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## Research Article

# SPATIOTEMPORAL VARIATION OF ROAD TRAFFIC ACCIDENT IN KOLKATA: AN APPRAISAL

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### ABSTRACT

Road traffic accidents are one of the most important problems being faced by modern urban areas. Most of the countries in present world have been witnessing such hazards due to increasing growth of vehicular traffic as a result of population explosion coupled with large-scale socio-economic activities. Rapid growth of motorized two and four wheelers, mixed traffic flow, inadequate infrastructural safety measures, lack of proper traffic safety and inadequate post-crash hazard management are the responsible reasons for the over increasing growth of road traffic accidents in South East Asian Countries. Most of the world megacities are located in the less motorized countries (LMC) and many more cities in these countries will grow to population of more than ten million in the next few decades. Present study area Kolkata was one of them. The present paper was concerned with the spatiotemporal variation of road traffic accident within Kolkata Police Jurisdiction. To find out the variation, the study dealt with the police station wise occurrence of fatal and non-fatal cases for the time span of 2007 to 2014. Police station wise degree of inequality had been measured by the Location Quotient. The obtained values of location quotient had been arranged in a temporal framework to show the spatiotemporal variation. By summing up the individual scores an aggregated index was calculated. An effort had also been taken to identify the possible factors of such variation incorporating the controlling measures which are being practiced by the Kolkata police and which can be adopted to reduce the rate of accident in the city.

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## INTRODUCTION

Transport infrastructure in most of the Indian Megacities is inadequate in terms of quantity as well as quality and Kolkata is not an exception in this regard. The burgeoning incident of road traffic accident is one of the most important resultant effects of these phenomena. Most of the developing countries are less motorized and present study area Kolkata is one of them. Fatality rates in Indian Metro cities are very high in comparison to the metro cities of the developed world. It is becoming increasingly evident that poor and vulnerable groups in low income and middle-income countries have a disproportionate share of the burden arising from road traffic injuries (World Bank, 2007). The situation is acute in these two groups of countries which account for more than 90 percent of such deaths—despite these countries owning less than half of all motor vehicles (WHO, 2009). There is a crucial

thing that without increased efforts and new initiatives, the worldwide total number fatal and non-fatal cases related to road traffic accident is estimate to rise by some 65 percent between 2000 and 2020 (Kopits E, Cropper M., 2003; Murray CJL, Lopez AD, 1996), and in low income and middle-income countries fatalities are expected to increase by as much as 80 percent (WHO, 2004).

### Study Area

Kolkata, the study area belongs to the low-income group countries of the South East Asia where the severity of the road traffic accidents is alarming in comparison to the high motorised countries of the Developing World. In initial phase the entire area of Kolkata Municipal Corporation (KMC) was not included in the area of Kolkata Police Jurisdiction. It is only since the latter half of 2010, that the entire area of KMC has started to be served by the Kolkata Police and as a result of

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it, total number of Police Stations has changed over the years. The entire Police Jurisdiction area has been sub-divided into certain divisions which are further divided into police stations. The number of divisions during the period of study i.e. 2007 to 2014 has increased from five to eight respectively. Likewise number of police stations also increased from forty eight to sixty nine (Fig No. 1).

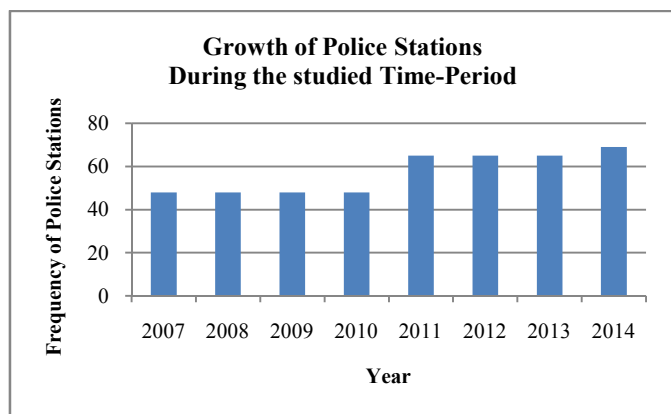


Fig 1

Source: Kolkata Police

**Objectives**

The primary objective of the present paper is to study the spatial variations of road traffic accidents within the Kolkata police jurisdiction. Study of spatial variation has been done in a temporal frame-work of eight years (2007-2014). Fatal and non-fatal both categories of cases are considered for this spatio-temporal study.

