A Research on Causes of Road Accidents and Finding Measures for its Prevention

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Abstract: *The elevation of the number of vehicles is a direct result of changes in people's lifestyles, which has led to a rise in the population of vehicles. Limited road space being utilized by a great range of vehicles has resulted in a pressing need for a well-considered policy on road safety. In India, the growth in the rate of accidents is directly proportional to the increase in the population of vehicle. This highlights the urgency for a comprehensive approach to look after the road safety issue. This study involved 112 participants who possessed a driving license. Among them, 57.14% (64 participants) received professional driving training, while 42.86% (48 participants) did not receive such training but possessed a training license. Only 20% of drivers frequently buckled up when operating a vehicle on major roads, as per the report. 11% of respondents claimed they occasionally used seatbelts when driving, while 69% of respondents stated they never did. These findings highlight the need for greater awareness and education regarding the importance of wearing seatbelts while driving.*

Keywords: *Accidents, road traffic, injury, driving license, road safety.*

I. INTRODUCTION

India has the bad image of having the fatalities mostly due to globally. Road safety is becoming a substantial social issue everywhere, but especially in India. Accidents have a negative economic impact and can result in injury, death, property and health damage, social suffering, and overall environmental deterioration. In India, there are multiple kinds of road users, including animal-driven carts, bicycles, hand carts, pedestrians, rickshaws, tractor trolleys, along with numerous kinds of two- as well as three-wheeled vehicles, buses, trucks, motor vehicles along with multi-axle commercial vehicles. Because of the variations in the lifestyle of people, the number of vehicles has been constantly elevating. The requirement and urgency for a well-structured policy on the subject of road safety has risen due to an increase in vehicle population and the restricted amount of road space being used by a wide range of vehicles. The number of vehicles on the road in India directly relates to the accident rate. 1.35 million People died in 2016 as a result of traffic-related causes, according to the Global Status Report on Road Safety (GSRRS-2018) report of World Health Organization (WHO). In 2016, the Pan American Health Organization (PAHO) reports that young adults of about the age of 15 to 29 years old, road accidents had been the second leading cause of mortality. [1] For instance, traffic accidents cause more years of potential life to be lost in Iraq than any other factor. Around two Iraqis die on the country's roads every two hours, or 7,000 people each year on average. In other words, roughly 25 Iraqis who leave their houses each day for school, job, university, social events or shopping never come back as they died in a traffic accident [2].

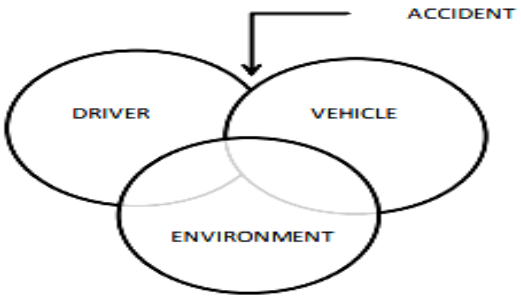

Figure 1 Causes of Accidents

Driver and intelligent safety systems are becoming substantial in today's fast-paced environment due to the ever-growing number of vehicles and population. Over 26.3% of all accidents involve fatalities, and in 2015 alone, there were 1.5 lakh fatalities. As a result, there is an increase in effort to integrate intelligent systems into vehicles that boost safety and stability, progress towards Internet of Things that talks about vehicle connectivity, and value-added activities that minimise human intervention. Also, we are moving towards digitalization, which involves incorporating digital technologies into daily life. Rear-end collisions are a common type of road accident that can occur due to various causes. Pedestrian crossings at intersections, a lack of driver awareness of the intersection's location, the upper layers of the carriageway's slippery surfaces, and a high volume of vehicles turning at the intersection are a few of these factors. Many techniques can be

applied to better understand these factors. A spot speed study, turning counts of vehicles passing through the intersection, volume counts for through traffic, reviewing pedestrian signs and crosswalk markings, checking the signage provided when approaching the intersection, assessing the carriageway's skid resistance, looking for adequate drainage, performing a spot speed study, and more are some of these methods. These techniques allow authorities to spot possible dangers and deploy appropriate measures to stop rear-end collisions at crossings.

