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Effect of Environment and Weather Condition on Road Accidents in India

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Abstract

India has world's second largest road network 66.2 lakh Km after USA 67.6 Lakh Km, comprising different categories of roads including National Highways and State Highways. The road transport sector contributes about 87% of passenger traffic and 60% of freight traffic movement in India. Road transport has emerged as the dominant segment in India's transportation sector with a share of around 4.5% in India's GDP. Despite much more importance of road transport, safety issues are associated with road transport. Road accidents are global challenging issue causing catastrophic causalities. Developing countries like India suffering more due to many factors responsible for large numbers of road accidents and associated fatalities. It has to worry that number of road accidents, fatalities and serious injuries have increasing trend year by year. There are many factors contributing high rate of road accidents, associated fatalities and serious injuries. Environment and weather conditions also affect the scenario of road accidents. Environmental factors like road riding characteristics, design issues, utilizes, potholes and patches, slippery or skidding surface, encroachments in different ways and poor lighting condition may have reasonable impact on road accidents. Similarly, poor weather conditions such as rain, fog, snow, storm and very high or very low temperatures may also affect the driver's comfort and visibility causing high numbers of road accidents in India.

Keywords- *Road Safety, Road Accident, Environment, Weather, Vehicle*

Introduction

Indian population is presently in December 2025 is expected to be 1,469,451,203 based on World meter's elaboration of the latest United Nations data. India is presently most populous country in the world, super passed China in 2023. Such populated country have main transport in land mode is roadway. As road network of India is concerned, it is second largest road network of 66.2 lakh Km after USA having a road network of 67.6 lakh Km, but it have to notice that USA presently have a population of 347,275,807. While China is concerned it has Population of 1,416,096,094 with a road network of 55.0 lakh km., globally top five countries of largest road network are United States, India, China, Brazil, and Russia. It is obvious that India has a significant road network to serve a large population. Most of the traffic and freight carried by means of road transport. Due this proportion of population and road network road safety is affected and Indian roads become more dangerous as road accidents are concerned. In fact, road accident is a global problem but developing countries like India faces much more loss due to road accidents. In 2023 as official Data released by Ministry of Road Transport and Highway, Government of India (MoRTH) indicates that in India within one year 4.8 Lakh Road accidents occurred in which 1.73 lakh fatalities and 4.6 lakh serious injuries happened. So, road accident is most catastrophic phenomenon in Indian transportation system. It is expected that directly or indirectly road accidents in India affects the country's GDP by approximately 3%.

Causes of Road Accidents

There are multiple factors responsible for road accidents such as human errors, vehicle issues and environmental factors. Human errors are over speeding, drunk driving, distractions such as using mobile phones, not using safety gear like helmet by two-wheeler and seat belts by four-wheeler vehicle drivers. Vehicle issues affecting road accidents are fitness of vehicle, brake failures, old tires, overloading and dimensional violations. Major environmental factors impacting road accidents are terrain of road, geometry of road, topography of area, bad weather, poor roads characteristics, and inadequate signage.

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Apart from two man-made factors human errors and vehicle issues there are two other factors impacting road accidents significantly are Environmental factors and weather conditions.

Environmental factors

There are different environmental factors affecting road accidents frequency and severities. Two factors impacting road environments are road engineering and weather conditions. Road Engineering includes faulty road design, road characteristics, riding quality and infrastructural deficits, all these factors lead road accident, its frequency and severity. Road Engineering factors may be one or more responsible for road accidents:

1. Blind Intersections
2. T/ Y-Junctions
3. Sharp Curves
4. Inadequate Radius of Curvature
5. Improper Acceleration Lanes
6. Improper Deceleration Lanes
7. Sudden Drop Lanes
8. Steep Slopes
9. Visual obstruction like bushes, sign, dusts
10. Encroachments
11. Utilities
12. Un Authorized Road Side Advertisements
13. Un Authorized Vendors
14. Un Authorized Parings
15. Improper Lighting
16. Inadequate Pedestrians Facilities
17. Animals
18. Improper Markings
19. Wrong Signage
20. Radiations/ smokes/ Chemical or Biological Hazards
21. Accidents Hazards
22. Construction Hazards
23. Noises

All these are some road engineering defects that cause vehicles to crash. Along with such improper geometrical design and poor alignment, low-quality materials cause quick wear and tear on the roads as well, further decreasing the level of road safety. Despite of all these previous data reflects that road accidents and fatalities are more in favorable road environments due other factors involving in road accidents.

Weather conditions: Apart from environmental factors harsh weather conditions also impacts the road accidents, frequency of road accident and fatalities rate in these accidents. Adverse weather conditions impact badly on road accidents by either reducing tire traction making slippery surfaces or by reducing visibility or both. Major adverse weather conditions are:

1. Rain
2. Storm
3. Speedy Winds
4. Ice
5. Snow
6. Fog
7. Oil Buildup
8. humidity
9. Earthquake
10. Tsunami
11. Land Slides
12. Sun Glare
13. High Temperature

All these factors hamper the road characteristics and its environment, rendering it damaged and slippery road or less visibility which affect the driver's comfort and psychology and hence, more prone to road accidents. Despite of all these, previous data shows that road accidents and fatalities are more in favorable weather conditions due other factors involving in road accidents.

Combined factors: Road accident is a result of complex situations and affected by more than one factors. Basically, three types of factors responsible for road accidents are:

1. Human Errors
2. The Vehicle
3. Road Environments

Weather issues incorporated in road environment. A study shows that combined effect of all these factors in different groups have different impact on road accidents. Statistics for Prime causes of Road accidents and their percentages are given in table below:

Serial Number	Factors: Prime Causes of Road Accidents			Accidents Percentages
	Human	Road	Vehicle	
1.	✓	X	X	65%
2.	✓	✓	X	25%
3.	✓	X	✓	5%
4.	X	✓	X	2%
5.	X	X	✓	2%
6.	✓	✓	✓	1%
Total				100%

Above data indicates that mainly human factor like over speeding, distraction and psychology have highest impact on road accidents. This is the reason that in clear and sunny weather more accidents happen. Similarly at clear and straight roads more accidents occur. In both these situations due to psychological careless driving imparts more accidents and more fatalities. Official data shows that nearly 70% accidents and approximately 70% causalities in road accidents occur in straight and clear roads and in sunny and clear weather mainly due to over speeding and careless or distracted driving in India.

Conclusions: Road accident is a complex phenomenon, involving multidisciplinary factors, hence it can be concluded that:

1. There are multi factors responsible for road accidents.
2. All these factors can be grouped as human errors, the vehicle and road environment.
3. In a particular road accident, more than one factor may have adverse impact.
4. One or more environmental factors may have bad effects to cause road accidents.
5. Single or multiple weather conditions may have adverse effect on road accidents.
6. In favorable environmental and weather conditions more accidents happen due to psychological reasons, careless and distracted driving.

7. Human Errors are major prime cause of road accidents.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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