Analysis of Road Traffic Accidents in Rawalpindi Using ArcGIS

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THESIS ACCEPTANCE CERTIFICATE

This is to affirm that the thesis titled,

"Analysis of Road Traffic Accidents in Rawalpindi Using ArcGIS"

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For

The degree of Bachelors

In

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DEDICATION

We dedicate this thesis to our parents for their love and affection. Their continued support was what motivated us to move forward and overcome all the hurdles that came in our way.

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List of Abbreviations

ITP	-	Islamabad Traffic Police
NTRC	-	National Transport Research Center
ERS	-	Emergency Response Service
PBS	-	Pakistan Bureau of Statistics
GIS	-	Geographical Information System
GDP	-	Gross Domestic Product
WHO	-	World Health Organization
IMF	-	International Monetary Fund
NHA	-	National Highway Authority
RTAs	-	Road Traffic Accidents
SOV	-	Single Occupancy Vehicle
VRU	-	Vulnerable Road User
RTIRN	-	Road Traffic Injuries Research Network
RTIs	-	Road Traffic Injuries

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ABSTRACT

Road Traffic Accidents (RTAs) is a major cause of concern for any traffic safety organization. Identification of accident hotspots, as they are normally called, is a precondition to come up with practical solutions for accident reduction. This study has focused on adopting a geospatial approach using Esri ArcGIS software to identify higher accident prone areas in Rawalpindi District of Pakistan. Data for the year 2017 was acquired from Rescue 1122, a public Emergency Response Service (ERS) and sorted out using MS Excel. Statistical analysis found motorcyclists and pedestrians to be the most Vulnerable Road Users (VRUs) and over speeding as the main cause for most of road crash fatalities. Spatial autocorrelation was performed using Moran's I test. Furthermore, geospatial mapping of data was performed using kernel density method and hotspot analysis (Getis-Ord Gi*). Traffic parameters such as the total number of accidents, total fatal accidents, severity, age wise distribution and other parameters were considered. Next, Voronoi maps were produced to identify ideal locations for providing emergency service facilities.

Chapter 1

1. Introduction

1.1 Background

Road transportation forms the backbone of every country. All industrialized countries have made tremendous progress through the development of their transportation system. It plays a vital role in economic development; carrying people, goods and services through an extensive infrastructure of roads/highways, railways/subways etc. Improvement and expansion of road network has\helped industries to proper and increase business activities, employment, property values, investment and tax revenues.

Pakistan, being a developing country of over 212 million people (2017 census) with a GDP (PPP) of $1.060 trillion (IMF,2017), has injected huge capital into the transport sector by building world- class motorways/freeways to connect its major cities. It has also invested billions to provide better paved roads in far-flung, under-developed areas. But on the other hand, its transport sector is the cause of thousands of deaths each year.

Road Traffic Accidents or RTAs in short, have led to human and economic losses in Pakistan and around the world. Most of such accidents are caused as a result of several factors mentioned below:

1. Poor geometric designs
2. Ineffective traffic management

3. Careless behavior of drivers such as not wearing seat belt and helmets. In addition, reckless driving including tailgating, not using indicators, over speeding, ignoring road signs and jumping red traffic light are responsible for accidents as well.
4. Carelessness on the part of pedestrians
5. Lack of awareness and obedience of road traffic rules

According to a recent World Health Organization (WHO) report, RTAs result in the deaths of 1.35 million people each year and injure about 4 times this number. About three- fourth of the victims are men and boys. An overwhelming 93 percent of these deaths occur in low and middle income countries including Pakistan. The report goes on to say that more than half of all road traffic deaths are among the pedestrians, cyclists, and motorcyclists (Global status report on road safety 2018). Another 20 to 50 million people suffer non-fatal injuries, many of whom have to live with disabilities for the rest of their lives.

Road crashes fatalities is now the seventh leading cause of deaths worldwide (Figure 1. 2016) moving three positions up from being the tenth in the year 2000. However, RTAs are not among the ten leading causes of deaths for high-income countries implying that that the situation is grim for developing countries in particular (WHO).