The major goal of this research is to give engineers relevant insights into information on the advantages along with downsides of particular road designs in order to develop and enhance future road designs. The study has four main objectives that will help it accomplish this goal. The study's initial goal is to determine how different road geometry parameters affect accidents. Second, it seeks to look into the specific circumstances surrounding the incidents, including the date, location, and causes of the collision. Thirdly, the study tries to assess the road's physical state, its construction, and its traffic management system. The study's final goal is to provide viable solutions or strategies that could successfully alleviate the likelihood and severity of accidents. Engineers can use this data to create safer, more effective roads that will boost the overall safety of road users by attaining these goals.

II. LITERATURE REVIEW

The aim of **[R.Abdulla, et. al., 2023]** is on identifying the kinds of factors that contribute to vehicle accidents in the Sulaymaniyah governorate and their effects on drivers. Between September 2019 and August 2020, the study was carried out in conjunction with the General Directorate of Traffic. In the locations of the crush events, an overall of 573 traffic accident kinds were gathered directly. The outcome demonstrates that collision-related Road Traffic Accidents (RTAs) account for 64.6% of the total and are the most common type. RTAs were more common in pickup, taxi, and motorbike vehicles than in private automobiles.

[Drosu A, 2020] analyzed the traffic accidents (Nacc) which resulted in fatalities along with injuries from 2011 to 2014 on Romanian highways, rural roads as well as urban roads. They took the monthly average temperatures (MAT) and precipitation amounts (MAPA) into consideration. Other weather factors that are considered each month include ice storms, sleet, rain showers, snow, showers of rain, snow storm, mixed precipitation, rime, fog, wind intensification, hoar frost, drizzle as well as glazed frost. Several linear regressions were utilized and tests have been done to determine both their overall significance and the specific coefficients of the explanatory factors. Nacc and the number of fatalities caused in rural along with urban areas are partially associated with MAT and rain showers. This study demonstrates that a 1 °C increase in MAT will result in a 2.42% increase in the Nacc. As the first study on this topic to be conducted in Romania, it came as a surprise to find that MAPA did not explain Nacc in the slightest, contradicting the findings of other studies that indicated a significant relationship between precipitation and traffic accidents.

According to **[Kumar, Sachin & Toshniwal, Durga., 2015]**, one of the primary goals of data analysis of accidents is the depiction of the primary causes of a road and traffic accident. The varied structure of the data on traffic accidents, however, makes the analytical work challenging. For addressing the variability of the accident data, data segmentation has been widely used. In this article, the authors suggested a framework for segmenting 11,574 traffic accidents that occurred on the road network of Dehradun (India) about 2009 to 2014 using the K-modes clustering technique (both included). Following that, in order to determine the numerous factors that can lead to an accident, both for the overall data set (EDS) as well as the clusters found using the K-modes clustering approach, association rule mining is utilised. The results of analysis based on cluster and analysis of entire data set are contrasted later. The findings show that k mode clustering along with association rule mining together produce valuable information that would otherwise go undiscovered if no segmentation was done before the generation of rules of association. Also, a trend analysis was conducted for each cluster and for EDS accidents, and it uncovered various tendencies in each cluster while revealing a positive trend for EDS. Moreover, trend analysis demonstrates how crucial it is to segment accident data before analysis.

According to **[Kumar, S., Toshniwal, D. 2017]**, In India, one of the most popular forms of transportation are Powered Two Wheeler (PTW) vehicles. Also, compared to other types of accidents on the road, PTW incidents happen more frequently. The factors that contribute to PTW accidents differ from those that impact other types of accident. For the identification of the factors which impact the severity of these accidents in several districts, this study will investigate recently developed PTWs road accident data from the Indian state of Uttarakhand. We first investigated three popular classification techniques—decision tree (CART), Nave Bayes, as well as Support vector machine—using the PTW accident data set for analysing the variables that affect the severity of road accidents in Uttarakhand. Its application in the decision tree algorithm's (CART) classification accuracy had been discovered to be superior to the other two methods. In order to distinguish the parameters influencing the seriousness of PTWV accidents in each of the 13 districts of Uttarakhand state, we decided to utilise the CART method. The PTWV accident data analysis with the use of CART for the state of Uttarakhand as well as its 13 districts reveals that each district has unique factors that are related to the severity of PTW accidents. In Uttarakhand, some districts have PTW accident patterns that are comparable, while others are observed to have different patterns. These findings are extremely helpful in determining the pattern of PTW accidents in Uttarakhand. These outputs can undoubtedly help in the reduction of the state of Uttarakhand's PTW accident rate.

