Road Traffic Accidents and Emergency Health Services of Rescue 1122: A Case Study of Bahawalpur City

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Abstract
The nineteenth reason on the list of leading causes of death worldwide is road traffic accidents (RTA). Every year, road traffic accidents cost the global economy $518 billion in lost revenue, with developing countries footing the bill for 65 billion dollars. As per World Health Organization (WHO), RTAs kill 1.25 million people and injure 20 to 40 million people worldwide. The present study aims to gain a comprehensive picture of the city of Bahawalpur's traffic accident statistics from 2017-21. Data were collected for this study from Rescue-1122. Each accident site was geocoded, and the data were enhanced, filtered, and organized. Hotspot analysis could help us better understand the causes of road traffic accidents in Bahawalpur. There were 41744 RTAs throughout five years. There were 42313 victims, 82% of whom were men and 18% of whom were women. The motorbike was the most frequently involved vehicle type," accounting for 21% of all collisions involving people between 21 to 30. A high number of accidents occurred in the eastern part of the city at all times due to the dense road network, congested infrastructure, and increased population. More accidents occur between 08:00 am to 04:00 pm on Sunday to Wednesday during the week and in March and October than in any other period due to good visibility. Due to this, the number of road traffic accidents has increased slightly over the years. The accessibility analysis shows that Rescue 1122 key centers offer services to 326,750 people living within 5 to 15 minutes of travel time and 252,000 people living between 15 to 30 minutes of journey time. Due to many populations relying on their services, Rescue 1122 must boost its emergency health services to help those injured in traffic accidents.
Keywords: RTAs, Hotspot Analysis, Emergency Health Services, Bahawalpur, Rescue-1122

1. Introduction

Road traffic accidents (RTAs) are becoming a bigger problem and are one of the top causes of death and illness around the world (Nazeer, Mohsin, &Rehman, 2021). Road Accidents happen when people don't follow traffic laws and hit other vehicles, pedestrians, or roadside signs and billboards. Road accidents have become a major social and economic problem because they cause deaths, injuries, and huge health problems (Heydari, 2014; Pan, 2014; Perrot, 2014). Road traffic accidents (RTAs) are a major cause of regional and global disease burden and are getting worse. Nearly 1.3 million people die every year in road accidents around the world. Also, 20 to 25 million people are hurt in accidents with injuries. According to data from the World Health Organization and the World Bank, the number of these injuries is likely to rise sharply by 2020 (Bank, 2010). According to the descriptive analysis, the average number of fatal and non-fatal accidents each year is 43.3% and 56.7%, respectively (Imran, 2015; Labana, 2015).

Pre-hospital care is provided by Emergency Medical Services (EMS). Ambulatory services, transportation of patients to and from treatment locations, and acute medical care, sometimes known as first aid, are all examples of pre-hospital medical services. Previously, emergency services were only accessible by road travel, but today air ambulance services are offered across the nation. The Punjab government formed a separate agency called "Punjab Emergency Service: Rescue 1122" to deal with emergencies. Emergency services are provided via the emergency services contact system with a specific phone number, 1122.

The area selected for this research is Bahawalpur city, which is situated in the south of Punjab and is the 11th largest city of Pakistan. The nature of the study design is descriptive in general and exploratory in specific, is the main cause to choose this area. moreover, like most of the other cities of Punjab, Bahawalpur city is facing urban sprawl, population increase, road infrastructure, and traffic congestion. Hence, this research is a step toward the improvement of emergency health services of this geographic unit.

This research attempts to assess the frequency and geographic distribution of traffic accidents in Pakistan's Bahawalpur. In this research, GIS is used to construct maps that show the number of accidents by location (Hotspot), gender, age group, and time (day/month/year that has the highest accidents). Governments may adopt in-time rescue services to assist minimize road traffic accidents by using the study's results.

This research aims to draw an analysis on RTAs managed by Rescue 1122 and its Research Questions

1. To investigate the pattern and distribution of road traffic accidents managed by Rescue 1122 in Bahawalpur City for the last five years (2017-2021).

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2. To investigate the demographic characteristics of the victims in the road traffic accidents managed by Rescue 1122 in Bahawalpur City for the last five years (2017-2021).
3. To investigate the major causes of road traffic accidents managed by Rescue 1122 in Bahawalpur City for the last five years (2017-21).
4. To investigate the accessibility of emergency health care and services in Bahawalpur City.

The results of this research might be used as a foundation by municipal planners and administration to build more roads to reduce traffic congestion in the city's major areas. Maps and datasets from this research may be useful to anyone working on transportation planning and other related concerns.

Figure 1: Map of Bahawalpur City showing the Rescue 1122 and BVH (Bahawal-Victoria-Hospital) Emergency Medical Services

2. Literature Review

RTA is the 11th leading cause of death in Pakistan (WHO, 2021) with a mortality rate of 17.12 per 100,000 people. This city has the highest number of road traffic accidents in Pakistan and the most RTA deaths in the country. Bahawalpur is a dangerous city because of the 36,000 road accidents that take place there each year. In addition to harming the economy, this issue is also putting families in a precarious position because the death of the family's breadwinner or a serious injury that results in a lifelong limp or expensive long-term treatment puts them in this precarious position (Kazmi&Zubair, 2014).

Vehicle, road infrastructure, and road user defects, as well as their interactions, have been the cause of several traffic accidents (Vlkovský, Šmerek, &Michálek, 2017). No matter how many researches show that human error is the primary cause of all accidents (Allahyari et al., 2008; Different categories of drivers, such as young drivers, senior drivers, and risky drivers, are the most common causes of traffic accidents. Accident investigation begins as soon as the scene of an accident is cleared, and all relevant data on the traffic environment, automobiles, and human factors are gathered. A major goal of the comprehensive accident study is to eliminate the factors that contribute to road accidents and the harm they cause. Young drivers are more likely to be involved in traffic accidents because of two long-term reasons. The following are some examples: As a result of their lack of driving expertise, teenage drivers are more prone to speeding or driving recklessly. Drivers under the age of 25 are more likely to make mistakes in their assessment of a route's difficulty or road surface.

