

Analysing the Key Causes of Road Accidents in Bangladesh

Keya Rani Das^{*1}, Bishnu Kumar Adhikary²,
Linnet Riya Barman³, Fatima Khatun⁴, Preetilata Burman⁵

**Corresponding Author*

Abstract

Bangladesh has experienced a concerning rise in traffic accidents over time, leading to numerous unintentional deaths and injuries. To address road safety effectively, it is crucial to first focus on the factors that contribute to these crashes. The primary purpose of this article is to systematically compile and analyse the contributing factors to road traffic accidents within the geographical boundaries of Bangladesh, with a particular emphasis on finding the key determinants. To carry out this objective, the study applied fishbone diagrams and Pareto charts as analytical tools, thereby facilitating a comprehensive examination of the underlying root causes associated with road accidents in the country. According to research, untrained drivers are the leading cause of road accidents in Bangladesh, as shown by the primary data we have gathered. Furthermore, data shows that six primary factors account for 80 percent of Bangladesh's traffic accidents. Through the enhanced consideration of these fundamental causes, the frequency of traffic accidents can be feasibly diminished, so preventing further injuries and fatalities. To reduce the frequency of road accidents, policymakers should address the major factors that cause accidents on the road.

Keywords: Bangladesh, Fishbone diagram, key causes, Pareto chart, road traffic accident

Cite as: Das, K.R., Adhikary, B.K., Barman, L.R., Khatun, F., & Burman, P. (2024). Analysing the key causes of road accidents in Bangeledesh. *Journal of Business and Social Sciences Research*, 9(2), 69-82. <https://doi.org/10.3126/jbssr.v9i2.72414>

INTRODUCTION AND STUDY OBJECTIVES

Road accidents are the most undesirable and unanticipated life-threatening occurrences that can happen to a road user.

In many nations throughout the world, it has grown to be one of the biggest societal issues and is escalating at an alarming rate. Every year, 1.35 million people die in road traffic accidents (RTAs), with most of these deaths occurring in persons

¹Keya Rani Das is an Assoc. Professor at the Department of Statistics, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Bangladesh. Email: keyadas57@bsmrau.edu.bd

²Bishnu Kumar Adhikary is an Asst. Professor at the Institute of Education and Research, University of Rajshahi, Bangladesh. Email: bkadhikary@ru.ac.bd

³Linnet Riya Barman is a MS student at Department of Agricultural Economics, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Bangladesh. Email: linnetriya@gmail.com

⁴Fatima Khatun is completed MS in Department of Agricultural Economics, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Bangladesh. Email: fatimakeya.info@gmail.com

⁵Preetilata Barman is a graduate in Agricultural Economics from Bangabandhu Sheikh Mujibur Rahman Agricultural University, Bangladesh. Email: preetypbs@gmail.com

between the ages of 15 to 29. Pedestrians, cyclists, and motorcyclists are particularly implicated in these fatalities, especially in developing nations, as evidenced by research conducted by the [World Health Organization-WHO \(2018b\)](#). Half a million individuals lose their lives, and 10 to 15 million people endure injuries each year due to road accidents worldwide, according to [Odgen \(1996\)](#). The severity of accidents presented in literature due to road traffic injuries ([Odero et al., 1997](#); [Ratanavaraha & Saungka, 2014](#); [Shankar et al., 1996](#)). In accordance with the research conducted by [Biswas et al. \(2022\)](#), approximately ninety percent of accidents occur within developing countries, which shows a higher frequency. Due to the increasing frequency of road accidents worldwide, one of the motives in the Sustainable Development Goals (SDGs) is to compare the loss of lives and injuries caused by RTAs in the time lag 2015 to 2020 as suggested by the [WHO \(2015\)](#). [Zafri et al. \(2020\)](#) points out concerning issues that being a developing country, Bangladesh is considered as one of the most unsafe countries in the world in terms of road crashes. There has been an alarming increase of road accidents since the past few years in the country. The [WHO \(2022\)](#) reported that pedestrians are the most vulnerable group of road-users as about 23% of the total road fatalities involve pedestrians. Furthermore, [Hasib et al. \(2020\)](#) highlighted that the reported mortality rate attributable to motor vehicles ranges from 30 to 60 deaths per 10000 vehicles. However, it is reasonable to assume that the actual death toll is likely to be higher than the officially recorded number. The fatality rate of traffic accidents in Bangladesh has been the subject of

several research. [Islam and Dinar \(2021\)](#) identified the leading causes of road accidents and the spatial distribution of road accidents using qualitative and semi quantitative methods. [Rahman et al. \(2021\)](#) developed a binary logistic regression model to identify the significant factors contributing to fatal motorcycle crashes in the country. [Hossain and Zaman \(2021\)](#) analysed the factors influencing road accident severity in Khulna city through a binomial logistic regression model. [Hossain et al. \(2023\)](#) used text data mining method to detect the crash contributing factors and patterns of fatal truck crashes in Bangladesh. Although it is impossible to end accidents, the damages caused can be lessened by taking proper measures. In this case, policymakers need to analyse the causes behind this issue. Though there may be several human, physical, and environmental factors behind the occurrences of road accidents, all the factors may not be significant. So, it is necessary to find out the significant causes where efforts should be made. The purpose of this study is to find out the key factors that are responsible for occurring road accidents in Bangladesh and suggest preventive measures to mitigate them.