According to **[Kumar, Sachin (2016)]**, Data mining has been demonstrated to be an effective method for analysing traffic incidents and producing useful outcomes. The majority of data analysis on traffic accidents employs data mining techniques with the goal of identifying variables that influence how serious an accident is. Yet, any harm caused by traffic accidents

is always undesirable in terms of loss of life, damage of property, as well as other economic factors. On occasion, it is found that particular areas experience more traffic accident incidences than others. Finding specific factors that contribute to the high frequency of accidents in these locations can be done with the help of an analysis of these places. Association rule mining is one of the common data mining methods for determining the correlation between different road accident variables is known as association rule mining. The accident locations in their publication were first divided into three groups by the researchers using the k-means algorithm: low-frequency, moderate-frequency, as well as high-frequency accident locations. Due to the K-means method to cluster the locations, a parameter is utilized known as the accident frequency count. Finally, in order to describe these places, we employed association rule mining. The rules indicated many elements associated with distinct types of traffic accidents at various sites with varying accident frequencies. Highway crossings are hazardous for all types of accidents, according to the association rules for high-frequency accident placement. Most two-wheeler accidents occurred in hilly areas, which were frequent accident sites. Colonies near local roads and intersections on highways are determined to be harmful for pedestrian hit incidents in areas with a moderate accident frequency. There are numerous low-accident spots around the district, and the majority of the incidents there were not life-threatening. Despite the fact that the data set was restricted to a few chosen attributes, our method was able to extract few useful concealed information from the data that might be utilised for taking some preventive efforts in these sopts.

According to **[Ramya V. Pratyasha, 2017]**, the anticipated population expansion and the resulting rise in demand for urban travel present difficulties for cities. Urban planning has a lot of problems with road safety. The accident events have received a lot of attention in scientific investigations on traffic safety and estimating the likelihood of accidents. One of the important fields of research in India is road accidents. Road traffic accidents are frequently caused by mechanical and human error, but spatial variables have received less attention than they deserve. Road accidents are typically categorized depending on the information that is currently known about them, like type of injury, time of the day, type of vehicle, etc. The road accidents complexity that might be caused by a range of environmental, social, as well as economic elements that are frequently overlooked by the traditional accident data collection can often be limited as a result. More consideration must be given to the analysis of traffic accidents, particularly their spatial patterns. On the other side, foreseeing traffic accidents is one of the most pressing challenges. A data mining method known as, Classification analysis, can be used to predict traffic accidents for adequate data for the purpose of learning model development. Rectified data has been divided into groups of varied nature before classification analysis was used to increase forecasting accuracy. Many studies have been conducted using information obtained from police records that only pertain to a small section of highways. Understanding and minimizing the effects of accidents depend heavily on how traffic flow changes on highways, particularly when there are accidents. The process of association rule mining is used to pinpoint potential accident scenarios, and the outcomes can be used to focus on some of the prevention efforts associated with accident in the regions determined for the various classification of accidents for the reduction in the number of accidents. This method focuses primarily on accidents that happen on highways, analyses accidents caused by specific critical elements, and applies a predictive model for accident prediction. Given that it presents information in a user-friendly Interface and supports traffic police' decision-making and accident reporting, this technology can be useful for the common person. The information will help in providing guidance to government agencies responsible for road planning.

