are a major but often neglected public health problem in India[2]. With the expansion in road network in India, the numbers of road accident have surged. Road traffic wounds and fatalities have emerged as major public health involve which impose socio-economic costs across the world, particularly costs related to deaths, disabilities and hospitalization. In India, population has grown at a compound annual growth rate of 10 per cent 2001-2011. Concomitantly, traffic risk and exposure have grown. During the year 2010, there were 4,97,686 road accidents, which resulted in deaths of 1,42,483 persons and injured 5,11,394 persons in India[3].

Road accidents has been increased significantly in Kolkata due to the fabulous growth of motor vehicles and the number of motor vehicles have been increased because of the swift population growth as well as rising economic behaviours of the peoples. Road accidents are basically kicked off by inappropriate communications between vehicles and other road users and pavement characteristics. This inappropriate communications could be the consequence of the intricate relationship of a number of issues, for instance, roadway features, numerical characteristics, traffic features, street users' activities, motor vehicle plan, features of the drivers' and environmental features. Therefore, the entire structure of accident incidence is a multifarious observable fact[4]. A number of studies on road users' accident have been carried out in various cities by numerous researchers. The prominent studies comprise Sing and Misra [2], Chakraborty et al [4], Chakraborty and Roy[5], Hassen et al [6] and Aderamo[7].

ROAD TRAFFIC INJURIES AND FATALITIES IN KOLKATA

With the expansion in road network, motorization and urbanization in Kolkata, the number of road accidents have surged. Road traffic injuries and fatalities have emerged as a major public health concern, Road traffic injuries and fatalities having one of leading causes of death, disabilities and hospitalizations which impose sever socio-economic costs the world. Road accidental risk both of death and injury cases is calculated with basis of accident data during 2009-2012. Tables 1 and 2 reports the pedestrians' and all road users' numbers involved in fatal and grievous injury cases in Kolkata.

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Table-1: All Road Users' Death and Injury (Vehicle-wise) in Kolkata

	2012		2011		2010		2009		Total
	Death	Injury	Death	Injury	2009-12	Injury	Death	Injury	2009-12
Two Wheeler	69	285	40	183	42	291	23	131	1064
Car	50	425	36	334	31	498	38	297	1709
Taxi	26	216	28	202	27	319	27	170	1015
Buses	121	325	96	216	84	384	123	438	1787
Mini Buses	15	69	24	53	16	58	17	83	335
Goods Vehicles	123	320	101	250	44	200	78	227	1343
Three Wheeler	12	92	15	84	11	98	16	142	470
Others	15	31	22	22	60	242	29	307	728
Unknown	67	191	56	120	39	149	66	209	897
Total	498	1954	418	1464	354	2239	417	2004	

Source: Kolkata Traffic Police Reviews

Table-2: Pedestrians' Death and Injury (Vehicle-wise) in Kolkata

	2012		2011		2010		2009		Total
	Death	Injury	Death	Injury	Death	Injury	Death	Injury	2009-12
Two Wheeler	22	157	20	121	25	205	13	93	656
Car	25	226	19	201	20	341	23	208	1063
Taxi	18	119	17	102	17	175	21	90	559
Buses	64	121	56	109	53	208	63	319	993
Mini Buses	7	31	13	32	13	35	9	60	200
Goods Vehicles	68	120	52	114	23	103	45	135	660
Three Wheeler	10	43	10	48	8	67	9	121	316
Others	9	16	15	13	31	173	10	234	501
Unknown	53	129	42	78	22	109	34	189	656
Total	276	962	244	818	212	1416	227	1449	

Source: Kolkata Traffic Police Reviews

Nevertheless, no important studies have showed on the road users' accidental risk of motor vehicles in Kolkata. In the present research work, an appraisal of the up to date stage the road users' accidental risk in Kolkata has been prepared.

LITERATURE REVIEW

A rising number of available studies on road traffic injuries and deaths demonstrate that this difficulty obtains progressively concentration by administrations, NGOs, researchers and the international society more generally. In this connection, a brief review of related literatures has been put forward in the following paragraphs:

