

A Review on Causes of Accidents in Two Wheelers

Leston Pinto¹, Sayyed Afnan², K Athul Bhat³, Shivaramu H T⁴, Yuvaraj K B⁵

Department of Mechanical Engineering, Mangalore Institute of Technology & Engineering,
Moodabidri, D.K -574225, Affiliated to VTU, Belagavi¹⁻⁵

Abstract: The review paper provides a comprehensive analysis of the factors contributing to two-wheeler accidents in India and offers insightful recommendations for policy measures and technological innovations to enhance road safety. It highlights the significant impact of human, vehicular, environmental, and infrastructure-related factors on two-wheeler accidents. Additionally, the paper emphasizes the need for multifaceted approaches involving stakeholders to address the complex issue of reducing two-wheeler casualties. The review also discusses ongoing technological advancements such as Emergency Brake Assist (EBA) and safety telematics devices, offering promising opportunities for mitigating accidents. Furthermore, the paper emphasizes the crucial role of road conditions and infrastructure in two-wheeler accidents and emphasizes the importance of government interventions and regulatory mandates. This comprehensive analysis and the outlined recommendations serve as valuable insights for policymakers, researchers, and stakeholders to address and mitigate the challenges associated with two-wheeler accidents in India.

Keywords: Two-wheeler accidents, India, human factors, vehicular factors, environmental factors, infrastructure factors

I. INTRODUCTION

- Background and significance of two-wheeler accidents

In India's streets everywhere you would sight two-wheeler which symbolizes convenience but a hidden truth that is not in numbers but in lives destroyed and affected communities. This review will try to understand the intricate fabric of two-wheeler accidents in India with the help of both international and Indian statistics, distinct trends and the multitude causers.

With this background of stark statistics, our explorations are based. The tolls for accidents involving two-wheelers in 2020 were nearly 159,000 deaths and the statistics paint a grim picture. Over one third of fatal two-wheeler road crashes highlight the need to unravel the key factors that are the cause of death during such accidents.

Similarly, the situation worldwide is no less unsettling. Three to four million lives have been lost as a result of road traffic crashes involving motorized two to three-wheelers around the globe within the last decade. Road traffic injuries are now major causes of death in India. In fact, two-wheelers constituted the highest proportion, 44.5%, of all road accident fatalities in the year 2021 and were most prevalent among the age group of 15 to 49 years.

Microscopic examination of accident data shows surprising trends. Rather surprisingly, it is more the two-wheeler than the four wheelers which affect the casualty figures. In 2022, such vehicles had approximately 75,000 accidents where two wheelers were involved, and over 32,825 pedestrian deaths; hence, this proves that such vehicles, as well as their occupants, are quite vulnerable. The variation across states indicates the need for a regionally targeted approach especially; Tamil Nadu leads in this category as a cause of road vehicle mortality. As a safety precaution, two-wheels should be kept away from other traffic.

Systematic analysis of two-wheeler crashes in the public domain. Specifically, the analysis shows that human errors such as driving without a valid license, not using helmets, over speeding greatly contributed to these incidents. This adds another element to the narrative including issues to do with vehicle design, failures in maintenance and the influence of safety hardware and technologies. Poor roads, weather considerations and bad traffic conditions are other sets of environmental factors that can be used to explain the context of two-wheeler accidents.

This review also touches on a number of interventions and prevention measures that are currently underway in these causes. The multimodal strategy includes educational campaigns, engineering safety in road environments and policy recommendations.

The concluding statement is that while appreciating these efforts, the change of mindset and behaviour towards safe acts will require continued joint action of all stakeholders. These have been made in order to ensure substantial reduction of two-wheeler casualties in India.