2.1. Literature Gap

Nazeer et al. (2021) conducted a study on the risk factors of RTAs in Bahawalpur City. Whereas this study focuses on the dynamics of RTAs as well as the demographic structures of the victims of the last five years. In the study conducted by Nazeer et al. There is hardly any study found on the temporal and spatial dynamics of RTAs as well as no investigations are found on the accessibility of Rescue 1122. This study will use primary data from Rescue
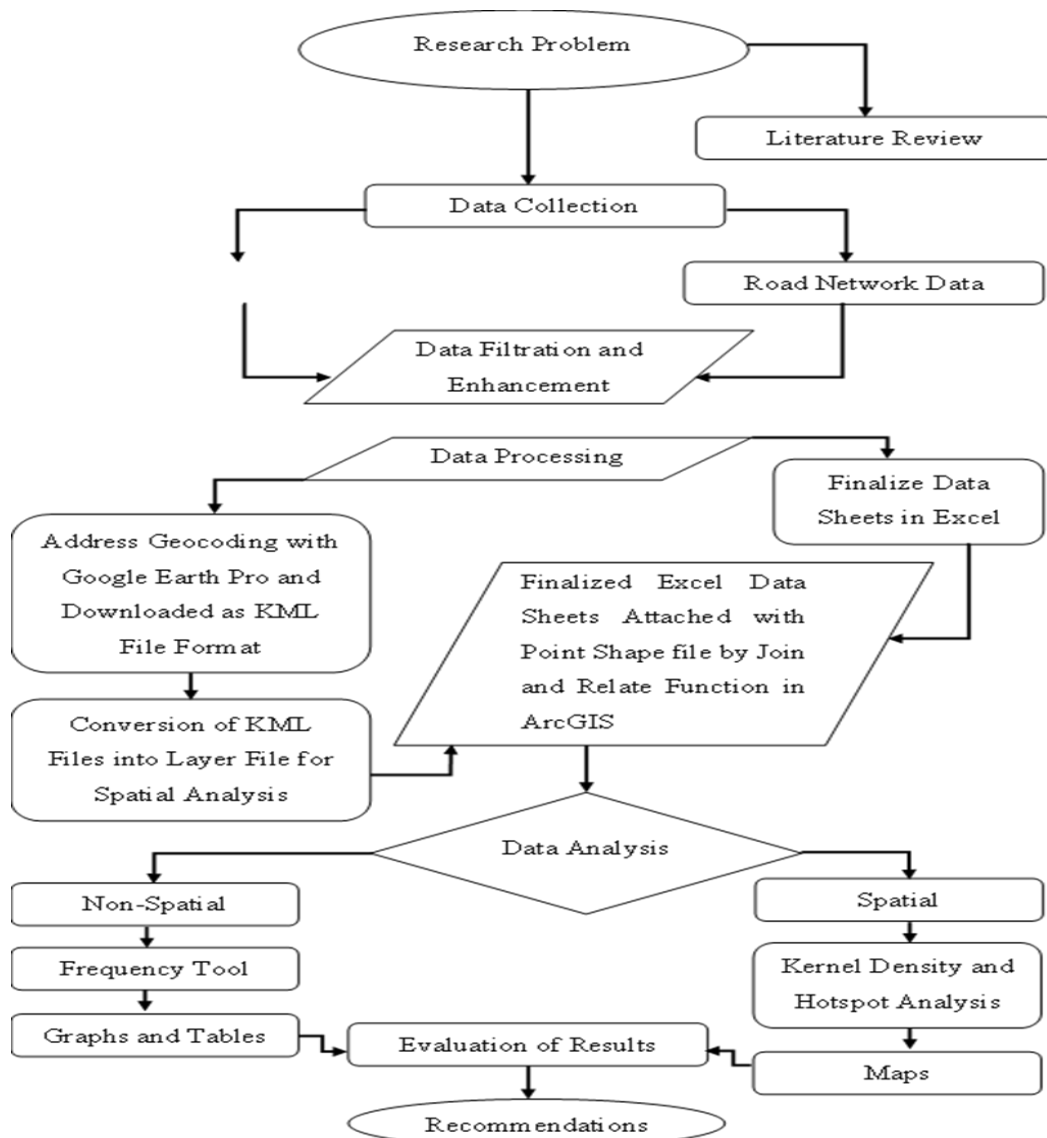
1122 to explore the dynamics of road traffic accidents (RTAs) and the accessibility of Punjab Emergency Services (PES) Rescue 1122 to the city and emergency health services (EHS).

3. Methodology

Accidents data was acquired from Rescue 1122 office to draw hotspot maps, and demographic characteristics, whereas, accessibility analysis will be conducted by using land use dataset and road network of the study area. Data required for this research is based on the road traffic accidents reported and managed by Punjab Emergency Services (PES) Rescue 1122, located within the premises of city, types of road accidents, time (year, month, day).

Table 1: Data Sources, Types, Purpose

Dataset	Variables	Type	Data Source	Purpose
Road Traffic Accidents	Demographic, Locality, Time, Emergency Service, Impact, No. of Injuries, No. of Deaths, Type of Vehicle, Causes	Qualitative and Quantitative	Office of Rescue 1122, Bahawalpur	Statistical and Spatial Analysis (Hotspot maps)
Road Network of Bahawalpur City	Types of Roads, Types of Land use, Barriers,	Spatial, Vector/Raster	ESRI, OpenStreetMap	Spatial Analysis (Accessibility of EMS and EHS)

Figure 2: Methodological Framework

4. Road Traffic Accidents (RTAs)

Table 2 shows the total number of accidents, the annual variation of accidents in percentages (%), fatal accidents, killed and injured persons from the year 2017-21. During 2017, a total of 6720 accidents were reported by in the

premises of Rescue 1122 of Bahawalpur city. The proportion of fatal accidents to the total road accidents has consistently fluctuates since 2017 from 1% to 0.7% in 2020. The severity of road accidents measured in terms of persons killed per 100 accidents has decreased from 1.1% to 0.8% in 2020.

Table 2: Details of road traffic accidents from 2017-21

Sr. No.	Year	Number of Accidents				Number of Victims		Accidents Severity[2]
		Total number of Accidents	Annual variation of Accidents (%)[1]	Fatal	Percentage of Fatal accidents	Killed	Injured	
1	2017	6720	--	65	1.0%	71	6966	1.1%
2	2018	8083	20%	39	0.5%	47	8216	0.6%
3	2019	8452	5%	37	0.4%	47	8399	0.6%
4	2020	8567	1%	65	0.8%	77	8559	0.9%
5	2021	9922	16%	67	0.7%	78	9853	0.8%

Source: Bahawalpur City Traffic Police Department, 2021

1. $Annual\ variation\ of\ accdients = \left(\frac{Current\ Year - Previous\ Year}{Previous\ Year}\right) \cdot 100$.

2. $Accidents\ Severity = \left(\frac{Total\ Number\ of\ Accidents}{Number\ of\ People\ Killed}\right) \cdot 100$.