LITERATURE REVIEW

Over the past five years, Bangladesh has been identified as a country with a significant amount of road traffic accidents ([Alonge et al., 2017](#)). So, it is important to study more about the causes of road traffic accidents in Bangladesh. Prior research has shown that many factors contribute to Road Traffic Accidents (RTAs), including traffic rule and signal violations, inexperienced drivers,

excessive speed, inadequate road conditions and management, and insufficient awareness (Jacoby et al., 2016). In a study conducted in Dhaka city from 2007 to 2011, Ahmed and Ahmed (2013) concentrated on a limited number of parameters. This research was conducted in the perspective of eight divisional cities. The degree of mishaps reported in literature resulting from traffic congestion injuries (Kockelman & Kweon, 2002). Rahman et al. (2021) applied binary logistic regression model to investigate the factors that influence pedestrian-vehicle crash in Dhaka. Six factors were found to be significant at 95% confidence level ($p\text{-value} < 0.05$). Those factors are weather conditions, time of day with lighting conditions, peak hours, and

presence of dividers on roadways, roadway classification, and vehicle type. Hasib et al. (2020) developed a machine learning model to identify the factors associated with fatal accidents. Biswas et al. (2022) developed a dynamic model to assess the driving factors responsible for increasing road accidents in Bangladesh. The model indicated that the road accident depends on the driver, misguided driver, and faulty vehicles. Accident rates rise over time as the number of negligent drivers rises. Additionally, the accident rate is highest when a negligent driver interacts with a defective vehicle. However, this study employed statistical quality control methodologies to identify the most significant causes of road accidents in Bangladesh.

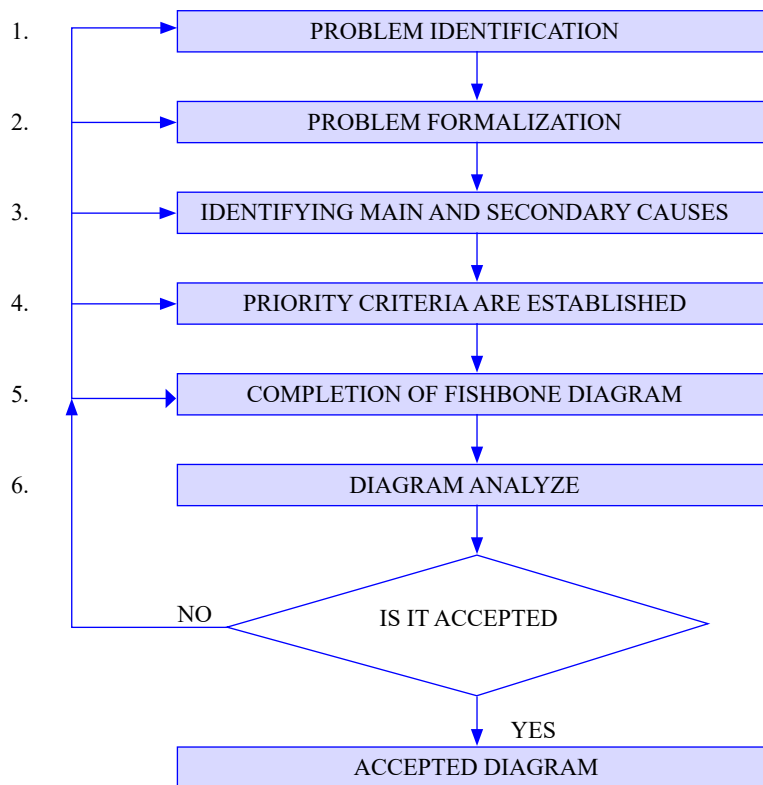


Figure 1. *Logic Plan of Fishbone Diagram Implementation*

Note. Ilie & Ciocoiu (2010).

RESEARCH METHOD

Data was collected from July 2021 to June 2022. We have taken 1600 primary data by face-to-face interview method from 8 divisional cities (200 from each division) in Bangladesh purposively. Responses were taken from drivers, passengers, and pedestrians. The variable of education level is categorised by 5 levels (0 for no education from any institution, 1 for primary level education, 2 for secondary level education, 3 for higher secondary level education, 4 for higher secondary level education).

Statistical Analyses

Fishbone Diagram: The fishbone diagram, formulated by Japanese statistician Kaoru Ishikawa, also referred to by his name as ‘Ishikawa Diagram.’ Due to its shape and normal structure, it is well known by the name of ‘Fishbone Diagram.’ This diagram focuses on the causes, effects of an event, and must be made by brainstorm. This was also found in the works of Hekmatpanah (2011). To identify quality imperfect prevention, an overall effect on efficient causes is presented by a diagram. The fishbone diagram is a presentation about the investigation of various cause and effect factors with their association (Ayverdia et al., 2014; Ishii & Lee., 1996). According to Shaw and Blundell (2014), the cause-and-effect diagram is renowned for identifying the underlying factors of a problem. According to Ilie and Ciocoiu (2010), the fishbone diagram can be constructed using the logical plan outlined in Figure 1. This plan is designed to pinpoint problems and set up measures to mitigate their associated risks.