II. TWO-WHEELER ACCIDENT STATISTICS

- Global and regional statistics on two-wheeler accidents

Globally, a quarter of road traffic deaths involve motorized 2–3 wheelers, with approximately 3.2 million deaths over the past decade. In India, road traffic injuries are the leading cause of death, especially in the age group of 15 to 49 years. In 2021, there were 4,12,432 road accidents reported in the country, claiming 1,53,972 lives and causing injuries to 3,84,448 persons. Two-wheelers have accounted for the maximum fatal road accidents, contributing 44.5 per cent of total road accidental deaths. The worst affected age group in road accidents is 18–45 years, which accounts for about 67 percent of total accidental deaths. Uttar Pradesh recorded the highest number of such deaths in 2021 followed by Tamil Nadu. ^{[1]-[5]}

- Trends and patterns in accident data

The data reveals alarming trends and patterns in two-wheeler accidents in India. Contrary to popular belief, it is two-wheeler accidents, not car accidents, that contribute significantly to casualties, with approximately 75,000 bikers and 32,825 pedestrians losing their lives in such incidents in 2022 alone. Two-wheelers account for a substantial quarter of total fatalities in crashes, causing 28% of pedestrian deaths, totalling 9,316 fatalities. Delving into state-wise statistics, Tamil Nadu reported the highest number of two-wheeler occupant deaths (11,140) and pedestrian deaths (4,427) in 2022, followed by

Maharashtra and Uttar Pradesh. The need for safety measures is evident, and experts recommend segregating two-wheelers from other traffic to mitigate accidents, emphasizing the vulnerability of these vehicles due to limited external protection for occupants in the event of a crash. ^[6]

III. FACTORS THAT CAUSE ACCIDENTS

3.1 HUMAN FACTORS

Errors made by humans contribute greatly to the road safety scenario in general and especially with regard to accidents involving two wheeled transports. The most common human error is driving without a valid license accounting for about 50.6 percent (2,08,763 incidents) of the total accidents on the road in 2021. Non-use of helmets is also common, and 43,614 two-wheeler riders did not wear helmets, leading to death of 28.3% of the total road accident fatalities in 2021. One of human error leading to collisions is over-speeding which involved two-wheels in 33.9%, with 25.8% being death related in 2021. Apart from driving under influence, human error is another contributing factor whereby it causes 24.4% of road accidents and 18.5% from the related deaths in the year 2021. The incidence of these human errors highlights the importance of raising awareness and promoting appropriate behaviour among two-wheeler riders in order to improve roads safety. ^[3]

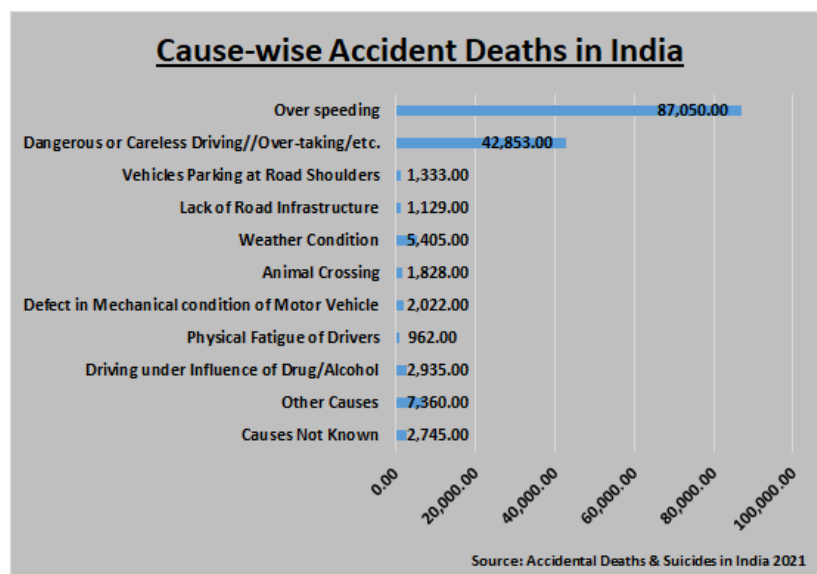


Fig 1: Cause-wise accident deaths in India ^[17]