**MATERIALS AND METHODS**

Temporal analysis of the fatal and non-fatal cases has been done based on time series analysis, whereas the spatial intensity of fatal and non-fatal cases is based on their level of inequality which is studied by the Location Quotient. After the completion of the police station wise computation, several categorises are identified based on the range of their spatial intensity and police stations have been arranged with deciphered range of categories for the studied time period of eight years. Entire exercise has been undertaken for the fatal and non-fatal cases.

**RESULT AND DISCUSSION**

*Temporal Analysis*

In order to understand the trend of accident situation in the Kolkata Police Jurisdiction area for the last eight years even better, data on trend analysis of fatal and non-fatal cases for the time span of eighteen years (from 1997 to 2014) has been collected from the Kolkata Police since variations particularly for cases other than fatal was much higher previous to the last eight years.

Total number of fatal cases was always observed to lie in between 400 to 500 but the year of 2010 was an exception when the observed figure was less than 400. Fatal cases in accidents depend on several factors ranging from technological difficulties, infrastructural aspects, behavior of passengers and drivers etc.

**Table 1** Intra Divisional Variation of Fatality

Divisions	Range of Fatality	2007	2008	2009	2010	2011	2012	2013	2014
North	>3								
	2-3		12.5	12.5					
	1-2	50	25	50	50	50	62.5	37.5	37.5
Central	<1	50	62.5	37.5	50	50	37.5	62.5	62.5
	>3	11.12							
	2-3				11.11			22.33	
Port	1-2	55.55	55.56	66.67	33.33	33.33	55.56	33.33	44.44
	<1	33.33	44.44	33.33	55.56	66.67	44.44	44.44	55.56
	>3								
Eastern Suburban	2-3						11.11		11.11
	1-2	42.86	28.57	42.86	57.14	33.33	44.45	44.45	44.45
	<1	57.14	71.43	57.14	42.86	67.67	44.44	55.55	44.44
South	>3								
	2-3								9.10
	1-2	33.33	40	46.66	46.67	45.45	54.55	54.55	36.35
South East	<1	66.66	60	53.34	53.33	54.55	45.45	45.45	54.55
	>3								
	2-3					12.50			11.11
South West	1-2					25	25	50	44.44
	<1					62.50	75	50	44.44
	>3								
South Suburban	2-3							20	
	1-2					60	20	20	50
	<1					40	80	60	50
South Suburban	>3								
	2-3					25	12.5	12.5	10
	1-2					25	50	50	50
	<1					50	37.5	37.5	40

Source: Computed by the authors

The lower number of fatal cases may be attributed to the abolition of old buses from the streets of Kolkata, when the riding quality improved and number of accidents might have reduced.

It is quite obvious that in comparison to the fatal cases, the frequency of non-fatal cases has been fairly high because it includes all types of injuries reported on road. Though it ranged from 500 to 2000, however in majority of the years it oscillated in between 1000 to 1500. In the year of 2002 and 2003 the actual value of non- fatal cases was very low and it was near about 500. In these two years the difference between fatal and non-fatal cases was negligible whereas in the year of 2013 and 2014 the same was very high perhaps due to the improvement of the life-saving system of the city or due to decreased severity of road accidents. There is a similarity between the trend of the fatal and non-fatal cases i.e. in both the cases the trend have been decreasing which may be considered as an indication of the gradual improvement of the condition of traffic in this city.

**Spatial Analysis**

For the purpose of spatial analysis eight years (2007 – 2014) has been considered. Location quotient has been used as explained in section 4 above to represent the spatial intensity.

**Police Station wise variation of fatal cases**

For understanding the variation in fatality rates among the police stations degree of inequality has been represented into four categories.

The study of the spatial intensity of fatality has revealed the predominance of lowest range of intensity i.e. the category of less than one. Though in the year of 2009 significant change was observed when maximum police stations were seen to be in between the range of one and two, yet in almost ninety percent of the years lowest range of intensity is predominant. Likewise in the year 2011 37 police stations recorded accidental fatalities in the first category. It may be said that an increase in Police Jurisdiction area increased the number of fatalities not only in the first category but also in almost all categories as compared to the previous years. There are few years like that of 2010 and 2012 when both the above mentioned categories depicted greater concentration of fatalities. Highest range of intensity was absent in almost all the studied years except for the year of 2007. It is to be noted from the above stated spatial distribution pattern that the percentage share of the third category i.e. the category in between more than two and less than three has gradually increased, which is to some extent alarming. Though the number of police stations had increased over the years as already stated above, nevertheless increased fatality incidences should not be taken lightly. It not only speaks of a poor road infrastructure and traffic management but also of the negligence and absence of knowledge trauma care or emergency care.