The highest number of fatal accidents is 1% in 2017 and comparing to the annual accident's variation in percentages, the fatality is also high as 1%. In the year 2020, the percentage of fatal accidents (0.8%) records the second highest. The lowest percentages of 0.4% and 0.5% fatal accidents occurred in the years 2019 and 2018, respectively. The year 2021 showed 0.7% of fatal accidents.

4.1. Road Traffic Accidents Analysis

Bahawalpur City has adequate road connection both inside its boundaries and to surrounding cities and towns. Bahawalpur City's Road network comprises multiple state highways, major roads, and streets. Analysing the locations of accidents can aid in determining the cause of the incidents. The map below depicts the locations (points) and hotspot areas of accidents involving all types of vehicles from 2017-21.
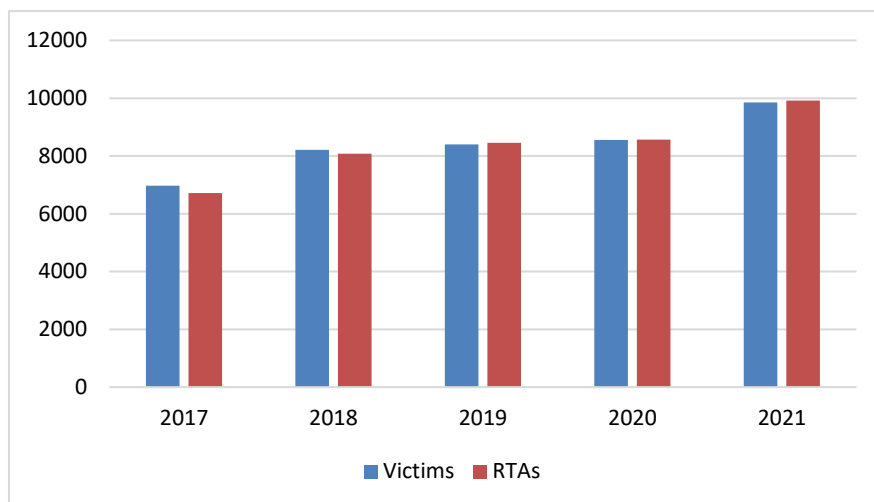

Figure 3: Hot Spots of Accidents in Bahawalpur (2017-21)

The Figure 3 shows that most of the accident events took place in the eastern part of the city, where road network and population is dense and also exhibits high traffic. The map shows hotspots and cold spots of the accident data. The data is processed in a GIS Platform to draw these analyses. None of the cold spots can be seen in any part of the city. The cold spots are those spots where accidents are in smaller number.
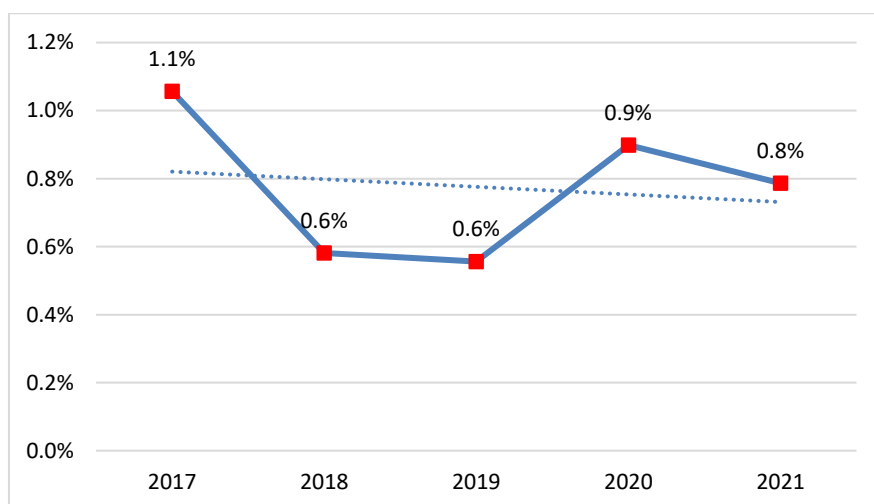
4.2. Demographic Variations

The demographic variations is one of the major objective of this study. The following graphs are drawn from the temporal data on the demographic variables, such as number of victims, gender-wise number of victims, and age groups.


Figure 4: Accidents and Victims

The Figure 4 shows the comparison bar graph of average number of accidents and the victims. The number of accidents has increased in the last five years. In the year 2017 the number of accidents were 6720 and victims were 6966, which increased gradually to 9853 (victims) and 9922 (accidents).


Figure 5: Accident's severity in Bahawalpur city from 2017-21

The above graph shows that from year 2017-2119 the number of fatal accidents has decreased from 1.1% to 0.8%. The fatal accidents are those which have a death in an accident case. The mean percentage of these years is 1 accident is fatal per 100 accidents. The injured persons in accidents are not included.
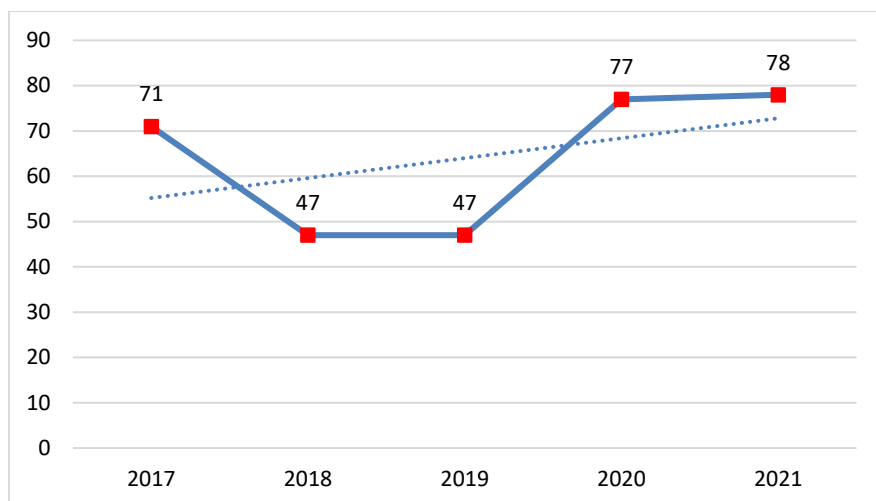
Figure 6: Number of persons killed in road accidents in Bahawalpur city from 2017-21