Pareto Chart: The Pareto principle is commonly known as 80-20 rule. Italian economist Vilfredo Federico Damaso Pareto named this technique. In the field of quality management system, Pareto analysis and the cause-and-effect diagram are viewed as fundamental methodologies (Patyal & Maddulety, 2015). The Pareto chart has been extensively discussed in the literature (Ahmed & Ahmed, 2011; Ahmed et al., 2013; Hossen et al., 2017; Joshi & Kadam, 2014; Wilkinson, 2006). For categorical observation, we can easily apply Pareto charts to control the quality if the frequencies are available against the category. A bar chart represents the categories from left to right by the rank order from largest to smallest bars. The biggest bar on the left side is the most significant factor than other bars representing categories of data (Benjamin et al., 2015). This chart orders from maximum frequency to minimum frequency of circumstances (Karuppusami & Gandhinathan, 2006).

DATA ANALYSIS AND DISCUSSION

Cause-and-Effect Diagram

Road accident problem is now a more acute problem in Bangladesh. By producing ideas and after that its application in fish shape diagrams, we have made the following cause-and-effect diagram on road accident issues in Bangladesh:

Discussion about Cause-and-Effect Diagram

Equipment: In this section we tried to accumulate the causes related to the tools or devices of the machine in the vehicle. The defective and imperfect instruments which are used in transportation coaches are a

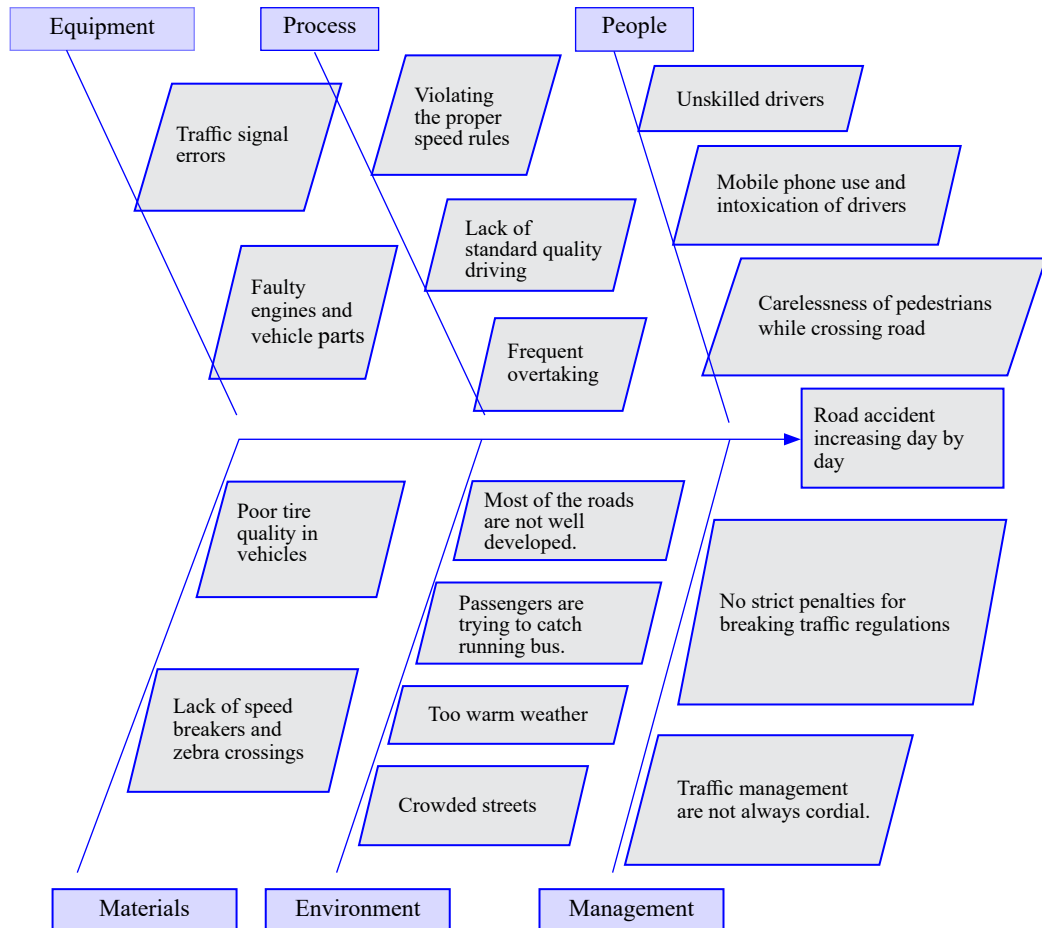


Figure 2. Fishbone Diagram on Road Accident in Bangladesh

major cause for the road accident. Many accidents result from brake system failures. Additionally, unclear traffic signals and misaligned steering systems can contribute to potential mishaps on the road.

Process: Drivers often hurry to arrive at their destinations. Due to this reason they try to drive faster and break the speed rules. Most of the drivers are not professionally trained. The tendency of overtaking is a serious reason for the road accident.

People: Accidents occur when careless pedestrians cross the street without looking in both directions. To keep everyone on the road safe, pedestrians and vehicles alike must abide by safety rules. Given that multitasking frequently results in attentional failures, drivers should not be allowed to use cell phones while driving. Also drinking habits are a concern for the drivers when they drive the vehicle. It can bring slackening while they drive, and it results in gruesomeness.