**Intra-divisional Variation of Fatal cases**

Attempt has also been made to understand the severity of the situation within the sub-divisions under Kolkata Police Jurisdiction.

**Table 2** Intra Divisional Variation of Non-Fatality

Divisions	Range of Non-Fatality	2007	2008	2009	2010	2011	2012	2013	2014
North	>2.25								
	1.5-2.25	12.5	12.5			12.5			12.5
	0.75-1.5	75	87.5	75	75	62.5	100	87.5	87.5
	<0.75	12.5		25	25	25		12.5	
Central	>2.25								
	1.5-2.25								
	0.75-1.5	100	77.78	88.89	88.89	88.89	77.78	77.78	77.78
	<0.75		22.22	11.11	11.11	11.11	22.22	22.22	22.22
Port	>2.25					22.23			11.11
	1.5-2.25						11.11		11.11
	0.75-1.5	85.71	85.71	85.71	85.71	44.44	55.56	55.56	77.78
	<0.75	14.29	14.29	14.29	14.29	33.33	22.22	22.22	11.11
Eastern Suburban	>2.25								
	1.5-2.25		11.11	11.11					
	0.75-1.5	100	77.78	77.78	88.89	100	100	85.71	85.71
	<0.75		11.11	11.11	11.11			14.29	14.29
South	>2.25								
	1.5-2.25	6.67	6.67	6.67					
	0.75-1.5	86.66	86.66	80	100	90.91	100	100	90.91
	<0.75	6.67	6.67	13.33		9.09			9.09
South East	>2.25								
	1.5-2.25					12.5		25	11.11
	0.75-1.5					50	100	62.5	77.78
	<0.75					37.5		12.5	11.11
South West	>2.25								
	1.5-2.25								16.67
	0.75-1.5					100	100	80	83.33
	<0.75							20	
South Suburban	>2.25								
	1.5-2.25					12.5			10
	0.75-1.5					62.5	87.5	100	70
	<0.75					25	12.5		20

Source: Computed by the authors

Table 1 reveals that Intra divisional spatial analysis represents an almost similar situation to that of police station wise variation. Among the five old sub-divisions, Eastern Suburban and South Divisions were in less critical situation in comparison to the other three old divisions of Kolkata Police perhaps due to their marginal locations and comparatively less congested and less diversified traffic. However over the last four years all the four out of the five shows an increasing number of fatal accident cases to be reported within their boundaries. Surprisingly South division showed a decreasing trend probably because of its better traffic management character. On the other hand, the newly formed police divisions display a more vulnerable situation. Mention may be made of South Suburban which has been in a more vulnerable condition since inception in comparison to the other two newly formed Police Divisions of Kolkata Police, because of it's over increasing economic activities and mixed land use pattern in compare to the other two newly developed Police Stations.

above mentioned category depicted almost sixty police stations in 2011 (Fig 5), while the number fell to fifty by 2014.

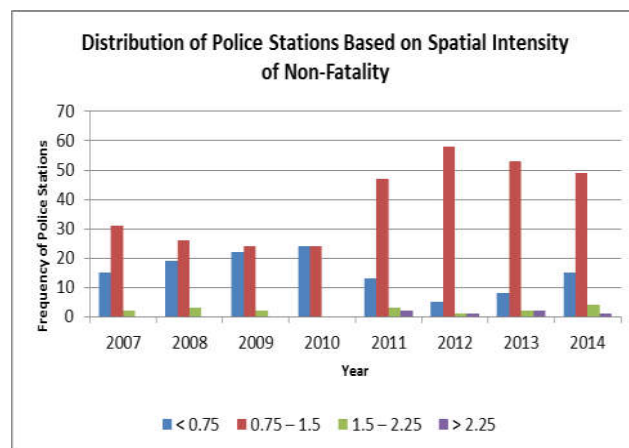


Fig 5 Source: Computer By The Author Based on Data Provided By Kolkata police

Fortunately enough distribution of non-fatality cases in other higher categories for all the Police Stations was very insignificant, in fact before the newly developed police divisions they were more or less absent. Frequency of police stations in uppermost category (>2.25) was highest in the Port Division. Between the years 2011 to 2014, presence of police stations was repeatedly observed in the uppermost category for this police division. However, all the newly added police stations also recorded non-fatality cases in the third category.