III. HUMAN ERROR

Examples of accidents brought on by human mistake include: (i) breaking traffic laws (ii) driving. The failure to utilize safety equipment like seatbelts and helmets does not cause accidents, but it is crucial for preventing fatalities and serious injuries in the case of traffic accidents. Except for a few limited exceptions, all drivers of two-wheelers must wear helmets. 2020 will see a 30.1% increase in fatalities and a 26% increase in injuries related to helmet use. Similarly, non-seatbelt use contributed to more than 11% of deaths and injuries (Table 1).

Table 1: Road Accidents due to Violation of various Traffic Rules

Category	2019			2020			% Change		
	Accidents	Fatalities	Injured	Accidents	Fatalities	Injured	Accidents	Fatalities	Injured
Over-speeding	3,19,028	1,01,723	3,26,85(	2,65,343	91,239	2,55,663	-16.8	-10.3	-21.8
% share of total	71.1	67.3	72.4	72.5	69.3	73.4			
Alcohol & drug consumption/ Drink and drive	12,256	5,325	10,564	8,355	3,322	7845	-31.8	-37.6	-25.7
% share of total	2.7	3.5	2.3	2.3	2.5	2.3			

Indiscipline on Lane/ Driving on wrong side	24,431	9,201	24,628	20,228	7,332	19,481	-17.2	-20.3	-20.9
% share of total	5.4	6.1	5.5	5.5	5.6	5.6			
Jumping red light	4,443	1,797	4,006	2,721	864	2,688	-38.8	-51.9	-32.9
% share of total	1	1.2	0.9	0.7	0.7	0.08			
Use of mobile phone	10,522	4,945	8,144	6,753	2,917	5,975	-35.8	-41	-26.6
% share of total	2.3	3.3	1.8	1.8	2.2	1.7			
Others	78,322	28,122	77,169	62,738	26,040	56,627	-19.9	-7.4	-26.6
% share of total	17.4	18.6	17.1	17.1	19.8	16.3			
All India	**4,49,002**	**1,51,113**	**4,51,36**	**3,66,138**	**1,31,714**	**3,48,279**	**-18.5**	**-12.8**	**-22.8**

The statistics on traffic accidents in India for 2019 and 2020 are presented in the study. The information is shown in terms of several traffic violation categories and the percentage change in collisions, fatalities, and injuries. With a 16.8% drop in accidents, a 10.3% drop in fatalities, and a 21.8% drop in injuries, over speeding is still the primary cause of traffic accidents. Drunk driving resulted in a considerable decrease of accidents (31.8%), fatalities (376%) and injuries (25.7%). Accidents, fatalities, and injuries related to reckless driving in the wrong lane or on the wrong side of the road decreased by 17.2%, 20.3%, and 20.9%, respectively. Jumping a red light alleviated accidents by 38.8%, fatalities by 51.9%, and injuries by 32.9%. When using a mobile device while driving, accidents, fatalities, and injuries all decreased by 35.8%, 41%, and 26.6%, respectively. The number of accidents, injuries, as well as fatalities, due to other causes decreased by 19.9%, 7.4%, and 26.6%, respectively. All types of accidents, fatalities, and injuries are on the decline overall. In India, there is still much work to be done to improve road safety.

Table 2. Road accidents due to Type of License (2018-2020)

Type of License	2018	2019	2020	Percent change in 2020 over 2019
Valid driving license	3,45,799	3,23,793	2,63,689	-18.6
% share in total	74.0	72.1	72.0	
Learner's license	23,593	22,209	16,977	-23.6
% share in total	5.1	4.9	4.6	
Without valid license	37,585	44,358	34,854	-21.4
% share in total	8.0	9.9	9.5	
Not known	60,067	58,642	50,618	-13.7
% share in total	12.9	13.1	13.8	
Total	**4,67,044**	**4,49,002**	**3,66,138**	**-18.5**