Table 1
Reasons of Road Accident and Corresponding Frequency

Causes of Road Accident	Frequency
Unskilled drivers	615
Most of the roads are not well developed	204
Faulty engines and vehicle parts	201
Traffic management system	102
Lack of monitoring by the local administration, police, Political parties etc.	92
Violation of traffic rules	88
Not maintain the punishment for breaking traffic rules/ Lack of proper implication of traffic rules	82
Streets are crowded	68
Frequent overtaking	59
Rent amount fixed by the owner	51
Rivalry situation among drivers	23
Pedestrians are not conscious	15

Note. Field Study, 2021-22

Materials: Components categorised as weak cannot yield decent quality production. Substandard quality wheels can cause an accident anytime. In this section we fix up the problem about speed breakers and zebra crossing. Sufficient speed breakers and zebra crossing are not visual in the street especially in narrow roads in the village side where people are more incautious about the road crossing.

Environment: The competition among public transport drivers to quickly reach their destinations and secure more passengers is quite intense. This condition results in jolts in the street particularly when streets are unimproved, and its final effect may be a serious accident. Bangladesh is an overpopulated country. For this reason, every route stays crowded and among the passengers there is a common propensity to seek priority over others. This excitement gives them a hurry

which results in an incident. Additionally, many passengers are caught off surprise since the bus in transit doesn't stop at that moment. So, misadventure exists through the environment. Sometimes weather will be the culprit to generate mishap.

Management: Everywhere it should be set up to preserve the rules and regulations regarding any country's laws. One offense makes another. Disruption of traffic rules is a serious crime. So, the penalty should be maintained strictly. But the present status reveals that it is not supported properly. The management of the traffic system can save accidents. There are alternative ways for the traffic system to control or decrease the rate of road accidents in different research papers (Evans 2003; Idowu et al., 2015).

Figure 3 shows unskilled drivers are the most affective reason for road accidents in Bangladesh. This chart writes down

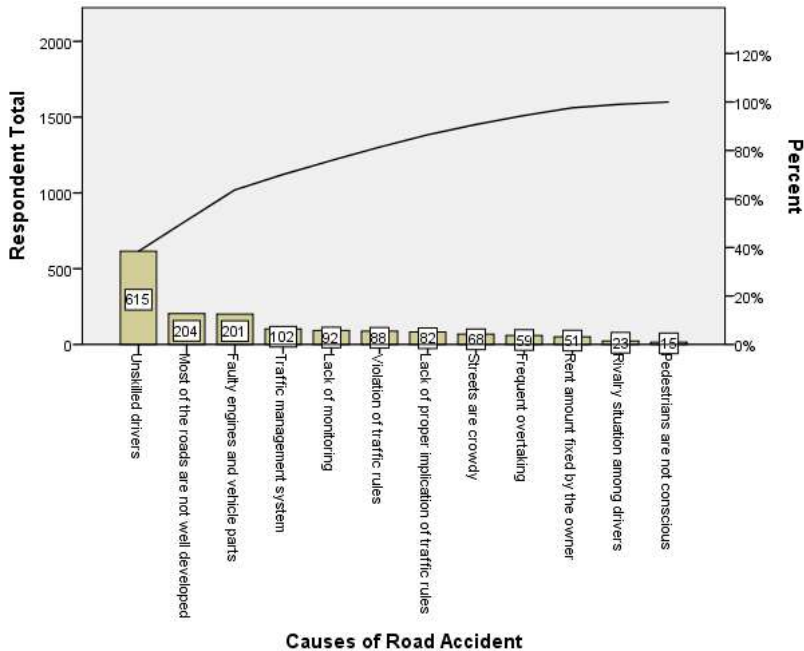


Figure 3. Pareto Diagram on Road Accident in Bangladesh

that 615 complaints were made against unskilled drivers which accounts for almost 39% of all complaints. In this result, 60% of all complaints are from the first four categories as unskilled drivers, most of the roads are not well developed, faulty engines and vehicle parts, traffic management system. The data from primary interviews emphasises the necessity of concentrating on the main causes of about 80% of traffic accidents in Bangladesh. These factors include unskilled drivers, poorly developed roads, faulty engines and vehicle parts, inadequate traffic management systems, lack of oversight by local authorities, police, and political parties, as well as violations of traffic rules. In contrast, the number of causes attributed to inattentive pedestrians account for only 13 incidents. About 204 respondents gave their answer about the causes of road accident is most of

the roads are not well developed whereas 201, 102, 92 and 88 respondents opined that faulty engines and vehicle parts, traffic management system, lack of monitoring by the local administration, police, political parties etc., violation of traffic rules respectively. Also, all these 12 reasons have important values but if we concentrate on the first 6 causes and try to solve these 6 then we reduce almost 80 percent of road accidents in Bangladesh according to this Pareto analysis conducted with our collected primary data. So, based on this research the policy makers are recommended to focus on these first 6 factors to save lives, prevent injuries, and reduce accidents on the streets.