3.2 VEHICLE-RELATED FACTORS

- Vehicle design and manufacturing defects

They are all sorts of breakdowns including a misfire of brakes, tyres, lights, and engine. For instance, brake failure can cause one not to be able to stop on time thus leading to a collision. Some features of the design of motorcycles could be responsible for more accidents. For example, two-wheelers are taller and less stable thus they can easily tip over compared to four-wheelers. Also, two-wheelers are smaller and less visible on the road which makes them more likely to be ignored by other drivers. [8]

- Maintenance and roadworthiness issues

Maintenance and roadworthiness issues Constant checks and speedy repairs should be undertaken in order to guarantee road safety. Additionally, riders should take into account these factors and be mindful of them by wearing high-visibility clothing and using headlights even during the day to enhance visibility [8]. There are 30 times accidents with two-wheelers compared to a car with its riders having high rate of death and disability [9]. Regular maintenance checks and repairs conducted by qualified mechanics can help identify issues before they lead to accidents. Riders should also be vigilant about checking tire pressure, lights, and other basics before each trip.

- The role of safety equipment and technology (e.g., helmets, anti-lock braking systems)

Safety equipment and technology is critical in averting two-wheeler accidents. One of the main safety precautions is helmets that can greatly decrease risk for head trauma [8]. Anti-lock brakes (ABS) stop the wheels from locking up thus allowing control of the motorcycle by the rider. Apart from that, innovations such as Emergency Brake Assist (EBA) are in the development stages. Thirdly, EBA overcomes deficient driver braking actions to substantially reduce stopping distances [10]. In addition, the advancements in technology resulted in assistance system such as safety telematics devices fitted with 3-axis accelerometers, GPS, cellular modem and requisite software algorithm [11].

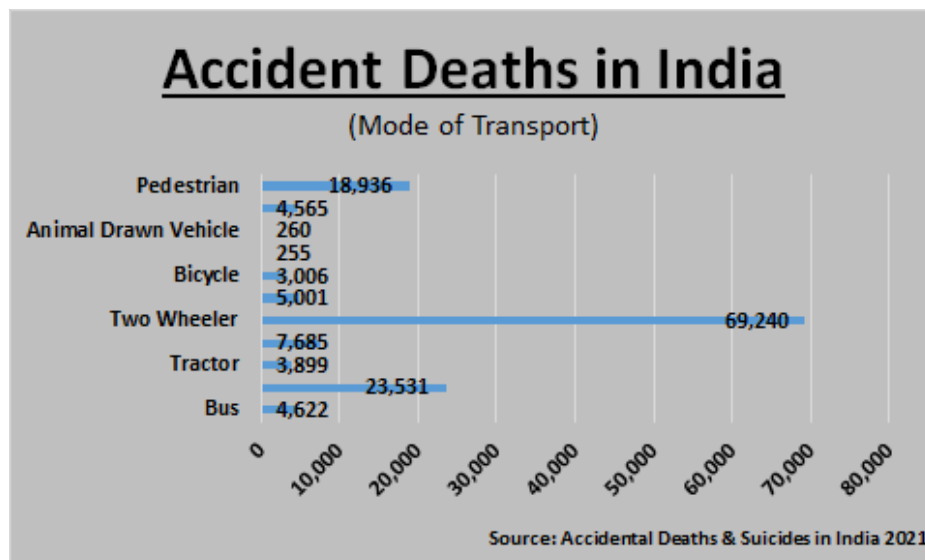


Fig 2: Mode of Transport in Accident Deaths in India [17]

3.3 ENVIRONMENTAL FACTORS

- Impact of road conditions and infrastructure

Impact of Road Conditions and Infrastructure: Road conditions and infrastructure play a crucial role in two-wheeler accidents. Poor road conditions, such as potholes, speed breakers, and lack of proper signage, can lead to accidents. Infrastructure-related issues, such as inadequate lighting and lack of pedestrian facilities, also contribute to accidents [12]. The Ministry of Road Transport and Highways has been working on identifying Black Spots on National Highways and on short term and long-term rectification of these black spots [3].