The above graph shows that the number of people killed in accidents, which have increased from 2017-2021. The year 2018 and 2019 shows the least number of killed people as 47 whereas year 2021 shows highest as 78.
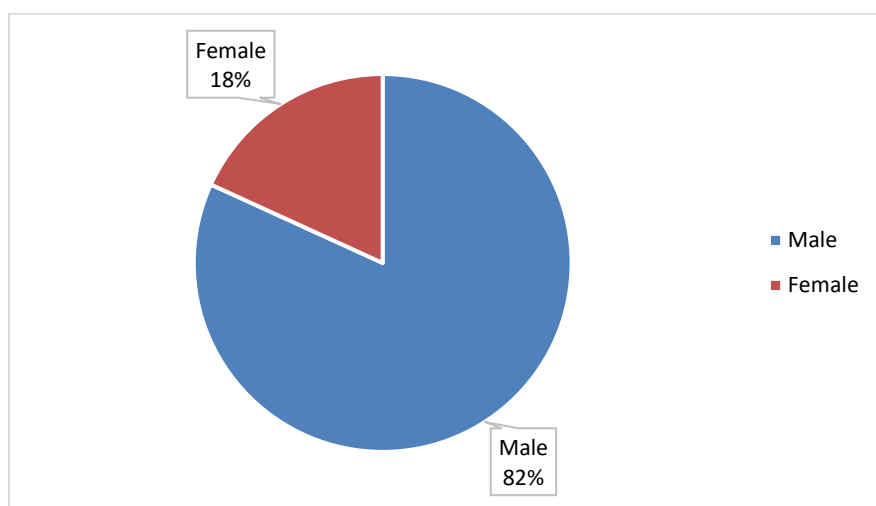
Figure 7: Chart showing the percentage of accidents based on gender

The above figure shows that the 82% male and 18% female were victims in the road accidents. The numbers have very high differences majorly due to the professional activities of the genders role in the city societies.

Table 3: Age-wise accidents

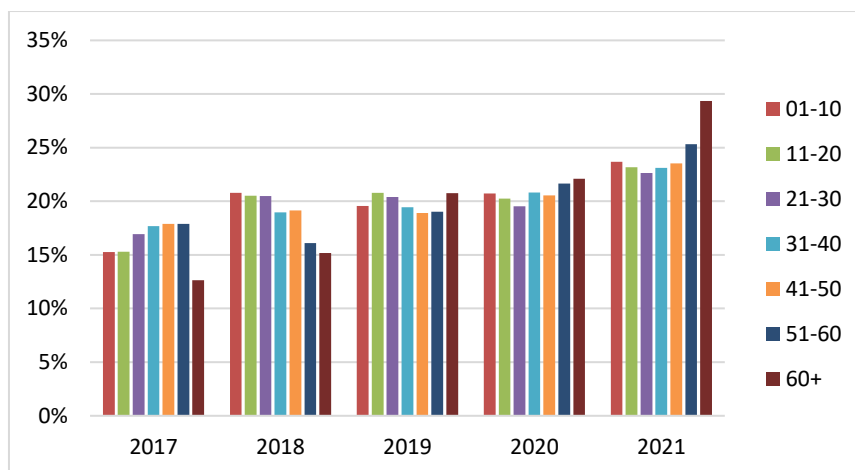| Age	Year					Total	Percentage
	2017	2018	2019	2020	2021		
01-10	419	571	537	569	650	2746	7%
11-20	1538	2061	2089	2034	2329	10051	25%
21-30	2001	2418	2410	2308	2673	11810	29%
31-40	1403	1505	1544	1651	1834	7937	20%
41-50	907	971	958	1042	1193	5071	13%
51-60	494	445	526	598	700	2763	7%
Total	6762	7971	8064	8202	9379	40378	100%

Figure 8: Age-wise Victims (2017-21)

Above table and graph shows total number of victims with their age groups.
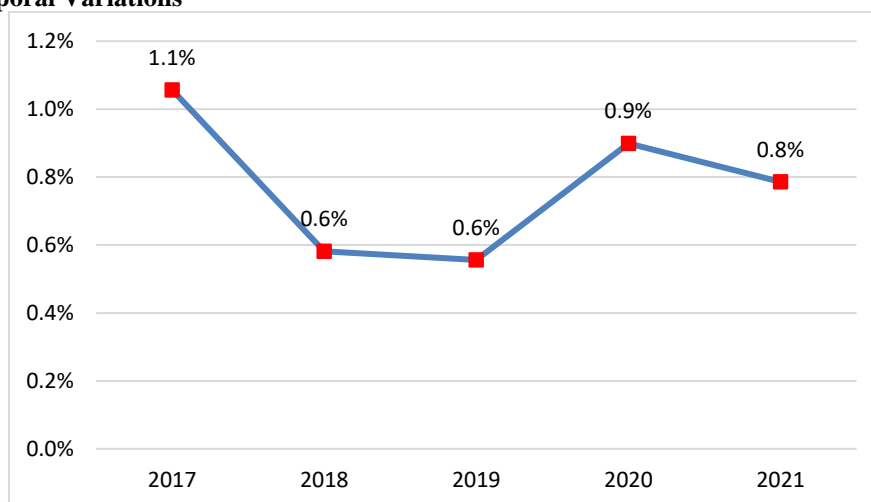
4.3. Temporal Variations

Figure 9: Annual variation of accidents in percentage from 2017-21

The above graph shows the annual variation in the accidents. The green bars show that the accidents have decreased from the previous years, and red bars show the increasing numbers of accidents than the previous year, as given in the Table 2. The number of accidents has decreased dramatically.
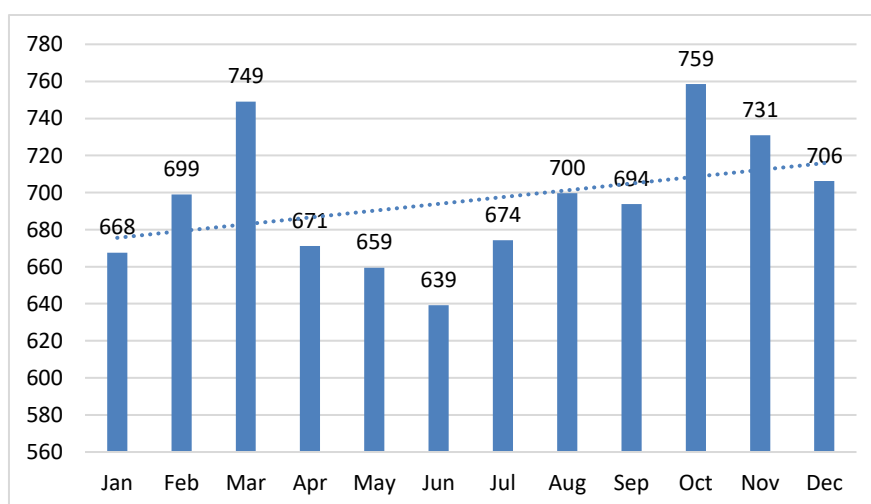

