

A Time Series Analysis of Road Accidents in Uttar Pradesh India

Dr. Shubhendra Singh Parihar

Associate Professor, Jaipuria Institute of Management, Lucknow, India Shubhendra.parihar@jaipuria.ac.in

Abstract

Article Info Volume 83 Page Number: 206 - 219 Publication Issue: July - August 2020

Article History Article Received: 06 June 2020 Revised: 29 June 2020 Accepted: 14 July 2020 Publication: 25 July 2020 What are the main factors that causes fatal accidents, grievous injuries and deaths due to accidents? Factors such as type of roads, structure of roads, weather conditions, specific time and space are studied to identify a relationship between the accidents and the pertinent cause. We investigated the main causes from the official road accidents records (file data) made available from Road safety cell, Transport department, UP, India.

The available data was not in a uniform format for the given period so a few aspects could not be analyzed due to duplication or unstructured form of records. Therefore we have taken only ten factors which were uniform throughout the period of study considered.

The findings indicate that there is a significant relationship observed between the accidents form on a particular factor under study. This study will provide insights to road safety cell of Transport department to understand the critical factor of fatal accidents and what effective measures can be taken to minimize fatal road accidents.

Keywords:Fatal accidents, Grievous Injury, Road structure, Road type, location of accidents.

I. INTRODUCTION

The incidence of road accidents, injuries and fatalities has amplified manifold in recent past. The road accidents have turn out to be a public issue and mortalities are from every segment of the society. These fatalities are caused by several factors involving designing of roads, behavior of road users and drivers of vehicles, so road safety demands an all-inclusive approach to identify solutions to prevent the cause and fatalities. Accidents unfortunately, are not often due to but are due carelessness. ignorance. to thoughtlessness and over confidence. William Haddon (Head of Road Safety Agency in USA) has pointed out that road accidents were associated with numerous problems each of which needed to be addressed separately.

Road traffic fatalities have been increasing at about 8% annually for the last ten years and show no signs of decreasing. (Mohan Dinesh, 2009) He also explained about crash patterns and at different factors like time of the day, Cities vs. Rural areas, road user category age and gender. The State of Tamil Nadu has recorded highest number of road accidents in 2017, but the number of persons killed in road accident has been the highest in Uttar Pradesh. Major States that achieved significant reduction in road accidents and fatalities in 2017 are Tamil Nadu, Maharashtra, Gujarat and West Bengal. Uttar Pradesh and Bihar were the worst performers recording large increase in the number of road accidents and fatalities in 2017 as compared to 2016 (Road safety department report, 2017)

To improve road safety, insights needed into preventable causes of road accidents. Police reports of road accidents are the main source of data used for informing research and policy on the cause of road accidents. (Rolison, J. J., Regev, S., Moutari, S., & Feeney, A. (2018).

The relative accident risks were increased on poor road and weather conditions; however, they were the highest for icy rain and slippery and very slippery road conditions. When comparing the relative accident risk based on road type, the results showed that the risk in poor weather and road



conditions was higher on motorways compared to two-lane and multiple-lane roads even though the overall risk was lower on motorways. Furthermore, the corresponding relative accident risks were generally higher for single-vehicle accidents compared to multi-vehicle accidents. (Fanny Malin, IlkkaNorros, sat Innamaa 2019)

II. LITERATURE REVIEW

Singh S. K. (2017) explained in his paper that accidental deaths and injuries in India varies according to age, gender, month and time. He further explained that road accidents are relatively high in May-June and December- January. Salgado M.S.L. Colombage, SM (1988) described in their study that the highest number of fatalities were in the age group 20–29 years. Cranio-cerebral injury was the commonest cause of death in all groups of victims. Noland RB (2003) found in his work that demographic changes in age cohorts, increased seat-belt use, reduced alcohol consumption and increases in medical technology have accounted for a large share of overall reductions in fatalities.