During the years 2018, 2019, and 2020, information on the various forms of driving licenses in India is included in the study. The information is displayed in terms of the quantity of valid driver's licenses, learner's permits, and licenses that are unknown or invalid. Also stated is the percentage increase or decrease in licenses awarded in 2020 compared to 2019. According to the data, there were 2.63,689 licenses issued in 2020, a fall of 18.6% from the number of licenses issued in 2019. Moreover, the proportion of licenses that were still in effect fell from 74.0% in 2018 to 72.0% in 2020. With a total of 16,977 licenses issued in 2020, the number of learner's licenses likewise fell by 23.6%. From 5.1% in 2018 to 4.6% in

2020, the proportion of learner's licenses in the total number of licenses declined. With a total of 34,854 licenses in 2020, the number of licenses that were either invalid or unknown reduced by 21.4%. From 8.0% in 2018 to 9.5% in 2020, these licenses' proportion to the overall number of licenses grew. The COVID-19 pandemic's effects may be to blame for the general trend, which indicates a reduction in the number of licenses issued in India.

IV. ACCIDENTS BY ROAD ENVIRONMENT

Accidents associated with the type of road geometry, such as curved, straight or steep, (ii) accidents related to the form of junction as well as form of traffic control, (iii) accidents related to the type of weather, (iv), accidents that occur in a specific geographic area (for example, a residence, institution, market, or commercial area), and (v) accidents related to other factors.

A. Road Accidents Due To the Type of Neighborhood

Road accidents due to the type of neighborhood were 18.5 percent less frequent in 2020 contrasted to the same period in 2019, and there were 12.8% lower fatalities and 22.8% fewer injuries. In 2020, all three indicators—accidents, fatalities, and injuries—show a drop in increase. As seen in Table 3, the residential area (where, accidents=19.8% and fatalities-14.9%) saw the second-largest drop in accidents and fatalities (-23.5% accidents and -17.5 fatalities).

Table 3 Accident classified by type of neighborhoods (for example, a residence, institution, market, or commercial area),

Area	Total accidents			Killed Persons			Injured Persons		
	2019	2020	Percentage change over previous period	2019	2020	Percentage change over previous period	2019	2020	Percentage change over previous period
Residential Area	85,095	68,237	-19.8	27,242	23,188	-14.9	82,364	62,516	-24.1
% Share in total	19.0	18.6		18.0	17.6		18.2	17.9	
Institutional Area	31,519	24,102	-23.5	9,812	8,095	-17.5	30,180	22,468	-25.6
% Share in total	7.0	6.6		6.49	6.15		6.7	6.5	
Market/ Commercial area	62,751	51,411	-18.1	17,123	15,514	-9.4	59,832	47,886	-20
% Share in total	14.0	14.0		11.3	11.8		13.3	13.7	
Open Area	2,03,001	1,73,483	-14.5	78,905	70,739	-10.3	2,12,453	1,68,315	-20.8
% Share in total	45.2	47.4		52.2	53.7		47.1	48.3	
Others*	66,636	48,905	-26.6	18,031	14,178	-21.4	66532	47,094	-29.2
% Share in total	14.8	13.4		11.9	10.8		14.7	13.5	
Total	**4,49,002**	**3,66,138**	**-18.5**	**1,51,113**	**1,31,714**	**-12.8**	**4,51,361**	**3,48,279**	**-22.8**

B. Road Accidents Classified by Road Features

Road elements that need skill, extra caution, and vigilance to navigate, such abrupt curves, potholes, and steep grades, are more likely to cause accidents. Data for 2020 show a considerable decrease in accidents, fatalities, and injuries (Table 4). The share of percentage of varied types of collision in the overall accident is certainly at par with the percentage share of

injuries along with fatalities, according to data on road accidents for 2020. Adhere to the same rules as in 2019 (refer Table 4).