Figure 10: Month-wise Accidents in Bahawalpur City (2017-21)

The monthly graph shows the average number of accidents, and is quite interesting, as it shows October and March with the highest number of accidents as 759 which is higher than other months. It might be due to the clear weather, which results higher congestion and therefore higher number of accidents. Other months shows 639-749 accidents. Average number of monthly accidents per year is 696. Accidents tend to follow a pattern based on the time of day. Daytime accidents outnumber night-time accidents.
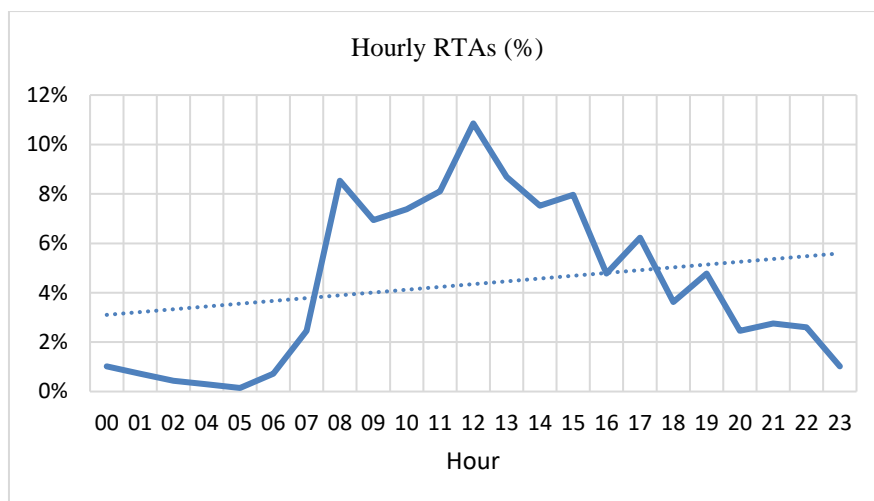
Figure 11: Timely Distribution of RTAs (2017-21)

The above graph shows the average number of accidents in terms of daytime. It is seen that highest number of accidents occur between 12:00 pm to 03:00 pm, and lowest during 01:00 am to 06:00 am.
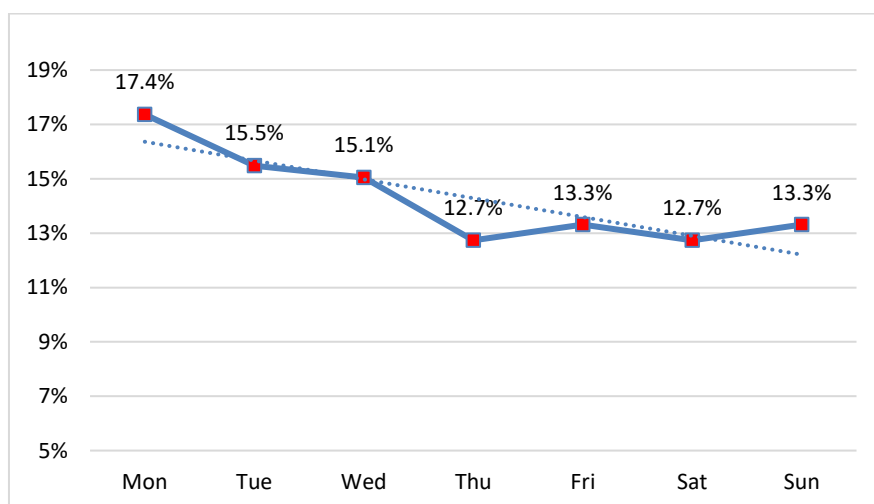
Figure 12: Weekdays Accidents Numbers (2017-21)

The above graph shows the average number of accidents. It can be seen that working days show highest number of accidents. Sunday shows rise of accidents which gradually decreased till Thursday. Other days show lower number of accidents compared to the other days. Highest accidents are found in Monday (17.4%), and lowest in Thursday (12.7%) and Saturday (12.7%).

4.4. Vehicles

Accidents occur for many causes, but the severity varies depending on the vehicle involved. Vehicles involved in accidents in Bahawalpur fall into eight categories: Motorbike, Car, Truck, Rickshaw, Bus, Van, Tractor Trolly and Other Vehicles. The graphs indicate the percentages of vehicles involved in RTAs from year 2017-21.
Figure3 shows the percentages of vehicles involved in the RTAs. It is found each year have showed the variation. In the year 2017 Truck and Bus have shown highest accidents as 29%, and motorbikes as the lowest as 14%. The year 2018 RTAs are highest in Bus, 2019 have highest in Vans, 2020 have highest in Tractor Trolly and 2021 have shown highest in Tractor Trolly as 38%, Other Vehicles as 29%, and Motorbikes as 24%.
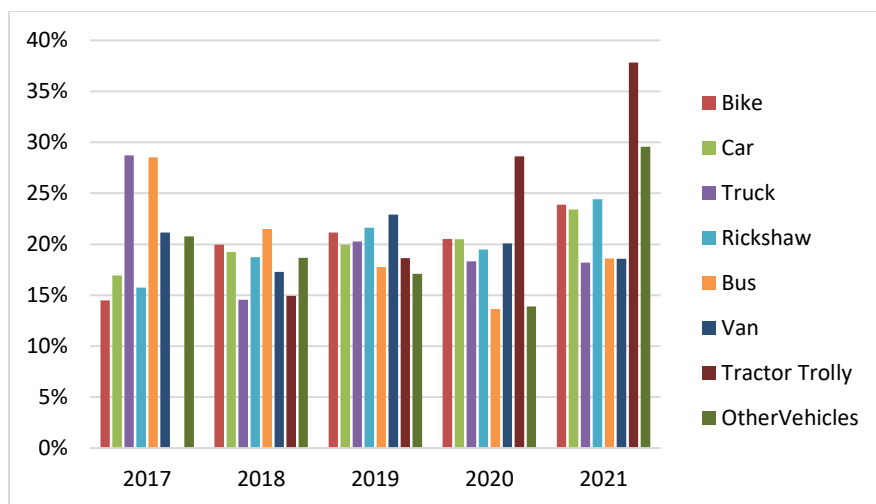
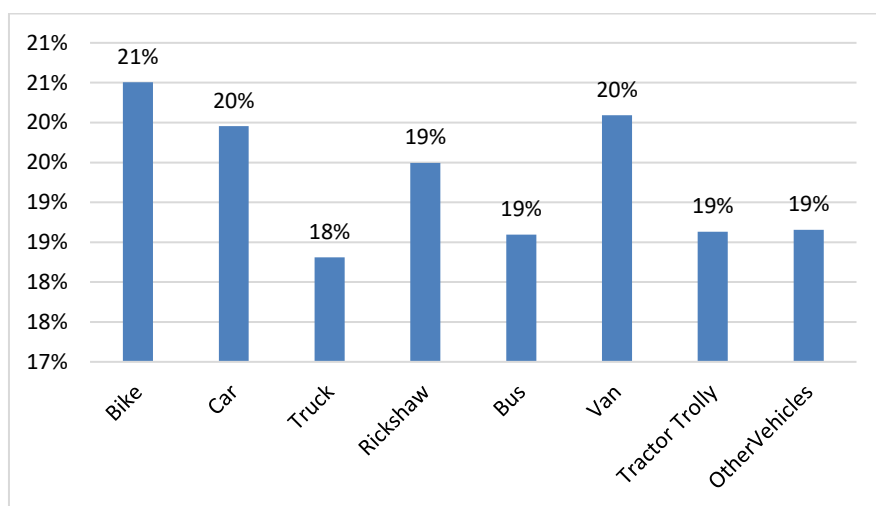**Figure 13: Vehicles in RTAs**