Unskilled drivers are responsible for road accidents which is the most efficient cause in this research finding. [Afsari and Rahman \(2018\)](#) presents an accident trend for driving

Table 2
Information About Drivers

	Age	Year in Experience	No. of Accident	Education Level
Minimum Value	16	0	0	0
Q1	26	6	3	1
Median	39	20	4	1
Mean	36.63	17.73	3.4	1
Q3	49	27	4	2
Maximum Value	55	39	10	4

Note. Field Study, 2021-22

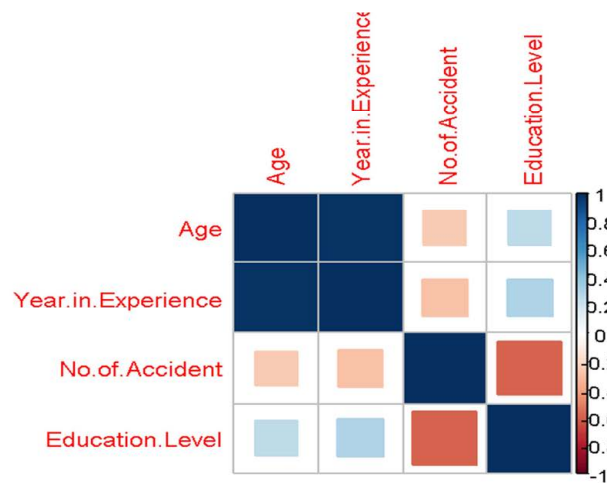


Figure 4. Correlation Study of Different Characters of Drivers

problems in Bangladesh. Again, faulty engines are equally responsible for the road accident which has also been discussed above in the fishbone diagram section.

On the other hand, the roads come across more traffic jams in the urban area. To guarantee safe and orderly road traffic, traffic control measures should be strengthened and rigorously enforced. Many times, drivers make an unpleasant situation among them with a contest as they need to go fast compared with others. Nonetheless, competitive conduct on the road should

be prohibited. This competition creates accidents many times. The traffic police or management system can implement efforts to mitigate this hazardous scenario and avert possible accidents. In many environments passengers rent vehicles and rent amounts are fixed by the owner. Respondents said that this fosters a harmful mentality among drivers, perhaps leading to road accidents. Due to this reason some drivers want to move fast and drive more frequently to collect money as they must pay a fixed amount to their vehicle owner. Also, the condition of the roads is expected

to deteriorate. Only 40 percent of main roads are in acceptable position in the national highway and district roads in Bangladesh (Rahman, 2012). Traffic police or traffic management systems can play a significant role on the crucial issue in catching too much speedy driving or overloaded vehicles. Destructive roads should be reconstructed so that consciousness may grow up through media. Traffic rules can be focused on more by the media and about punishment for violating traffic laws. Monitoring systems can reduce the rate of accidents by the local administration, police, political parties etc. Violation of traffic laws is a sign of daring driving. So that punishment system must be applied on those drivers who are breaking the traffic laws and regulations. In this way many mishaps can be destroyed.

Bangladesh is an overpopulated country. So, in most of the urban areas the density of population is remarkably high. As a result, streets stay crowded most of the time in many areas. It is a problem as huge populations overtake roads more unconsciously which brings mishap in their lives. In Bangladesh, the mortality rate of pedestrians is low compared with other reasons included in this study. Countries of the South-East Asia region also have a small mortality rate for pedestrians. Some research depicts the road accident deaths owing to pedestrians in some countries (Bhalla et al., 2017; Levulyte et al., 2017; Shinar, 2012; Raban et al., 2014).

According to the result of this study unskilled drivers are the most significant causes of road accidents. Some answers were taken from the drivers and the analysis result are below:

This diagram shows that there is a strong positive correlation between drivers age and their experience times (in years). Also, it presents weak negative correlation between drivers age and number of accidents. Same result between experience times and number of accidents. A significant negative correlation has been found between driver's education level and the number of accidents.

Discussion

To find the most important causes of road accidents in Bangladesh, we used statistical quality control methodologies in this study. Zafri et al. (2020) employed a multivariate binary logistic regression model to identify the key factors influencing motorcycle crashes in Dhaka City, Bangladesh. Eleven factors were found to be statistically significant (p -value <0.01). These included the day of the week, seasonal condition, road location type, roadway geometry, roadway class, collision type, presence of motorcycle defect, striking vehicle type, helmet use, and striking vehicle driver condition. Hasib et al. (2020) built a model using a machine learning approach to detect the variables related to fatal accidents. The model concluded that the accident ratio is high for Dhaka, Noakhali and Comilla cities and there the accident rate is higher in daytime compared to nighttime. Also, in this study we have collected data from eight divisional cities in Bangladesh including Dhaka city. Road accidents are linked to vehicle types. Troublesome vehicles include buses, autorickshaws, and microbuses. Hossain et al. (2023) picked out the contributing factors associated with fatal truck crashes using text data mining approach. Poor environmental conditions

such as dense fog, wrong-way driving, overtaking, were identified as the important contributing factors in truck-bus crashes.

Even though there are several literatures available on this topic, the approaches used in this study are hard to find in other literatures. Furthermore, unlike most prior studies that have concentrated on a certain area of Bangladesh, or any vehicle caused accidents, this study has focused on identifying the important factors behind every form of road accident that occurs in the country. These are the specifications that make this study unique.