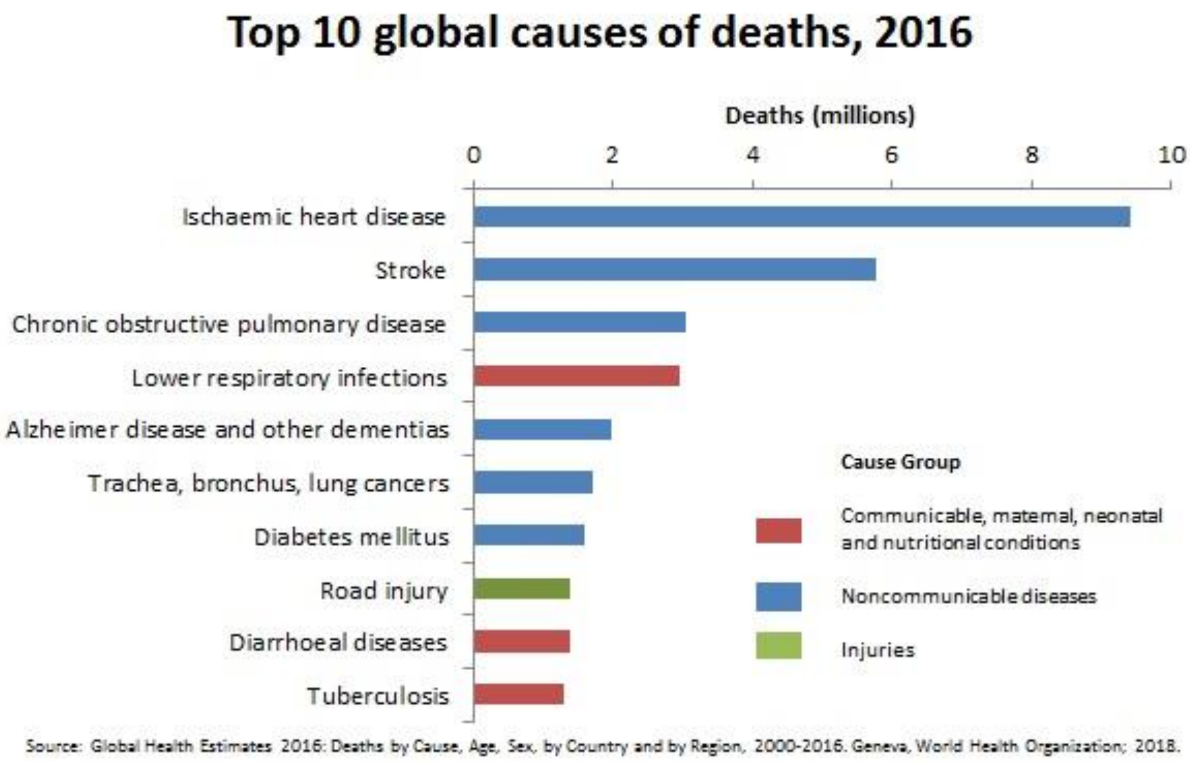


Figure 1.1: Top 10 leading causes of deaths in 2016 (WHO, 2018)

In Pakistan, road traffic accidents kill more people compared to the loss of lives due to terrorism in the country. According to National Counter Terrorism Authority (NACTA) 1081 people died in terrorist attacks across the country in 2015; the National Highway & Motorway Police (NHMP) officials have disclosed that on average 15000-16000 people die in Pakistan annually due to traffic accidents (The Nation, July 2018). As a result, the country has the worst road accident rate in Asia while it is ranked 48th worldwide (Express Tribune, February 2019).

In Pakistan, Punjab has the highest number of recorded accidents; close to 29,524 were killed in 51,715 accidents (PBS, 2004-2013). Sindh comes in second place with over 9,639 fatalities in 13,965 accidents while Khyber Pakhtunkhwa recorded 27,939 accidents resulting in 9,494 fatalities. In Khyber Pakhtunkhwa and died. In Balochistan, 2,250 fatalities were reported in 4,085 accidents. Pakistan Today report shows that the ratio of fatalities per accident has been the highest in Sindh at up to 86 percent whereas it is the lowest in KPK (36 percent). The national average for the ratio of deaths per accident stand at 55 percent.

In Rawalpindi city, the Rescue 1122 service responded to a total of 22,971 emergencies calls; out of these 9,539 calls (42 percent) were related to road traffic accidents. The Provincial Monitoring Cell (PMC) has reported 227,390 road traffic accidents took across the Punjab in 2015 whereas 201,120 RTAs were reported in 2014, an increase of 6.13 per cent. Traffic accidents increased by 7 percent in Rawalpindi, 5 percent in Lahore, 3.9 percent in Gujranwala, 3.24 percent in Multan and 2.82 percent in Faisalabad (The News International, 2016). One obvious thing to deduce from the report is the highest ever increase that is recorded for Rawalpindi. The population of the city is exposed to serious traffic accidents which merit immediate attention.