Chakraborty and Roy [5] observed the features of traffic accident of Kolkata based on road safely level in terms of accident harshness index, rate of accident casualty, risk of accident causality and accident risk. They found that rates of accident causality has been decreased and suggested that the traffic process management in Kolkata may have perked up. Singh[9] examined the road travel injuries and deaths as a concealed outbreak in Uttar Pradesh, India. Regardless of this, road security is so far to be a political precedence in UP. The time has move toward for the state and local governments to restrict travel accidents in the course of road security education and enforcement and furthermore to intervene the result of accidents by conniving safe roads in the midst of reasonable and cost-effective appraises. Hassen et al [6] examined the risky driving behaviours for road traffic accidents among drivers in Mekele City of Ethiopia based on quantitative cross-sectional study with a sample size of 350 drivers using statistical tests. They found that drivers of secondary education in addition to by means of high average monthly income were more likely to have risky driving behavior. Having supportive attitude towards risky driving behaviors and not getting guidance about risky driving from important others augments the possibility of developing dangerous driving behavior. Interferences aimed at developing negative approach towards dangerous driving behaviors on drivers and noteworthy others should be executed to fetch positive behavior change. The interferences require to be segmented with educational status and

income. Aderamo [7] observed the consequence of road traffic accident injuries on productivity in Nigeria based on secondary data with the application of statistical tests. The empirical results confirm that an obvious association subsists between road traffic accident injuries and productivity in Nigeria. The study lastly prepared a few suggestions to perk up road safety in Nigeria. Nordfjærn [9] examined the differences in road traffic culture with non-transport accidental risk perception and risk willingness in Norway and Turkey based on questionnaire survey. This study also aimed to scrutinize differences in how these constructs predict speeding and rule violations in the two countries. The empirical results demonstrated that Turkish road users reported more fatalistic beliefs and focused more on written information and sounds in road traffic whereas Norwegian drivers put greater emphasis on oral and visual traffic information. Norwegians also reported more extroverted orientations in traffic. The convincing amount of this retrospective appraisal of pertinent literature created till date on the obtainable topic discloses broad room for the strength and initiates of this work and replicates various important proofs that confirm its feasibility, as may be noticeable here it. Nor has any earlier research inspected the road users' accidental risk in Kolkata.

OBJECTIVES OF THE STUDY

The most important object of the present study is to observe the road users' accidental risk in Kolkata. More specifically it seeks to dwells upon mainly the following issues: (i) To observe the all road users' accidental risk under study; (ii) To examine the pedestrians accidental risk under study; (iii) To make some suggestions for reducing the road accidents in Kolkata.

METHODOLOGY OF THE STUDY

Trustworthy and methodical data on road traffic injuries and deaths is inadequate. A common need of trustworthy statistics in most metropolitan cities generally have no methodical very important registration structure and however a huge number of roads collide and fatalities are not proclaimed to the police. But in Kolkata, more or less deaths and injuries that take place because of road crashes are accounted to the police. In this way, this study is based on secondary data acquired from Kolkata Traffic Police Reviews (KTPR) for the period between 2009 and 2012. Motorization in terms of buses, minibuses, taxi, car, two wheelers, goods vehicles, three wheelers etc. is certainly a new current incident in India however fewer attempts have also been prepared in Kolkata to execute a traffic mishap observation method. Furthermore, the accessible database of deadly road crashes comprises completely collective data[10]. In road traffic, risk comprises four elements that include the amount of journey within the structure by unlike users, the fundamental probability of a collapse, specified a meticulous spotlight, the probability of wound, specified a collapse, and finally the result of wound[11].

In recent times, the protection of road traffic has turn out to be a tremendously severe difficulty for almost every metropolitan city in India. An increasing density of the traffic reasons a growing quantity of accidents related with losses of fatalities or injuries. Data from accident facilitate to accomplish the necessary analyses and set up the trends of the traffic protection. The particular assessment apparently needs a widespread attribute of risk intensity to facilitate consists in immediate deliberation of risk factors of every traffic accident, probability of a definite traffic accident incidence and suitable appearance (assessment) of traffic accident effects.

It is apparent that there subsists a new multifaceted assessment with the application of risk *R* in the following form: R = P × C. Where R = risk of traffic accident, P = probability of traffic accident incidence and C = effect of traffic accident. To specify the risk of traffic accident in relation to this equation it is obligatory to measure probability of accident incidence P and effects of traffic accident C. Risk assessment is practice of purported degree of risk D_R that can be articulated by the following equation:

$$\mathbf{D_R = C_{Ai}\, \Sigma N / \Sigma C_A\, N_i}$$

Where C_{Ai} = number of effects by specified cause of accident, ΣCA = number of effects by all accidents, ΣN = number of all accidents, Ni = number of accidents by specified cause of accident. Degree of risk D_R designates how many times the specified cause of accident is more dangerous than statistically significant average cause of an accident[13].

Probability of traffic accident incidence includes a total scheme of occurrence and employing a classical definition, capable of the probability share of frequency of precise form of traffic accident and total amount of traffic accidents in the period under the study. Probability of traffic accident P can be expressed in the following equation:

P of observed accident = probabilities of diverse vehicles (for death X for injury)

P of expected accident = expected probabilities as a whole based on lease square trend.

D_R for death or injury = probabilities of diverse vehicles X probabilities for expected accident

EMPIRICAL RESULTS AND ANALYSIS

Table 3 discloses the vehicle wise degree of accidental risk for all users' under study. Those degrees

of accidental risks have been computed by Stodola methodology.