Figure 14: Averages of Vehicles in RTAs

Figure 4 shows the averages of vehicles involved in RTAs. It is found that motorbikes hold the highest as 21%, 2nd highest is the Cars, and Vans as 20%. Whereas the remaining are the 19%.
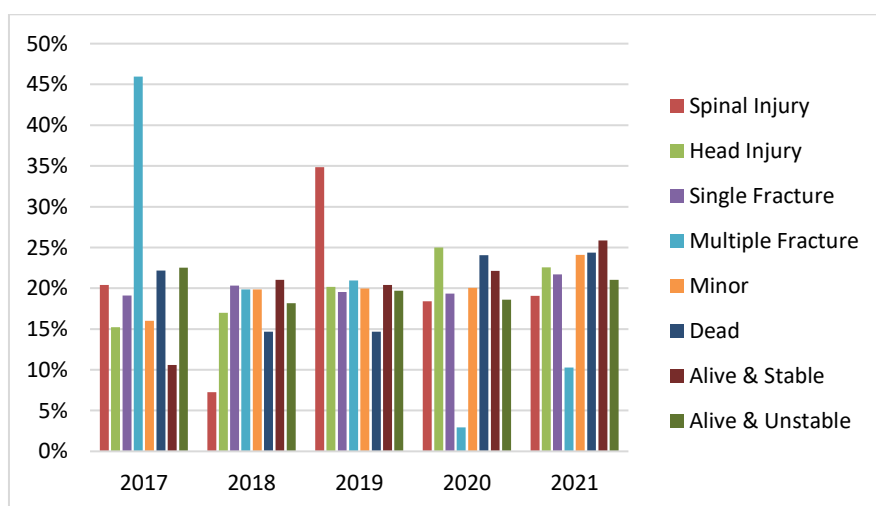
4.5. Road Traffic Injuries (RTIs)


Figure 15: Injuries Types

Figure 5 shows that in the year 2017 the most common injury was multiple fractures, in 2018 was the multiple fractures, single fracture, and minor injuries, the most common in 2019 was spinal injury, in 2020 the most common injury was head injury, and in the year 2021 the most common injury was minor injuries, and head injuries.
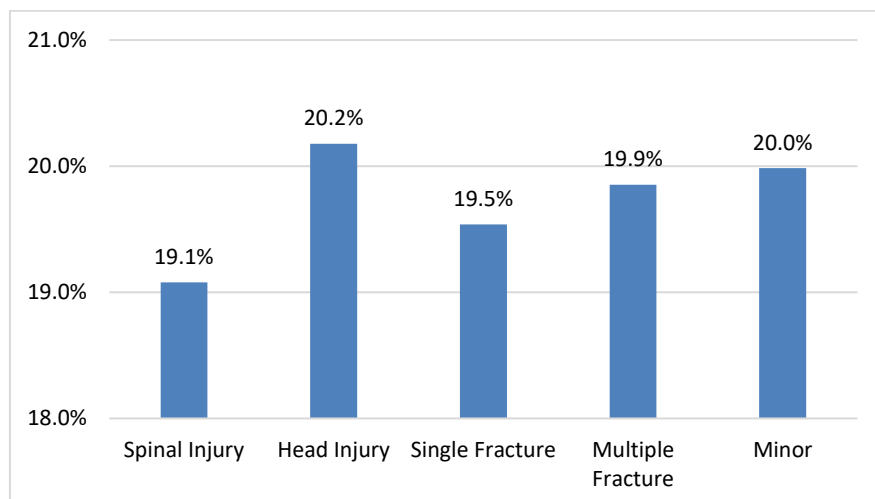
Figure 16: Averages of Injuries of Road Accidents

The Figure 6 shows the overall injuries in the previous five years. It is found that the most common injury is the head injury.

4.6. Causes of Road Accidents
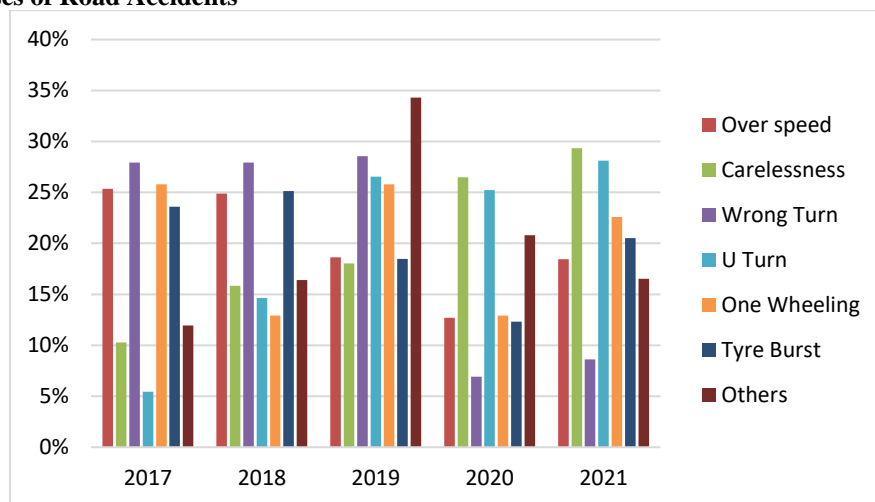
Figure 17: Causes of Road Traffic Accidents (2017-2120)

4.7. Overspeed

One of the most common causes of a car accident is someone who isn't paying attention. The number of accidents caused by distracted driving has risen over the last few decades. Drivers should pay full attention to the road at all times, and they should learn to do the same. Drivers can die if they look at texts and reply to texts while driving. They can also make phone calls and read while driving. The Figure 17 shows that the number of accidents due to distraction are high in numbers in each year. 22%, 25%, 26%, 17% and 9% in the year of 2017, 2018, 2019, 2020 and 2021, respectively.