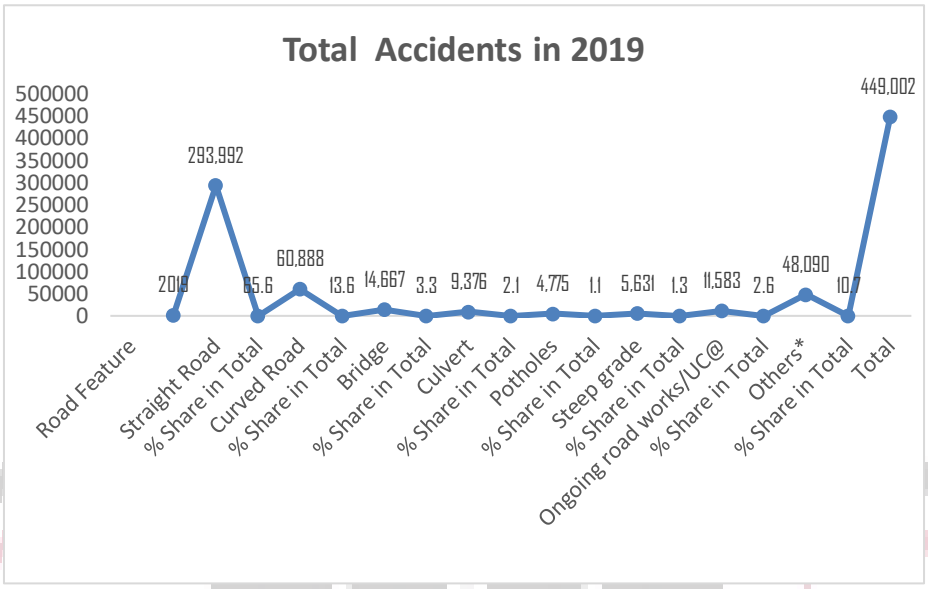

Figure 2 Road accidents in 2019 due to road feature

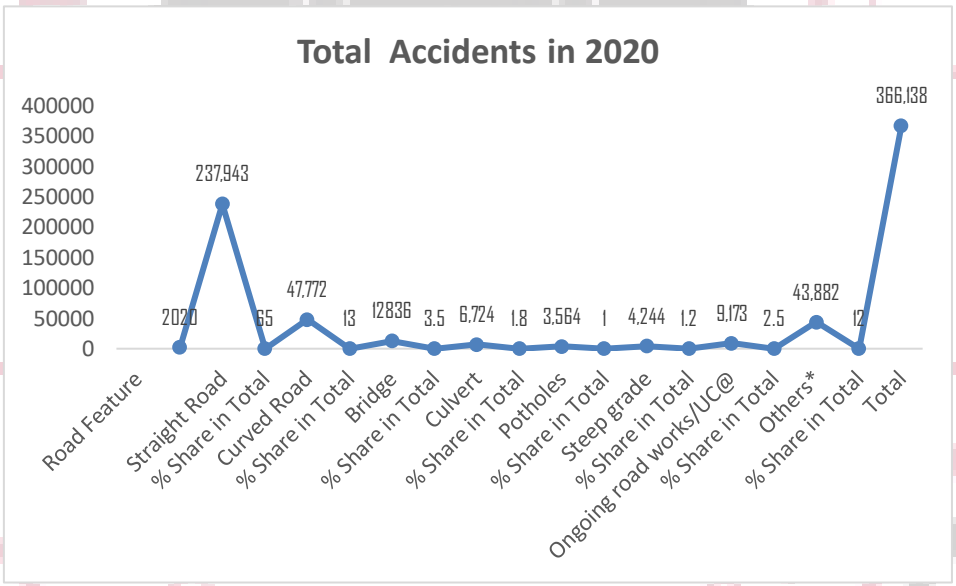

Figure 3 Road accidents in 2020 due to road feature

Table 4: Accidents, Persons killed as well as Injuries due to Road Feature 2019-2020

Road Feature	**Killed Persons**			**Injured Persons**		
		2020	**Percentage change over previous period**	**2019**	**2020**	**Percentage change over previous period**
Straight Road	96,624	85,032	-12	2,98,321	2,26,651	-24.0
% Share in Total	63.9	64.6		66.1	65.1	
Curved Road	20,141	16,746	-16.9	63,954	4,8213	-24.6
% Share in Total	13.3	12.7		14.2	13.8	