Table-3: Vehicle wise degree of accidental risk in different years - All users'

	Death					Injury				
Types of vehicle	2012	2011	2010	2009	Average of 2009-12	2012	2011	2010	2009	Average of 2009-12
Two Wheeler	0.319	0.169	0.289	0.126	0.2258	0.336	0.221	0.317	0.149	0.2557
Car	0.144	0.095	0.133	0.129	0.1252	0.312	0.251	0.338	0.210	0.2777
Taxi	0.126	0.124	0.195	0.154	0.1499	0.267	0.256	0.364	0.202	0.2723
Buses	0.333	0.242	0.344	0.400	0.3298	0.228	0.155	0.249	0.296	0.2321
Mini Buses	0.221	0.323	0.350	0.295	0.2969	0.259	0.203	0.201	0.299	0.2404
Goods Vehicles	0.451	0.339	0.24	0.337	0.3417	0.299	0.239	0.173	0.204	0.2287
Three Wheeler	0.126	0.144	0.171	0.198	0.1596	0.246	0.230	0.242	0.365	0.2705
Others	0.102	0.136	0.604	0.231	0.2681	0.053	0.039	0.385	0.510	0.2467
Unknown	0.368	0.281	0.319	0.427	0.3486	0.267	0.172	0.192	0.282	0.2283
Mean	0.243	0.206	0.294	0.255	0.2495	0.252	0.196	0.273	0.280	0.2503
t-statistics	6.387	7.528	7.06	7.454	9.555	10.34	9.649	11.55	8.633	46.801
Probability	0	0	0	0	0	0	0	0	0	0
Note: Significant at 1% level of significance at 2-tailed test.										

Table 4 also discloses the vehicle wise degree of accidental risk for pedestrians under study. Those degrees of accidental risks have been computed by Stodola methodology.

Table-4: Vehicle wise degree of accidental risk in different years – Pedestrians

	Death					Injury				
Types of vehicle	2012	2011	2010	2009	Average of 2009-12	2012	2011	2010	2009	Average of 2009-12
Two Wheeler	0.1504	0.1327	0.2927	0.1463	0.1805	0.308	0.2395	0.3593	0.164	0.2677
Car	0.1055	0.0778	0.1445	0.1598	0.1219	0.2736	0.2455	0.3688	0.2263	0.2786
Taxi	0.1444	0.1324	0.2335	0.2774	0.1969	0.274	0.2369	0.3599	0.1862	0.2643
Buses	0.2891	0.2455	0.4099	0.4684	0.3532	0.1568	0.1425	0.2408	0.3716	0.2279
Mini Buses	0.157	0.2829	0.4992	0.3322	0.3178	0.1995	0.2077	0.2012	0.347	0.2388
Goods Vehicles	0.4621	0.3429	0.2676	0.5034	0.394	0.234	0.2243	0.1794	0.2366	0.2186
Three Wheeler	0.1419	0.1377	0.1944	0.2103	0.1711	0.1751	0.1972	0.2438	0.4429	0.2647
Others	0.0806	0.1303	0.4752	0.1474	0.2084	0.0411	0.0337	0.397	0.5402	0.2530
Unknown	0.3624	0.2787	0.2575	0.3827	0.3203	0.2531	0.1544	0.191	0.3332	0.2329
Mean	0.2104	0.1957	0.3083	0.292	0.2516	0.2128	0.1868	0.2824	0.3165	0.2496
t-statistics	4.841	6.359	7.415	6.351		7.859	8.227	9.678	7.594	
Probability	0.001	0	0	0		0	0	0	0	
Note: Significant at 1% level of significance at 2-tailed test.										

To find out this probability we can employ enough realistic data in the statistics of the traffic rate of accident. The shock can be measured a measure of the traffic accident relentlessness. It is an important fraction of magnitude of risk. Here survives a common inversion attitude derived from the reality that an accident with a high level of probability of incidence,

however with non-serious shocks has furthermore a low level of risk rate and vice versa, an accident still extremely questionable although with severe effects is measured as very much dangerous.

Usually the shock of traffic accident can be recognized:
1) While a harshness level can be recognized to every accident as a relative value of accident shock with a sense of influence, within the interval range of probabilities: $0 \leq P \leq 1$, with potential explanation: with no shocks P min $\rightarrow 0$, disastrous shocks P max $\rightarrow 1$.
2) While harshness of single categories of accidents is recognized by a scale - Injury, death, with precise explanation of harshness of individual categories. In a few fields for every category there subsists a maximum value of publicly adequate probability of accident incidence.