4.8. Careless Driving

A lot of people die when they get into accidents because they speed up. Even when someone is running late, but it's best to drive according to traffic rules. Most of the time, reckless driving leads to terrible accidents. The results show that the number of accidents due to reckless driving are 15%, 14%, 16%, 16%, 21% and 26% in the year of 2017, 2018, 2019, 2020 and 2021, respectively.

4.9. Wrong Turn

It is very important to wear a seat belt while driving. Because it keeps the posture correct, it also lessens the chances of getting hurt in a head-on crash. It also makes it more likely that the drivers will be able to get away from the accident without a lot of damage. The Figure 17 shows that the number of accidents due to reckless driving are 17%, 13%, 12%, 18%, and 15% in the year of 2017, 2018, 2019, 2020 and 2021, respectively.

4.10. U Turn

Wet roads are slippery, so they can be dangerous for cars because the wheels lose their grip on wet roads. Even though it is difficult that a person can't always avoid driving in the rain, it's best to avoid the slippery streets whenever possible. It's also important to pull over and wait until the rain stops. The Figure 17 shows that the number of accidents due to reckless driving are 5%, 8%, 9%, 8%, and 12% in the year of 2017, 2018, 2019, 2020 and 2021, respectively.

4.11. One Wheeling

Poor road conditions can't be avoided and can be very upsetting for people who drive. Avoid potholes at all costs if to avoid damaging the vehicle. The Figure 17 shows that the number of accidents due to reckless driving are 5%, 8%, 9%, 8%, and 12% in the year of 2017, 2018, 2019, 2020 and 2021, respectively.

4.12. Tyre Burst

Tailgating is when a driver drives behind another vehicle and doesn't leave enough space to stop without causing a collision if the vehicle in front suddenly stops. The Figure 17 shows that the number of accidents due to reckless driving are 12%, 10%, 8%, 4%, and 2% in the year of 2017, 2018, 2019, 2020 and 2021, respectively.
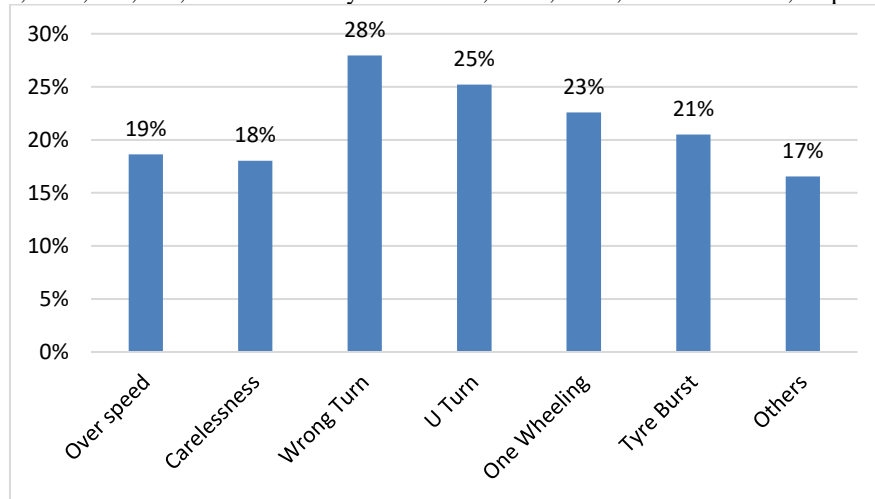
Figure 18

The above figure shows the averages of all the causes of RTAs in Bahawalpur from 2017-2021. It is found that wrong turn, U-turn, and one-wheeling are the first three major causes of 55% accidents, whereas last five causes such as overspeed, carelessness, tyer burst, and others accounts the 45% of traffic road accidents in the study area.

## 5. Accessibility Analysis of Emergency Health Services

Service areas are drawn on emergency health services (Rescue 1122) main centre and key centres on the road network using a GIS platform. The service area of Bahawalpur city network includes all accessible locations with defined impedance. The 25-minute service area is used as an average for all types of road networks in this study, and it covers all streets that can be accessed within 5, 10, 15, 20, 25 and 30 minutes from that location. Service regions can aid in determining facility accessibility. Concentric service zones demonstrate how access varies with impedance.

The above map shows the time travel map of Rescue 1122 services. The time intervals of 5, 10, 15, 20, 25 and 30 minutes are drawn. There are eight centers, which provide emergency health services to citizens. These hospitals are majorly located in the densely populated area. These emergency services are located at

1. Foji Basti (Central Stations Kali Pulli);
2. One Unit Chok (Key Points);
3. Farid Gate (Key Points);
4. Larri Adda (Key Points);
5. Gulzar e Sadiq (Key Points);
6. Welcome Chok (Key Points);
7. PSO Pump University Road (Key Points); and
8. New Sabzi Mandi (Key Points).

These centers provide services to 326,750 number of populations by 5-15 minutes of travel time, 252,000 number of populations from 15-30 minutes of travel time.