People who are young and inexperienced had been into higher traffic accidents due to alcoholism than experienced drivers (Freydier et al., 2014). This study also encompasses comparable results where unskilled drivers were the most significant reason for road accidents in Bangladesh. Drivers' education level and the number of accidents had a negative correlation in this study's findings. It is found that drivers who attended efficient educational programs with evaluation methods had less probability of occurrence of road accidents (Mayhew et al., 2017; Shell et al., 2015). There were negative correlations between the experience of drivers and the risk of accidents and injuries (Ballestros & Dischinger, 2002; Wong et al., 1990). This study showed related results as a weak negative correlation is found between drivers experience and the number of accidents. In the last century, Japan had significant economic growth resulting in an increase in vehicle owners. But traffic accidents increased especially accidents due to alcohol intoxication (Nishitani, 2019).

Again, hit-and-run accidents due to drug and alcohol intake were higher in Japan compared to other countries (Fujita et al., 2014). Therefore, alcohol abuse needs to be tackled to ensure the safety of roads in Bangladesh. Control policies and safety devices, such as airbags and automated driving helped to reduce traffic accidents and its fatalities (WHO, 2018a). Similar safety measures along with awareness among young people are necessary to avoid such a drastic situation in Bangladesh. To increase awareness among young drivers and to reduce road accidents, educational approaches based on empathy, emotions, and mutual understanding might be helpful (Topolsek, 2019). The awareness of vision zero, which is a strategy to minimise fatalities from traffic crashes with fair safety, is high among road safety professionals. To ensure the safety of roadways for everyone, the vision zero campaign needs to be broadened across the country targeting the non-professionals (Evenson, 2018). A similar approach might be fruitful for Bangladesh. In the case of transport demand forecasting, the most influencing factors were population growth and the level of motorisation. It correlated with Bangladesh which is also a densely populated country. Moreover, traffic forecasting analysis in the past two decades indicated that the future traffic growth had been overestimated by transport planners in both the UK and the US, with an insignificant impact on transport planning investments (Mayerthaler, 2016). Therefore, more effective measures need to be addressed in big cities of our country like Dhaka. It is estimated that there is a positive association between income and the level of motorisation (Knoflachner,

2012). Nevertheless, effective public transport facilities might indicate otherwise which has been observed in major European cities (Sperling & Claisen, 2002). It is not unknown that more dependency on cars and unorganised transport problems resulted from the increase in the level of motorisation (Mayerthaler et al., 2016). Hence, we need a more effective traffic policy to control motorisation as Bangladesh is graduating from the Least Developed Countries (LDC).

CONCLUSION AND IMPLICATIONS

Road traffic accidents and injuries are a grave issue in Bangladesh in present times.

This study presents significant and efficient causes of road accidents in Bangladesh. In this paper, we got six major reasons as unskilled drivers: most of the roads are not well developed; faulty engines and vehicle parts; traffic management system; lack of monitoring by the local administration, police, political parties etc.; and violation of traffic rules, for which 80 percent of road accidents happen according to our data. So, if we give more concentration to these major causes, then we may reduce our road accidents and save more injuries and lives. An accident plays a role in the national economy for any country. So, policymakers should take steps on the major causes for road accidents so that we can reduce the rate of road accidents.

Funding

The authors declare that they have no conflict of interest.

Conflict of interest

The authors declare that they have received no financial support for this study.

REFERENCES

- Afsari, F., & Rahman, F. I. (2018, February 9-11). Analysis of accidents trend due to driving problems in Bangladesh [Paper presentation]. In *Proceedings of the 4th International Conference on Civil Engineering for Sustainable Development*. KUET, Khulna, Bangladesh.
- Ahmed, M., & Ahmad, N. (2011). An application of Pareto analysis and cause-and-effect diagram (CED) for minimizing rejection of raw materials in lamp production process. *Management Science and Engineering*, 5(3), 87-95. <https://doi.org/10.3968/j.mse.1913035X20110503.320>
- Ahmed, I., & Ahmed, B. (2013) Urban road accidents in Dhaka, Bangladesh. *16th International Conference on Road Safety on Four Continents*, Beijing, May, 1-9, p. 15-17.
- Ahmed, T., Acharjee, R. N., Rahim, M. A., Sikder, N., Akther, T., Khan, M. R., Rabbi, M. F., & Saha, A. (2013). An application of Pareto analysis and cause-effect diagram for minimizing defect percentage in sewing section of a garment factory in Bangladesh. *International Journal of Modern Engineering Research*, 3(6), 3700-3715.
- Ayverdia, L., Nakiboğlu, C., & Aydın, S.Ö.Z. (2014). Usage of graphic organizers in science and technology lessons. *Procedia - Social and Behavioral Sciences*, 116, 4264-4269. <https://doi.org/10.1016/j.sbspro.2014.01.929>