- Weather-related considerations

Weather-Related Considerations: Weather conditions can significantly impact road safety. Reduced visibility, slippery road surfaces, and decreased traction can increase the likelihood of accidents. It is essential for riders to adapt their driving behaviour to accommodate changing weather conditions, and for authorities to provide adequate road maintenance and warnings during adverse weather.

Dense fog, excessive rainfall, strong winds, and similar conditions make driving more challenging, which can result in horrifying accidents if drivers fail to exercise extra caution [7]. For instance, skidding is one of the most commonly reported issues during rains [13].

- Traffic congestion and urban planning

Rapid urbanization and increasing vehicular growth lead to traffic congestion, which is a significant contributor to road accidents. Inadequate urban transportation facilities and irregular zoning of land also contribute to the problem [14]. Two-wheelers weaving and swerving unpredictably through traffic, taking over sidewalks, or parking anywhere pose a danger to themselves and to others [9].

IV. INTERVENTIONS AND PREVENTIVE MEASURES

- Educational and awareness campaigns

Educational campaigns have been conducted to spread awareness about safe riding practices. For instance, Suzuki Motorcycle India Pvt. Ltd.'s Road Safety Awareness Drive aims to educate, raise awareness, and bring about a change in mindset to take road safety precautions seriously [15]. Honda Motorcycle & Scooter India has also conducted a Road Safety Awareness Campaign in Dhanbad, Jharkhand [16].

- Engineering solutions for safer road environments

Engineering solutions like better road infrastructure, traffic calming techniques, and segregated lanes have also been employed in major cities to enhance road safety. For instance, the Smart Cities Mission in India encouraged cities to install CCTV cameras at various intersections [9].

- Policy recommendations and future directions

Going forward, policy recommendations include graduated licensing for young motorcyclists, mandating anti-lock braking systems and protective clothing, improving post-crash care facilities, and adopting a safe system approach to road design. The Government of India amended the Motor Vehicle Act in 2019, introducing stringent penalties for traffic violations. Further, safety features were included in vehicle design, such that now all two-wheelers are equipped with an All-Time Headlight ON or Automatic Headlight On (AHO) system [9].

However, continued efforts are needed to change social attitudes and behaviours towards safety. A multifaceted approach involving all stakeholders is required to achieve the goal of reducing two-wheeler casualties in India.

V. CONCLUSION

In conclusion, this review paper has provided a comprehensive analysis of the multifaceted factors contributing to the high rate of two-wheeler accidents in India. The analysis highlights the role of human errors, vehicle conditions, road infrastructure, and environmental factors in accident causation. While the government has taken some policy measures to improve road safety, continued efforts are needed to address the complex interplay of factors behind two-wheeler crashes. Graduated licensing programs, mandatory ABS and protective gear, improved trauma care, and adoption of safe road design principles are some recommendations outlined. Additionally, emerging vehicle technologies like EBA and telematics devices offer promising opportunities to mitigate accidents. However, a collaborative approach involving all stakeholders - government, vehicle manufacturers, road engineers, health sector, enforcement agencies and road users is crucial. Impactful policy changes, safety mandates, infrastructure upgrades, and societal commitment to safe road use behaviour are pivotal to enhancing two-wheeler safety on Indian roads.

REFERENCES

- [1]. Causes of road accidents (no date) Gov.in. Available at: <https://jhtransport.gov.in/causes-of-road-accidents.html>
- [2]. Yasin, Y. J., Grivna, M. and Abu-Zidan, F. M. (2022) "Motorized 2-3 wheelers death rates over a decade: a global study," *World journal of emergency surgery*, 17(1). doi: 10.1186/s13017-022-00412-4.
- [3]. *ROAD ACCIDENTS IN INDIA 2021* (no date) *Nic.in*. Available at: https://morth.nic.in/sites/default/files/RA_2021_Compressed.pdf
- [4]. PTI (2022) *Two-wheelers claimed highest number of lives in accidents in 2021: NCRB report*, *The Hindu*. Available at: <https://www.thehindu.com/news/national/two-wheelers-claimed-highest-number-of-lives-in-accidents-in-2021-ncrb-report/article65829329.ece>
- [5]. Radhakrishnan, V. (2022) *Data*, *The Hindu*. Available at: <https://www.thehindu.com/data/data-in-2021-over-15-lakh-died-in-road-accidents-most-were-young-men-speeding-on-two-wheelers/article65844935.ece>