Temporal Analysis of Different Types of Accident Cases in Kolkata (1997 - 2014)

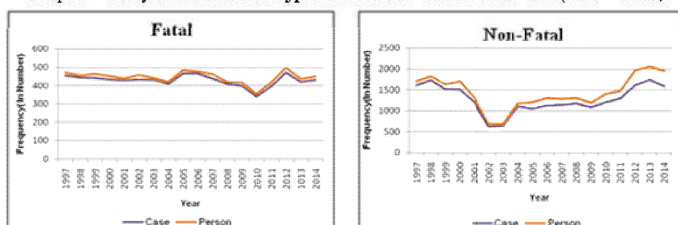


Fig 2 & 3

Source : Kolkata Police

**Police Station-wise Variation of Non-fatal Cases**

Consideration of the spatial distribution of non-fatal cases over the Kolkata Police Jurisdiction depicts a comparatively different picture where the percentage share of second lowest category i.e. the category of 0.75 to 1.5 was highest. Not only that, the percentage of Police Stations in this category has started to increase which is quite alarming.

**Intra-divisional Variation of Non-Fatal cases**

A study of the intra divisional cases shows that before 2011 incidences of non-fatality was highest for Port Division followed shortly by Central division. It may be stated that both these areas depict a very congested road character with heavy vehicle movement and mixed mode of traffic occupying the same road space. This increases the chances of collision cases undoubtedly. Among the newly developed police sub-divisions non-fatal accident rates is almost high in all the three as seen in Table 2. It is to be noted here that incidences of non-fatality in the highest category did not occur in any of the newly developed divisions. Likewise even in the existing police divisions non-fatality cases did not record in any of North, Central, Eastern Suburban and South divisions.

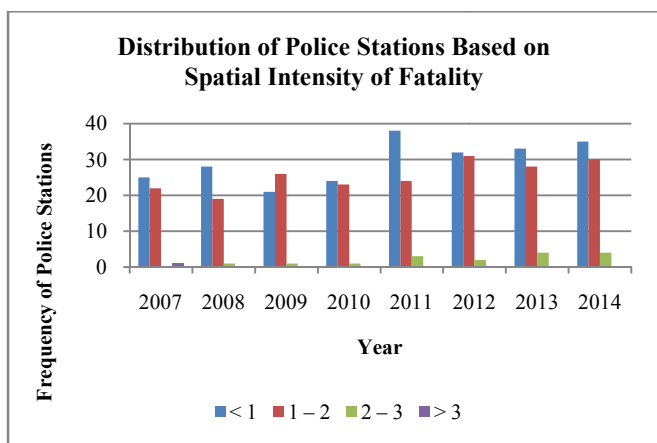


Fig No 4

Source: Computed by the author based on data provided by Kolkata Police

Though a marginal decline is observed by 2014, yet the fact that overall accident cases excluding fatalities have increased in the city should not be overlooked. Not only the number of vehicles in limited road space poses a problem, but also poor traffic management and behaviour of both drivers and pedestrians enhance accident rates which include collision cases as well as injuries. Frequency of non-fatality cases in the

**CONCLUSION**

The trend of accident cases both of fatalities and non-fatalities have been on an increase in the city though their severity has been reduced significantly, with development of emergency accident care facilities. Nevertheless this also largely points out to the lacunae that exist between the authorities in charge of traffic management in the city and the road users. Though the various programme and policies undertaken by the Kolkata Police is significantly high in number but their implementation faces serious difficulties. This is the reason why the number of accidents in the city still remains very high. It is to be mentioned here that in comparison to the other metro cities in the country, the rate of road traffic accident in Kolkata is way less, which definitely is a positive indication that in future, Kolkata Police will be able to reduce the accident numbers further. What is necessary is a mutual performance of both the traffic management personnel as well as the road users in

driving the city streets. Until and unless, the road users i.e both drivers and pedestrians take part in using the road safety norms by obeying the traffic rules it will be indeed a difficult goal to reduce the number of traffic accidents in a busy metro city like Kolkata

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