- Alonge, O., Agrawal, P., Talab, A., Rahman, Q. S., Rahman, A. F., Arifeen, S. E., & Hyder, A.A. (2017). Fatal and non-fatal injury outcomes: Results from a purposively sampled census of seven rural subdistricts in Bangladesh. *Lancet Global Health*, 5(8), e818–e827.
- Ballesteros, M. F., & Dischinger, P. C. (2002). Characteristics of traffic crashes in Maryland (1996-1998): Differences among the youngest drivers. *Accident Analysis & Prevention*, 34(3), 279–284. [https://doi.org/10.1016/S0001-4575\(01\)00023-9](https://doi.org/10.1016/S0001-4575(01)00023-9)
- Benjamin, S. J., Marathamuthu, M. S., & Murugaiah, U. (2015). The use of 5-WHYs technique to eliminate OEE's speed loss in a manufacturing firm. *Journal of Quality in Maintenance Engineering*, 21, 29–39.
- Bhalla, K., Khurana, N., Bose, D., Navaratne, K. V., Tiwari, G., & Mohan, D. (2017). Official government statistics of road traffic deaths in India under-represent pedestrians and motorized two-wheeler riders. *Injury Prevention*, 23, 1-7.
- Biswas, A., Tasnim, K., & Biswas, M. H. A. (2022). Mathematical modeling applied to assess the driving factors of increasing road accidents in Bangladesh. *Khulna University Studies*, 757-767.
- Evans, L. (2003). The new traffic safety vision for the United States. *American Journal of Public Health*, 93(9), 1384-1386.
- Evenson, K. R., LaJeunesse, S., & Heiny, S. (2018). Awareness of vision zero among United States' road safety professionals. *Injury Epidemiology*, 5(1), 03–04. <https://doi.org/10.1186/s40621-018-0151-1>
- Freydier, C., Berthelon, C., Bastien-Toniazzo, M., & Gineyt, G. (2014). Divided attention in young drivers under the influence of alcohol. *Journal of Safety Research*, 49, 13–18. <https://doi.org/10.1016/j.jsr.2014.02.003>
- Fujita, G., Okamura, K., Kihira, M., & Kosuge, R. (2014). Factors contributing to driver choice after hitting a pedestrian in Japan. *Accident; Analysis and Prevention*, 72, 277–286. <https://doi.org/10.1016/j.aap.2014.07.002>
- Hasib, K. M., Showrov, M. I. H., & Das, A. (2020, September). Accidental prone area detection in Bangladesh using machine learning model [Paper presentation]. *3rd International Conference on Computer and Informatics Engineering (IC2IE)* (pp. 58-62). IEEE.
- Hekmatpanah, M. (2011). The application of cause and effect diagram in the Oil industry in Iran: The case of four liter oil canning process of Sepahan Oil Company. *African Journal of Business Management*, 5(26), 10900-10907.
- Hossain, A., Sun, X., Alam, S., & Das, S. (2023). Crash contributing factors and patterns associated with fatal truck-involved crashes in Bangladesh: Findings from text mining approach. *Transportation Research Record: Journal of the Transportation Research Board*, 2678(7), 706-725. <https://doi.org/10.1177/03611981231209031>
- Hossain, M. E., & Zaman, M. U. (2021). Analyzing the factors influencing road traffic accident severity: A case study of Khulna city. *Plan Plus*, 11, 143-164. <https://doi.org/10.54470/planplus.v11i1.10>
- Hossen, J., Ahmad, N., & Ali, S. M. (2017). An application of Pareto analysis and cause-and-effect diagram (CED) to examine stoppage losses: A textile case from Bangladesh. *The Journal of the Textile Institute*, 108(11), 2013-2020.
- Idowu, A. P., Williams, K., & Olonade, E. (2015). Online road traffic accident monitoring system for Nigeria. *Transactions on Networks and Communications*, 3(1), 10-30.
- Ilie, G., & Ciocoiu, C. N. (2010). Application of fishbone diagram to determine the risk of an event with multiple causes. *Management Research and Practice*, 2(1), 1-10.

- Ishii, K., & Lee, B. (1996). Reverse fishbone diagram: A tool in aid of design for product retirement. *Proceedings ASME Design Engineering Technical Conferences and Computers in Engineering Conference, 96-DETC/DFM-1272*.
- Islam, M. A., & Dinar, Y. (2021). Evaluation and spatial analysis of road accidents in Bangladesh: An emerging and alarming issue. *Transportation in Developing Economies, 7*(1). <https://doi.org/10.1007/s40890-021-00118-3>.
- Jacoby, S. F., Winston, F. K., & Richmond, T. S. (2016). Using local context to inform road traffic injury prevention in global employee wellness programs. *Injury Prevention, 22*(2), A1–A397.
- Joshi, A., & Kadam, P. (2014). Application of pareto analysis and cause effect diagram for minimization of defects in manual casting process. *International Journal of Mechanical and Production Engineering, 2*(2), 36–40.
- Karuppusami, G., & Gandhinathan, R. (2006). Pareto analysis of critical success factors of total quality management: A literature review and analysis. *The TQM Magazine, 18*(4), 372–385. <https://doi.org/10.1108/09544780610671048>
- Kockelman, K. M., & Kweon, Y.-J. (2002). Driver injury severity: An application of ordered probit models. *Accident Analysis & Prevention, 34*(3), 313–321. [https://doi.org/10.1016/S0001-4575\(01\)00028-8](https://doi.org/10.1016/S0001-4575(01)00028-8)
- Knoflacher, H. (2012). *Grundlagen der Verkehrs- und Siedlungsplanung: Siedlungsplanung. Verkehrsplanung (Vol. 1). [Basics of transport and settlement planning: Settlement planning. Traffic Planning (Vol. 1)]*. Böhlau Verlag Wien. <https://doi.org/10.7767/boehlau.9783205792055>
- Levulyte, L., Baranyai, D., Sokolovskij, E., & Török, Á. (2017). Pedestrians' role in road accidents. *International Journal for Traffic and Transport Engineering, 7*(3), 328–341. [https://doi.org/10.7708/ijtte.2017.7\(3\).04](https://doi.org/10.7708/ijtte.2017.7(3).04)
- Mayerthaler, A., Leth, U., & Frey, H. (2016, May 23–25). The effects of forecasts on the level of motorization - A self-fulfilling prophecy? [Paper presentation]. *4th International Conference on Road and Rail Infrastructure*, CETRA, Sibenik, Croatia.
- Mayhew, D., Vanlaar, W., Lonero, L., Robertson, R., Marcoux, K., Wood, K., Clinton, K., & Simpson, H. (2017). Evaluation of beginner driver education in Oregon. *Safety, 3*(1), 9. <https://doi.org/10.3390/safety3010009>
- Nishitani, Y. (2019). Alcohol and traffic accidents in Japan. *IATSS Research, 43*(2), 80. <https://doi.org/10.1016/j.iatssr.2019.06.002>
- Odero, W., Garner, P., & Zwi, A. (1997). Road traffic injuries in developing countries: A comprehensive review of epidemiological studies. *Tropical Medicine and International Health, 2*(5), 445–460.
- Odgen, K. W. (1996). *Safer roads: A guide to road safety engineering*. Institute of Transportation Studies, Department of Civil Engineering, Melbourne, Australia.
- Patyal, V. S., & Maddulety, K. (2015). Interrelationship between total quality management and six sigma: A review. *Global Business Review, 16*(6), 1025–1060. <https://doi.org/10.1177/0972150915597607>
- Raban, M. Z., Dandona, L., & Dandona, R. (2014). The quality of police data on RTC fatalities in India. *Injury Prevention: Journal of the International Society for Child and Adolescent Injury Prevention, 20*(5), 293–301. <https://doi.org/10.1136/injuryprev-2013-041011>