In Great Britain, the severity of accidents has three categories: slight, serious and fatal injury. Motorway accidents can be divided into two groups according to the location where the initial impact happened: hard-shoulder (HS) and main carriageway (MC). When comparing the level of accident severity of these two groups in Great Britain, it can be concluded that the severity of HS accidents is significantly higher. (Michalaki, P., Quddus, M. A., Pitfield, D., &Huetson, A. (2015)

Julia B Edwards (1996) explained in her study that the weather might be a contributing factor in an accident, although not necessarily the principal one. Variations in accident frequency in fine weather, rain, high winds, fog and snow are detailed and comparison made between frequency of accident occurrence and weather conditions. Julia B Edwards (1998) has establish in her study that accident severity decreases significantly in rain compared with fine weather, while severity in fog geographical variation. Evidence shows for accident severity in high winds remains inconclusive.

Adli H. Al-Balbissi (2010) found in their study that male accident rates are significantly higher. This trend is consistent through all the analyses. Accident differences are significant only in normal driving conditions. Drivers over age 50 had the lowest accident rates. Accident rate differences were caused by lack of attention and impatience among male drivers. (RuthBergel- Hayata, Mohammed Debbarha, ConstantinosAntonioub& George Yannisb, 2013

Mannering F.(2018) explained in his study that the temporal instability is likely to exist for a number of fundamental behavioral reasons, and this temporal instability is supported by the findings of several recent accident-data analyses. The paper goes on to discuss the implications of this temporal instability for contemporary accident-data modeling methods (unobserved heterogeneity, data driven, traditional, and causal inference methods) and concludes with a discussion of how temporal instability might be addressed and how its likely presence can be accounted for to better interpret accident data-analysis findings

III. METHODOLOGY

This study is based on secondary data of road accidents which is classified as fatal, grievous and non-fatal injuries. The accidents frequencies on multiple explanatory variables is examined to understand the pattern and frequency of injuries on various dimensions like time, type of road, weather condition, cause of accident, nature of accident, location of accidents, location, type of vehicle, age of vehicle etc. A time series analysis of seven years data is done to identify the severity of the phenomenon and its growth pattern.

A data set of seven years of road safety department is taken to review the type of road accidents due to various reasons. It was a classified data on various parameters like age of vehicle, type of road, type of vehicle, time interval, type of weather etc. The available data set was rearranged to make it feasible for meaningful analysis.

There were nine explanatory variables identified from the data file suitable for analysis. The nine explanatory variable are as follows –

All conditions based on "Year wise median"			
Month over month	Weather	Driver	
*F , *GI, *K	Condition	behavior at	
		time on	
		driving	
Time segments in a	Type of	Age of	
day (Rural &Urban	vehicle	vehicle	



– Hour wise)		
Type of Road (Expressway, National Highway, State Highway and other roads	Road Structure	Location of incidence

Table-1 (List of explanatory variables) *F stands of Fatal, *GI stands of Grievous injury and *K stands of Killed in accidents phenomenon The median of explanatory variable is calculated to understand the pattern and the variables need to be focused by the road safety department so that the incidence of such accidents can be reduced optimally.

This nine is to nine matrix gave us deep insights of accidents frequency on various variables. This dissection of data help to see the pattern and growth of accidents.



IV. ANALYSIS AND INTERPRETATION

Figure-4.2 (month over month median of fatal accidents)

The month wise analysis of accidents according to category (Fatal, Grievous and killed) reveals that the highest rate of fatal accidents and in the month of May (median-1544, 10.2%). The high rate of grievous injury are again in May (median-1377, 10.4%) and June (1272, 9.3%). The month of



March is also showing high rate of grievous accidents (Median 1380, 9.3%). The total number of deaths due to accidents are the highest in the month of May (1818, 10%) and June (1600, 9.4%) followed by March (1597, 9.1%). Refer Figure (4.0, 4.1, and 4.2)

However the minimum number of fatal accidents (1013, 6.9%), Grievous (887, 6.7%) and Deaths due to accidents (1148, 6.8%) registered in January month.