- [6]. Das, A. K. (2023) *Two-wheelers responsible for maximum road fatalities in India, killed 28 per cent pedestrians last year: Report*, Swarajyamag.com. SwarajyaMag. Available at: <https://swarajyamag.com/infrastructure/two-wheelers-responsible-for-maximum-road-fatalities-in-india-killed-28-per-cent-pedestrians-last-year-report>
- [7]. Road accident causes in India: A comprehensive analysis (2023) Acko General Insurance. Available at: <https://www.acko.com/driving-licence/road-accident-causes/>
- [8]. Manufacturer, T.-W. (no date) The automobile sector in India, Gov.in. Available at: <https://static.pib.gov.in/WriteReadData/specificdocs/documents/2023/feb/doc2023217160601.pdf>
- [9]. Jindel, J. et al. (2021) "Making roads safer for India's popular two-wheelers," World Bank Blogs. World Bank Group, 2 February. Available at: <https://blogs.worldbank.org/endpovertyinsouthasia/making-roads-safer-indias-popular-two-wheelers>
- [10]. Singh, A. (2020) "Next step in two-wheeler safety in India & new car safety tech Continental will roll out in 2020," The Financial Express, 3 January. Available at: <https://www.financialexpress.com/auto/car-news/two-wheeler-safety-india-new-car-safety-features-continental-adas-systems-esc-mandate-emergency-braking/1811503/>
- [11]. Mukherjee, D. (no date) How Assistive Technology can reduce 2-wheeler fatalities on Indian roads, Etauto.com. Available at: <https://auto.economictimes.indiatimes.com/autologue/how-assistive-technology-can-reduce-2-wheeler-fatalities-on-indian-roads/2158>
- [12]. Road infrastructure factors influencing accidents and injuries on Indian roadways (2016) TrafficInfraTech Magazine. Available at: <https://trafficinftratech.com/road-infrastructure-factors-influencing-accidents-and-injuries-on-indian-roadways/>
- [13]. Garg, A. (2022) Monsoon 2022: Top 5 problems faced by two-wheeler riders and how to prevent them, Zee News. Available at: <https://zeenews.india.com/auto/monsoon-2022-top-5-problems-faced-by-two-wheeler-riders-and-how-to-prevent-them-2486346.html>
- [14]. Verma, A., Harsha, V. and Subramanian, G. H. (2021) "Evolution of urban transportation policies in India: A review and analysis," *Transportation in Developing Economies*, 7(2). doi: 10.1007/s40890-021-00136-1.
- [15]. Sayeda, S. (2022) Uniting the joy of riding with the joy of safety: Suzuki Motorcycle India Pvt. Ltd.'s Road Safety Awareness Drive has an important message to tell, Economic Times. Available at: <https://economictimes.indiatimes.com/industry/csr/initiatives/uniting-the-joy-of-riding-with-the-joy-of-safety-suzuki-motorcycle-india-pvt-ltd-s-road-safety-awareness-drive-has-an-important-message-to-tell/articleshow/90116834.cms>
- [16]. Honda motorcycle & scooter India conducts road safety awareness campaign in dhanbad, Jharkhand (no date) Honda2wheelersindia.com. Available at: <https://www.honda2wheelersindia.com/media-center/PressReleaseDetails/3399>
- [17]. Singh, N. (2022) *A Crash Course on Indian Roads: Over 1,104 Accidents, More Than 426 Deaths Daily in 2021*, News18. Available at: <https://www.news18.com/news/india/a-crash-course-on-indian-roads-over-1104-accidents-more-than-426-deaths-daily-in-2021-6113779.html>