- Rahman, Md. H., Zafri, N. M., Akter, T., & Pervaz, S. (2021). Identification of factors influencing severity of motorcycle crashes in Dhaka, Bangladesh using binary logistic regression model. *International Journal of Injury Control and Safety Promotion*, 28(2), 141–152. <https://doi.org/10.1080/17457300.2021.1878230>
- Rahman, T. (2012). *Road accidents in Bangladesh: An alarming issue*. End Poverty in South Asia-World Bank Blogs. <https://blogs.worldbank.org/endpovertyinsouthasia/road-accidents-bangladesh-alarming-issue>
- Ratanavaraha, V., & Suangka, S. (2014). Impacts of accident severity factors and loss values of crashes on expressways in Thailand. *IATSS Research*, 37(2), 130-136.
- Shankar, V., Mannering, F., & Barfield, W. (1996). Statistical analysis of accident severity on rural freeways. *Accident Analysis & Prevention*, 28(3), 391-401. [https://doi.org/10.1016/0001-4575\(96\)00009-7](https://doi.org/10.1016/0001-4575(96)00009-7)
- Shaw, D., & Blundell, N. (2014). Analysing causes of avoidable waste in complex systems: A case study from the nuclear industry. *Journal of Cleaner Production*, 85, 41–50.
- Shell, D. F., Newman, I. M., Córdova-Cazar, A. L., & Heese, J. M. (2015). Driver education and teen crashes and traffic violations in the first two years of driving in a graduated licensing system. *Accident Analysis & Prevention*, 82, 45–52. <https://doi.org/10.1016/j.aap.2015.05.011>
- Shinar, D. (2012). Safety and mobility of vulnerable road users: Pedestrians, bicyclists, and motorcyclists. *Accident Analysis & Prevention*, 44(1), 1-2. <https://doi.org/10.1016/j.aap.2010.12.031>
- Sperling, D., & Claisen, E. (2002). The developing world's motorization challenge. *Issues in Science and Technology*, 19(1).
- Topolsek, D., Babić, D., & Fiolić, M. (2019). The effect of road safety education on the relationship between Driver's errors, violations and accidents: Slovenian case study. *European Transport Research Review*, 11(1), 07. <https://doi.org/10.1186/s12544-019-0351-y>
- Wilkinson, L. (2006). Revising the pareto chart. *The American Statistician*, 60(4), 332-334. <https://doi.org/10.1198/000313006X152243>
- Wong, T. W., Phoon, W. O., Lee, J., Yio, I. P., Fung, K. P., & Smith, G. (1990). Motorcyclist traffic accidents and risk factors: A Singapore study. *Asia Pacific Journal of Public Health*, 4(1), 34–38. <https://doi.org/10.1177/101053959000400106>
- World Health Organization. (2015). *Global status report on road safety 2015*. https://www.who.int/violence_injury_prevention/road_safety_status/2015/en/
- World Health Organization. (2018a). *Global status report on alcohol and health 2018*. <https://apps.who.int/iris/bitstream/handle/10665/274603/9789241565639-eng.pdf>
- World Health Organization. (2018b). *Global status report on road safety 2018*. https://www.who.int/violence_injury_prevention/road_safety_status/2018/en/
- World Health Organization. (2022). *Road traffic injuries*. <https://www.who.int/news-room/factsheets/detail/road-traffic-injuries>
- Zafri, N. M., Prithul, A. A., Baral, I., & Rahman, M. (2020). Exploring the factors influencing pedestrian-vehicle crash severity in Dhaka, Bangladesh. *International Journal of Injury Control and Safety Promotion*, 27(3), 300-307. <https://doi.org/10.1080/17457300.2020.1774618>