Figure-5.0 (peak hours when accidents frequency is high)



Figure-5.1 (peak hours when accident frequency is high)



Figure-5.2 (peak hours when accident frequency is high)







Figure-6.2 (peak hours when accident frequency is high)

The high frequency of fatal, grievous and deaths due to accidents vs. time segments divided into each segment of 3 hours reveals that the high frequency of fatal accidents are during between 3PM-6PM (1133 median) and 6PM-9PM (Median-1110) followed by 9AM-12PM (Median-1099) whereas the minimum no. of fatal accidents are between 12 Night to 3 AM (Median-502) and 3AM-6AM(664), Grievous (543 between 12 night to 3 AM, 675 between 3 AM to 6AM). The deaths due to accidents were found ((median 702 (12 night to 3 AM), Median-799 3AM-6AM)). Refer figure (5.0, 5.1 and 5.2)





Figure-7.1 (accident frequency vs. road type)





Figure-7.2 (accident frequency vs. road type)

The high rate of accidents are in National Highways (5547) and state Highways (5181) whereas the minimum number of accidents occurred in expressways (Median-583). The similar pattern is observed in case of grievous injury and deaths due to accidents. The median grievous injury case (4767) in state highways and national

highways (4334) and the least in express ways (634).

The median deaths due to accidents are the highest in National Highways (6188) and State Highways (6024) and it is least in expressways (801). Refer figure (7.0, 7.1 and 7.2)





The analysis of fatal accidents vs. weather conditions reveals that the maximum number of fatal accidents occurred during sunny and clear weather (Median- 5133) followed by rainy season

(median- 2380) and foggy & Misty (median-2043).



Figure-8.1

The similar pattern is observed in case of Grievous injury cases where the maximum incidence happened during sunny and clear weather (median5245) followed by rainy season (median - 2247) and foggy & misty weather conditions (median-1604).







The maximum number of deaths due to accidents are in clear weather (median- 5865) as compared to

rainy and foggy weather (Median- 3041). Refer figure (8.0, 8.1 and 8.2)





The accident frequency analysis vs. the type of vehicle reveals that car/jeep/Van/Taxi (median-3552), motorized two wheelers (median -3462), Truck and Lorry (median-2343), tempo/Tractor (Median-1447).The less number of accidents and type of vehicle involved are hand drawn cart (median -54), animal drawn cart (median-55),

heavy articulated vehicles (median- 108) and cycle rickshaw (median-143). The inference could be the high speed vehicles are having more propensity for fatal accidents as compared to slow speed vehicles. The similar pattern is observed in case of Grievous injury cases which is further followed in case of deaths due to accidents cases.





Figure-9.1



Figure-9.2





The analysis of accidents and structure of road reveals that the maximum accidents occurred at Tjunctions (median-2296) followed by staggered junction (median -1362), Y-junction (1077), four armed (median-1017). The frequency is less in round about junctions (median-631).





Figure-10.1

The similar pattern is observed in case of grievous injury due to accidents. Thus we can say the focus point to minimize such accidents is to have a traffic control mechanism on T-junctions and staggered junctions more.





The deaths due to accidents is not an exception and follow the same pattern as in case of fatal and

d grievous injury cases. Refer figure (10.0, 10.1 and 10.2)





The analysis of accidents occurrence vs. behavior of driver reveals that the maximum accidents happened due to over-speeding (median-3080) followed by consumption of alcohol (median-1455) and driving on wrong side (median- 929) in fatal case of accidents. Refer figure (11.0)



The similar pattern is observed in case of grievous injury cases. The over speeding, consumption of

alcohol and driving on wrong side causes more grievous injuries. Refer figure (11.1)





The more number of persons killed due to over speeding and alcohol consumption as compared to

driving on wrong side and jumping red lights. Refer figure (11.2)



Figure-12.0











The new vehicles (age less than 5 years) are having high chances of accidents as compared to older vehicles. This may be due to new vehicles can be

get-up-and-go fast. Almost in every parameter the speed is having direct or indirect relationship with type of accidents. Refer figure (12.0, 12.1 and 12.2)



Figure-13.0

The high incidences of fatal accidents are in open areas (Median 3670) followed by market area (median- 1541), residential areas (median -1178).