Table-5: All users' observed Accident and Possibility of Accidental Risk

Types of vehicle	Death	Injury	Observed accident	Possibility of Accidental Risk
Two Wheeler	0.2258005	0.2556752	0.2407379	0.2251
Car	0.1252136	0.2776796	0.2014466	0.2251
Taxi	0.1499039	0.2722993	0.2111016	0.2251
Buses	0.3297975	0.2321427	0.2809701	0.2251
Mini Buses	0.296872	0.2404172	0.2686446	0.2251
Goods Vehicles	0.3416789	0.2287401	0.2852095	0.2251
Three Wheeler	0.1596201	0.2704645	0.2150423	0.2251
Others	0.2681204	0.2466777	0.2573991	0.2251
Unknown	0.3486262	0.2282576	0.2884419	0.2251
Mean	0.249515	0.250262	0.249888	0.2251
t-statistics	8.5466	38.3867	22.0379	4.43E+16
Probability	0	0	0	0
Note: Significant at 1% level of significance at 2-tailed test.				
Degree of risk for Injury = 0.50442		Degree of risk for Death =0.50549		

Since degree of risks for traffic accident are about 0.50 in both the cases, which indicates that moderate shocks are seen for pedestrians' traffic accidents in Kolkata (table-5). Because degree of ultimate risk is very much depending on the observed and expected probabilities, it is necessary to check the validity of the level of significance. To test the difference between the observed and expected accidental risks, Sandler's A-test is more suitable. This test is significant because the calculated value of A-test is less than the table value at 5% level of significance at 8 degrees of freedom. It rejects the null hypothesis and designates that degree of risks for traffic accident in Kolkata is moderate risky if the peoples used the road for crossing as well as breaks the traffic signal as well.

Table-6: Pedestrians' Observed Accident and Possibility of Accidental Risk

Types of vehicle	Death	Injury	Observed accident	Possibility of Accidental Risk
Two Wheeler	0.180524	0.267682	0.2241029	0.231
Car	0.12188	0.278559	0.2002198	0.231
Taxi	0.196926	0.264252	0.2305888	0.231
Buses	0.353211	0.227932	0.2905715	0.231
Mini Buses	0.317825	0.238849	0.2783368	0.231
Goods Vehicles	0.39402	0.218562	0.3062907	0.231
Three Wheeler	0.171094	0.264748	0.2179211	0.231
Others	0.208356	0.253008	0.230682	0.231
Unknown	0.320316	0.232929	0.2766224	0.231
Mean	0.251572	0.249613	0.250593	0.231
t-statistics	7.9042	36.0715	20.0465	4.43E+16
Probability	0	0	0	0
Note: Significant at 1% level of significance at 2-tailed test.				
Degree of risk for Injury = 0.51895		Degree of risk for Death = 0.52302		

Since degree of risks for traffic accident are more or less 0.52 in both the cases, which indicates that more than moderate shocks are seen for pedestrians' traffic accidents in Kolkata (table-6). In view of the fact that degree of ultimate risk is immensely depending on the observed and expected probabilities, it is obligatory to test out the legitimacy of the level of significance. To test the difference between the observed and expected accidental risks, Sandler's A-test is more appropriate. This test is significant because the calculated value of A-test is less than the table value at 5% level of significance at 8 degrees of freedom. It rejects the null hypothesis and designates that degree of risks for traffic accident in Kolkata is slightly risky if the peoples used the road for crossing as well as breaks the traffic signal as well.

CONCLUSION

The dilemma of deaths and injuries in consequence of road users' accident risks in India includes almost all metropolitan cities are severe as much as necessary to insist concentration of particular influences. Despite the compassionate features of plummeting road users' deaths and injuries, a sturdy case can be prepared of plummeting collide deaths on financial reason only. The primary findings of the study are the degree of accidental risk for all road users' and pedestrians have been fluctuated under study and at the same time the risk is different for unlike kinds of motor vehicles, as supported in,[2]. Also it is observed that all users' and pedestrians deaths were highest in 2010 and all users' and pedestrians injuries were highest in 2009. Furthermore, all users' and pedestrians deaths and injuries were highest by goods vehicles and unknown vehicles. Road accidents are unsurprising and consequently avoidable. With the aim of fight the difficulty, there necessitates to be close up harmonization and association, employing a holistic and included move toward, athwart numerous segments as well as a lot of controls. At the same time as there are lots of interferences that can set aside subsist and boughs, political force and obligation are important and exclusive of them petite can be attained. The moment to proceed is nowadays. Road users universally justify improved and safer road journey, as supported in[12]. Also it is essential at this moment that several investigations should be carried out in the future to examine the potential reasons of concern of motor vehicles in road accidents with the aim of locating suitable corrective measures. It would sequentially assist to perk up the overall road protection condition in Kolkata as well.

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