1.2 Situation of RTAs in Rawalpindi:

The city of Rawalpindi (Figure 1.2) is served by two major arterials: Peshawar Road and Murree Road. Peshawar Road is part of National Highway 5 or N-5 connecting Rawalpindi city to the rest of the country. It is a six lane-road including an interchange at Pirwadhai Morr. Auxiliary lanes are provided at some intersection whereas channelization across the stretch of the road is found to be inadequate. Significant congestion and log-jams are common particularly during rush hours. The commuters have to endure long queues every day. Major traffic hotspots are found on this road where motor cyclists are most vulnerable to accidents.

Figure 1.2: Google map of Rawalpindi District also showing routes of M-1 and M-2 Motorways

Murree Road is another major arterial connecting Rawalpindi to Islamabad and traversing densely populated areas. It is a six-lane road which runs parallel to the newly constructed Rawalpindi/Islamabad Metro Bus Project. Even after major uplift of the existing road, commuters face delays and congestion particularly at intersections. Motor cyclists and pedestrians are helpless and exposed to accidents since there are inadequate facilities for both.

The twin cities of Rawalpindi/Islamabad have witnessed a significant rise in the number of accidents. According to police records, the fatality rate per 100,000 populations is 6.1 in the twin cities. The recorded RTAs here are one of the highest in all of Pakistan. There is a possibility that road accidents in Rawalpindi have been reported regularly, as compared to the ones reported in other cities; which is why the ratio of fatalities per 100,000 people is high here. The said rate for Punjab was 3.3 while for Sindh, Khyber Pakhtunkhwa, Balochistan, and Azad Kashmir it was:

2.1, 4.5, 3.2, and 4.3 respectively. If the accidents are allowed to increase at the current rate, a 77 percent increase is projected in road accident fatalities by 2020. By 2030, it is expected to increase by 200 percent (ProPakistani, 2018).

1.3 Significance of This Research/ Problem Statement:

The increasing level of road traffic accidents in Rawalpindi and the consequent injuries and deaths strengthened the case for this analysis.

Our study is aimed at identifying and locating such areas which are prone to road accidents not only on the major highways but on the entire road network of Rawalpindi. These traffic hotspots, as they are normally called, would be analyzed to identify the root causes of accidents occurring on a recurring basis. Unfortunately, there has not been a comprehensive evaluation of RTAs in Islamabad/Rawalpindi to date, and the results from this study would help in evaluating the issues related to RTAs.

1.4 Objectives

The objectives of this research project are:

1. To identify traffic accident hot spots in Rawalpindi using geographic information system
2. To suggest mitigation measures to improve traffic conditions at accident hotspots.

1.5 Organization of Thesis

This thesis is composed of five chapters the detail of each chapter is discussed below:

Chapter 1: Includes the background of the study, research objectives and problem statement.

Chapter 2: Includes literature review on the various methodologies used to conduct research using ArcGIS software. Previous studies done in this regard have been included

Chapter 3: This chapter explains the methodology adopted.

Chapter 4: Analysis techniques used on our data have been mentioned in detail.

Chapter 5: Results and conclusions deduced have been discussed in the last chapter.

Chapter 2

2. LITERATURE REVIEW

2.1 Background

The emphasis of this chapter is to provide an overview of the work already done by our seniors/leaders/high-ups in this field, on this topic and related to this scope. Also, RTA related topics are defined and described in following texts.

2.2 Road Traffic Accidents

A Road Traffic Accident (RTA) is said to occur when a road vehicle collides with another vehicle, pedestrian, animal or geographical or architectural obstacle. It may result in fatality, injury and property damage. Generally, drivers suffer the most in case of head on collisions whereas skidding and rolling over of vehicles are responsible for passenger casualties.

2.3 Types of Road Traffic Accidents

Vehicle collisions may be classified into following types:

2.3.1 Rear End Collision:

It occurs when a vehicle crashes into a vehicle in front of it. Generally, the car behind is at fault.

Figure 2.3.1: Rear-End Collision (photo courtesy: attorneynewmexico.com)

2.3.2 Head-On Collision:

It occurs when the front ends of two cars collide with one other in opposite direction and may cause serious physical damage to divers and their vehicles.

Figure 2.3.2: Head-On/Frontal Collision (photo courtesy: birminghammail.co.uk)

2.3.3 Side Impact Collision:

It occurs when one or more vehicles are hit on their sides. Generally the driver hitting another vehicle is the one to be blamed.