The low rate of incidence are near narrow bridges (median -272), encroached areas (median -334). The low rate of incidences are also observed



pedestrian crossing (median- 422), near petrol pumps (median- 469), near a religious place (median- 543) and hospitals (median - 589). This may be due to proper signage and marking in these

areas and people may be conscious when driving near hospitals but the incidence is not less near institutions and schools. Refer figure (13.0, 13.1 and 13.2)





Analysis reveals that the accidents are more vulnerable in the month of March, April, June and October. The interpretation could be like the number of accidents are more frequent in summers and during festive season in India Because October and November are the months when a lot of festivals occur. The location which are more vulnerable for accidents are Open area, near or inside the village, in Bazaar and near residential area. The reason for higher frequency in open area is the speed of vehicles in open is high and that's why the probability of accidents goes up. Bazaars are crowded and people do not follow traffic rules and thus accidents occurs. Residential area are also



found prone to such happenings. The accidents re less near office area complexes, Hospitals, religious places and recreational places (Cinema complex). It may be due to proper guidelines of vehicle movement and people are also aware of to drive cautiously. Sign boards for safe driving near such places also useful in controlling such incidences.

The relationship between the fine weather, weather of mist and fog and extreme weather condition and frequency of accidents is high.

The relationship between the age of vehicle and frequency of road accidents found if the vehicle is new (1 to 5 years old) or vehicle is more than 10 years old the probability of accident is high.

The nature of accidents analysis reveals that the maximum incidence of accidents are in overturning (on T-junctions and Staggered junctions). This may be due to poor vision on such junctions and driver not able to access the other side vehicle movement. The speed barkers and traffic lights can reduce such incidences on such junctions.

The analysis of maneuvers type reveals that the number of accidents are more where diversion take place. The other alarming zones are crossing, going ahead of overtaking or going ahead without overtaking.

The probability of accidents increases with overloading. Any serious mechanical defect in the vehicle also causes accidents. If vehicle is overloaded or in high speed, the chances of accidents increase sharply.

The incidence of accidents are high on surfaced road whereas incidence is less on metaled road. The incidence of accidents is very less on Kachha compared to

V. DISCUSSION

The analysis shows that the distribution of road accidental deaths and injuries in India varies according to month and specific time segments. The incidence of accidents are high in the months like May, June and March whereas less in January. When we analyzed relationship of weather with type of road accidents, we found that the accident rate is high in clear weather. If we correlate these two phenomenon can lead to a conclusion that the weather is normally clear during May and June but it is normally odd in the month of January. There are high rate of accidents during 9AM to 12 Noon and during evening hours 3PM-9PM. These are peak hours when people either going for work or returning after work. They are in hurry to reach their respective destinations so some carelessness happens and this phenomenon lead to more accidents. We can also conclude that the working age group is the most susceptible population; In general, males face higher accident than their female counterparts. The high rate of accidents are on national highways and state highways as compared to express highways. It means proper direction, signage and even road condition with less obstructions reduces the accidents rates. So highways must be obstructed with fencing from both the sides to avoid entry of any obstruction in between. The type of vehicles involved in fatal accidents are normally two wheelers and light motor vehicles whereas less incidences are observed in case of hand and animal pulled carts or cycle and cycle rickshaw. This phenomenon clearly indicates that high speed is root cause of all type of accidents. All sort of mechanism which can control speed especially in junctions and crowded areas can reduce accidents significantly.