The city needs more emergency health services to accommodate the occupants in the road accidents, as large number of populations depend on these services. Whereas, the travel time is also quite high to reach by the facility.
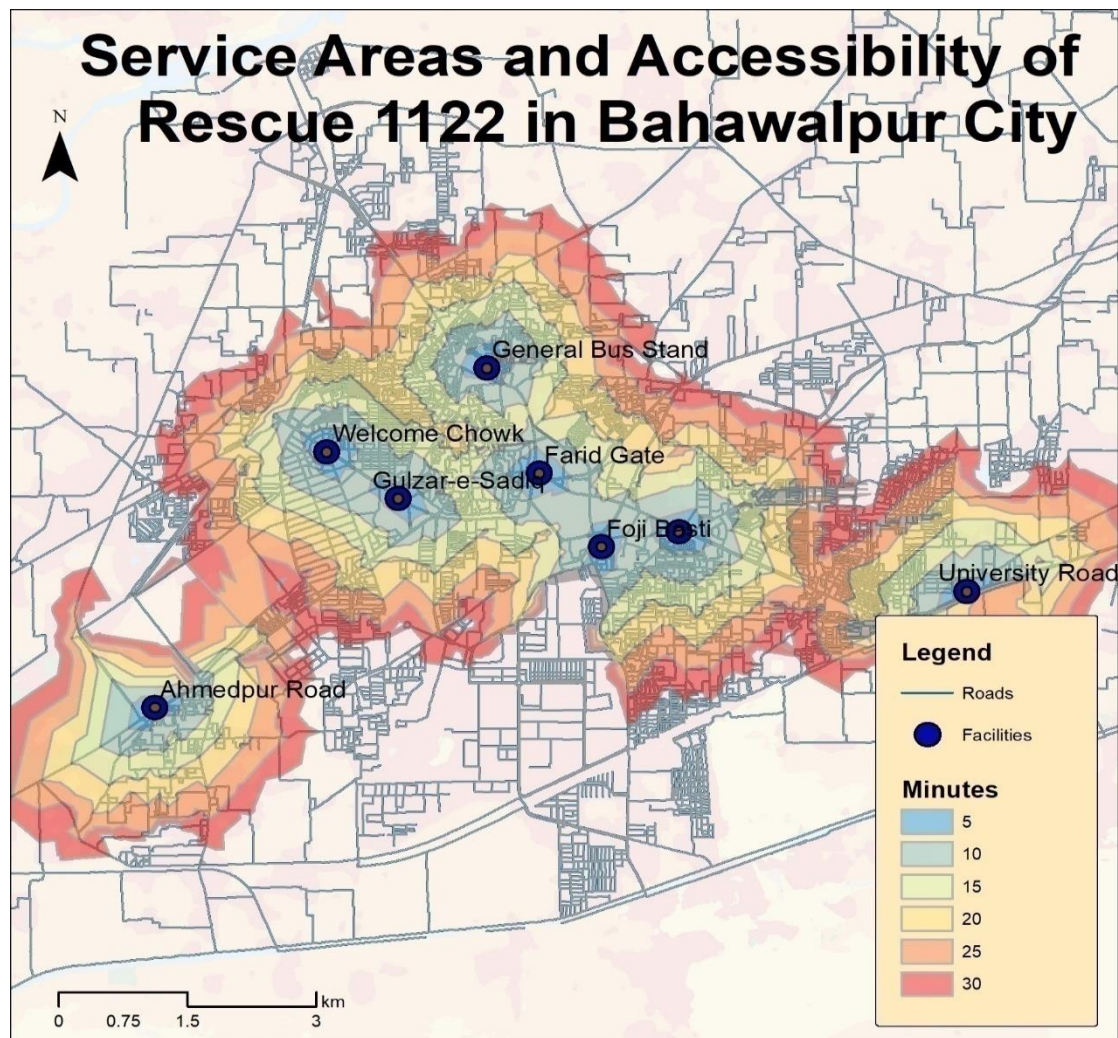
Figure 19: Service Areas and Accessibility of Rescue 1122 in Bahawalpur City

6. Conclusion

Bahawalpur road traffic accidents are the subject of this study. In addition to hotspot location, temporal trends; hourly time, day, month, and year, more demographical aspects such as the number of victims, gander victim, and age category were analysed. For the period of 2017 to 2021, we also looked at the more involved vehicle category. According to research, the number of traffic fatalities in Bahawalpur is steadily rising. As the number of two-wheeled vehicles (Motorbikes) on the road grows in cities and suburbs, we see an increase in traffic accidents. As a result of this study, the eastern part of the city has been a constant location for dangerous road traffic accidents during the study period. Clustering and intensity of road traffic accidents can be seen on the hot spot map, while the cold spots show clustering of low values, such as major intersections, link roads or parking along the roadways. It is clear from the temporal trends map that the study area's spatial pattern is highly variable. This is due to a variety of factors, including city mega-construction, driving habits, demographics, and, perhaps most importantly, weather. The frequency of traffic accidents is higher on dry days than on days when it has rained. Road traffic accidents occur more frequently during the day than at night, according to a statistical analysis. Between 08:00 amto 04:00 pm accidents claim the most lives. The month of March and October also has a high rate of RTAs, with many occurring on weekends, especially on Fridays, from 2017 to 2021. The demography of a city is severely impacted by road traffic accidents, according to a comprehensive study. Teenagers are a high-risk generation. Regardless of whether they were driving or riding a bicycle, they were harmed. In Bahawalpur city, the "two-wheeler" category contains a large portion of RTA between the ages of 10-19 and 20-29 over the course of four years. The "Light Vehicle" category of public transportation is responsible for a significant number of accidents. It is hoped that this study will serve as a foundation for future research into RTAs. Using GIS (geographic information system) in the field of transportation and RTAs in Bahawalpur City, this study makes a small contribution.

The Rescue 1122 key centres offer services to a total of 326,750 people living within 5 to 15 minutes of travel time, and 252,000 people living between 15 to 30 minutes of journey time. As a result of the huge number of people who rely on these services, the city has to increase the number of its emergency medical services so that it

can better assist those who are injured in traffic accidents. On the other hand, the amount of time necessary for travel is substantial in order to access the facility.

6.1. Recommendations

Here are a few suggestions based on the findings of this study that can be implemented in order to reduce the frequency of road traffic accidents as well as their severity in terms of damage. It's possible that putting these suggestions into action will take some time, but some are so general that relevant authorities can act right away to help prevent this catastrophe.

- At vulnerable times, Traffic Police should deploy more traffic wardens to hotspot locations so they can safely and frequently manage traffic loads.
- Before issuing a driver's licence, a licencing agency should thoroughly evaluate each applicant's driving ability. Teenage bikers account for 46% of Bahawalpur's RTA, making this a pressing issue for that demographic.
- This death game in a mega city must be stopped by a strong enforcement of the law against one-wheeling, traffic control, and legislative authorities.
- In urban areas, public transportation is the primary mode of transportation. Traffic control authorities should organise technical workshops for drivers of Mazda vans, Suzuki pickups, and Rickshaws, which participate in RTAs, to learn how to drive safely and courteously in congested areas or during peak hours.
- The study also found that overcrowding among passengers is a problem, prompting the traffic control department to devise a policy with an immediate timetable for mitigating this issue.
- To lessen the impact of any unfortunate events on the road, speed limits in urban areas should be set at 40 km/h, especially in the city centre.
- In the case of a traffic accident, data collection is a critical but delicate issue. It is therefore recommended that traffic wardens and/or police officers receive training in the use of GPS and other location marking devices.

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