Bridge	5,553	5,049	-9.1	14,818	12,211	-17.6
% Share in Total	3.7	3.8		3.3	3.5	
Culvert	3,641	2,762	-24.1	8,682	6,017	-30.7
% Share in Total	2.4	2.1		1.9	1.7	
Potholes	2,140	1,471	-31.3	4,013	3,064	-23.6
% Share in Total	1.4	1.1		0.9	0.9	
Steep grade	2,160	1,604	-25.7	5,340	3,977	-25.5
% Share in Total	1.4	1.2		1.2	1.1	
Ongoing road works/UC[@]	4,455	3,894	-12.6	10,251	8,005	-21.9
% Share in Total	2.9	3.0		2.3	2.3	
Others[*]	16,399	15,157	-7.6	45,982	40,141	-12.7
% Share in Total	10.9	11.5		10.2	11.5	
Total	**1,51,113**	**1,31,714**	**-12.8**	**4,51,361**	**3,48,279**	**-22.8**

4.3 Road Accidents by Weather Condition

Due to how the weather affects the state of the road surface and motorist visibility, the probability of accidents increases. Driving is more hazardous when there is low visibility and a slippery road surface, which includes heavy rain, dense fog, and hailstorms. As per the Table 5, the number of accidents, fatalities, as well as injuries has alleviated across the board, with the exception of hail along with sleet.

Table 5: Road Accidents due to Weather Condition (2019-2020)

Weather Condition	**Total Accidents**			**Killed Persons**			**Injured Persons**		
	2019	**2020**	**Percentage change in 2020 over 2019**	**2019**	**2020**	**Percentage change in 2020 over 2019**	**2019**	**2020**	**Percentage change in 2020 over 2019**
Sunny/clear	3,30,295	2,61,046	-21.0	1,03,765	88,239	-15.0	3,39,636	2,53,421	-25.4
Rainy	39,825	36,161	-9.2	14,240	13,283	-6.7	39,573	34,552	-12.7
Foggy &misty	33,602	26,541	-21.0	13,405	12,084	-9.9	30,776	23,111	-24.9
Hail/ sleet	4,043	4,752	17.5	2,036	2,095	2.9	3,945	4,074	3.3
Others	41,237	37,638	-8.7	17,667	16,013	-9.4	37,431	33,121	-11.5
Total	**4,49,002**	**3,66,138**	**-18.5**	**1,51,113**	**1,31,714**	**-12.8**	**4,51,361**	**3,48,279**	**-22.8**

V. RESULT AND DISCUSSION

Many people are murdered and injured on our roadways every day. There is never a guarantee that those travelling by foot, bicycle, or motor vehicle will arrive at their destinations or return home safely. This includes people going to work or school, playing in the streets, or taking long journeys. After serious accidents, hundreds of people spend weeks in the hospital, many of them are unable to live, work, or play as they once did. The main risk factors for injuries due to road traffic at Midways Regional Hospital are typically drivers without valid driving licenses, disarranged city and highway roadways, drivers who smoke, failure to obey traffic signs, and exceeding posted speed limits. This survey revealed that 55 (54%) of drivers received driving instruction whereas 55 (46%) did not, which had a substantial impact on Kandahar's RTAs because they were unaware of the local traffic regulations. This analysis revealed that, of the 112 participants who possessed a driving license, 64 (57.14 percent) had received professional driving instruction, whereas 48 (42.86 percent) had only received training license-level instruction. According to the study's findings, only 20% of drivers routinely utilize seatbelts while they drive on roads, while 69 percent of respondents indicated they never used a seatbelt and only 11% said they sometimes did.

V. CONCLUSION

This paper discusses the relationship between the elevations in the number of vehicles along with the need for a well-considered policy on road safety. It also mentions the growth in the rate of accidents in India and the urgency for a comprehensive approach to address road safety. The research paper further examines the results of a study involving 112 participants who possessed a driving license, focusing on their professional driving training and seatbelt usage. The study found that just 20% of drivers frequently used seatbelts while driving on main roads, indicating the need for greater awareness and education on the importance of wearing seatbelts while driving. Overall, the paragraph emphasizes the importance of road safety and the need for a comprehensive approach to address it.

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