VI. CONCLUSION

This analysis of main factors which causes accidents reveals that the pattern of incidences is similar in all the three type of accidents - fatal, Grievous injury and deaths due to accidents. The month of May and June supposed to have more number of accidents. It may be due high temperature and poor maintenance of Tyre and vehicles. Similarly the maximum incidence of accidents observed during 6AM-9 AM followed by between 3PM-9PM; normally these are office hours and people are in hurry to reach their destinations. It was very interesting to observe that the maximum incidence of accidents happens during clear weather and high speeding. It is obvious when weather is clear, people drive fast and results in casualties. This research study has certain limitation of availability of comprehensive data which can provide deeper insights of causes of types of accidents. The future research has scope to investigate causes of accidents on more explanatory variables which has not been covered in this study.

VII.ACKNOWLEDGEMENTS

I humbly acknowledge the support provided by Road safety cell, Transport Department, UP to



provide me data to study and an open access to meet officers to understand and analyze the road accidents scenario in Uttar Pradesh.

17

VIII. FUNDING

This research did not obtain any explicit grant from funding agencies in the civic, profitable, or not-forprofit sectors.

REFERENCES

- Rolison, J. J., Regev, S., Moutari, S., & Feeney, A. (2018). What are the factors that contribute to road accidents? An assessment of law enforcement views, ordinary drivers' opinions, and road accident records. Accident Analysis & Prevention, 115, 11–24. doi:10.1016/j.aap.2018.02.025
- [2] Malin, F., Norros, I., &Innamaa, S. (2019). Accident risk of road and weather conditions on different road types. Accident Analysis & Prevention, 122, 181–188. doi:10.1016/j.aap.2018.10.014
- [3] Johnston I. Action to reduce road causalities. World Health Forum 1992; 13(203): 154-62
- [4] Singh, S. K. (2017). Road Traffic Accidents in India: Issues and Challenges. Transportation Research Procedia, 25, 4708– 4719. doi:10.1016/j.trpro.2017.05.484
- [5] Singh, Sanjay K. 2005. Review of Urban Transportation in India. Journal of Public Transportation, 8 (1): 79-97. DOI: http://doi.org/10.5038/2375-0901.8.1.5
- [6] Salgado, M. S. L., &Colombage, S. M. (1988). Analysis of fatalities in road accidents. *Forensic science international*, 36(1-2), 91-96.
- [7] Noland, R. B. (2003). Traffic fatalities and injuries: the effect of changes in infrastructure and other trends. Accident Analysis & Prevention, 35(4), 599-611.
- [8] Edwards, J. B. (1996). Weather-related road accidents in England and Wales: a spatial analysis. Journal of transport geography, 4(3), 201-212.
- [9] Edwards, J. B. (1998). The relationship between road accident severity and recorded weather. Journal of Safety Research, 29(4), 249-262.
- [10] Al-Balbissi, A. H. (2003). Role of gender in

road accidents. Traffic injury prevention, 4(1), 64-73.

- [11] Hakim, S., Shefer, D., Hakkert, A. S., &Hocherman, I. (1991). A critical review of macro models for road accidents. Accident Analysis & Prevention, 23(5), 379–400. doi:10.1016/0001-4575(91)90058-d
- [12] Bergel-Hayat, R., Debbarh, M., Antoniou, C., &Yannis, G. (2013). Explaining the road accident risk: weather effects. Accident Analysis & Prevention, 60, 456-465.
- [13] Greibe, P. (2003). Accident prediction models for urban roads. Accident Analysis & Prevention, 35(2), 273–285. doi:10.1016/s0001-4575(02)00005-2
- [14] Mohan Dinesh (2009) IATSS Research volume 33 No.1
- [15] Michalaki, P., Quddus, M. A., Pitfield, D., &Huetson, A. (2015). Exploring the factors affecting motorway accident severity in England using the generalized ordered logistic regression model. Journal of Safety Research, 55, 89–97. doi:10.1016/j.jsr.2015.09.004
- [16] Mannering, F. (2018). Temporal instability and the analysis of highway accident data. Analytic Methods in Accident Research, 17, 1–13. doi:10.1016/j.amar.2017.10.002