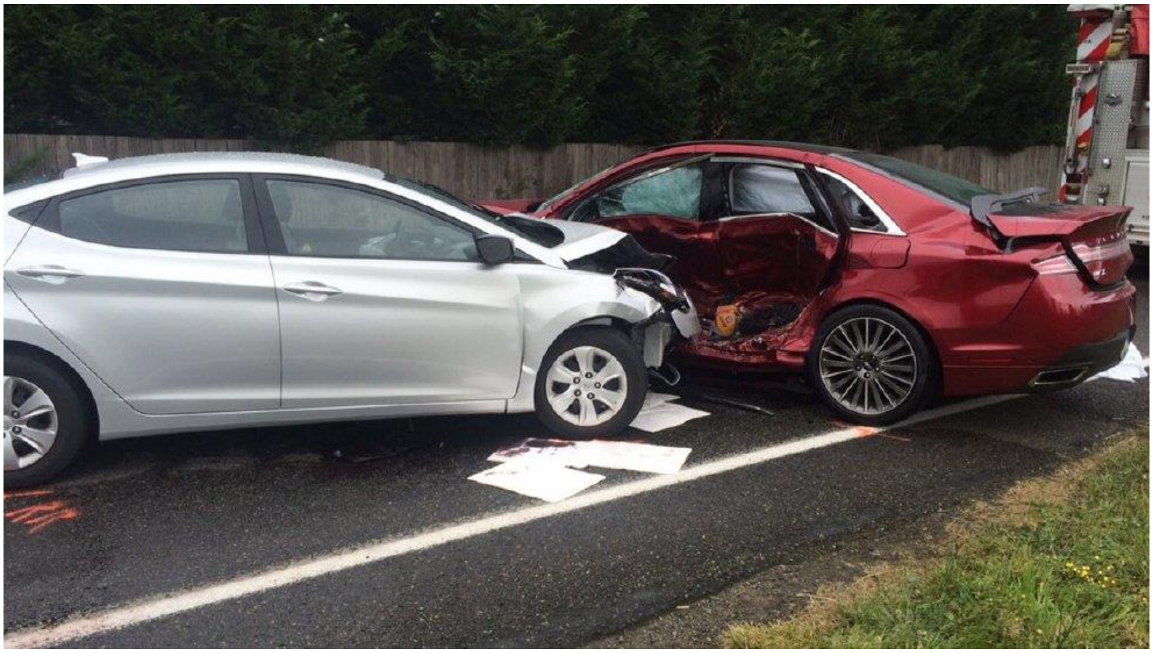


Figure 2.3.3: A Side Impact Collision (photo courtesy: https://www.hsinjurylaw.com)

2.3.4 Roll over:

It occurs when a vehicle tips over onto its sides or roof. It can cause serious injuries and even be fatal. It happens when car tires hit some obstruction on the pavement which results in its rolling.

Figure 2.3.4: Car Rollover (photo courtesy: brownpersonalinjury.com)

2.3.5 Multiple vehicle pile-up:

A multiple vehicle pile-up is a severe road accident involving many car crashes and usually results in smashed vehicles and twisted metal. Several vehicles may get crashed in such accidents which mostly occur on high-speed roads such as the motorways and highways. It generally occurs in snowy weather when the roads het slippery and visibility is limited.

Figure 2.3.5: A multiple vehicle pile-up

2.4 Classification on the Basis of Severity of a Road Traffic Accident

Road accident data is classified on the basis of severity. The most severe accidents result in deaths and serious injuries while minor accidents may cause less severe injuries or only vehicle/property damage. RTA category in terms of severity is discussed below.

2.4.1 Fatal Accident:

There is no single definition of a fatal accident since many countries have their own legal definitions. A fatal accident is the most severe kind of accident and results in at least one death. While some fatal accidents result in sudden death, others result in eventual death within thirty days. This definition, road crash death within 30 days of the crash, is followed by 80 of the 178 countries. A fatal accident may produce legal complexities for the motorists involved in collisions and the penalty will depend on the level of negligence on part of the other driver. In Pakistan, no legal definition has been developed and generally an on-spot death is considered to be fatal (Accident.laws.com)

2.4.2 Non-Fatal Accident

This kind of accident causes injuries only and does not result in neither an immediate nor an eventual death. Injuries may range from minor to major:

2.4.2.1 Major Accident:

A major accident is the one that not only cause physical injuries but also considerable damage to vehicles involved in the crash as well as damage to road infrastructure such as barriers, traffic signals, street light poles etc. Serious injuries may result in such accidents which include fractures, concussions, crushing, severe cuts and laceration, severe general shock and other injuries that require emergency medical treatment. In Australia, a major accident is defined as the one causing "an injury which results in the person being admitted to hospital, and subsequently discharged alive either on the same day or after one or more nights stay in a hospital bed" (Australian Government Department of Infrastructure, Regional Development and Cities, 2007).

2.4.2.2 Minor Accident:

A minor road accident is the least severe of all road accidents and cause only minor bruises or sprains. An injured person is hospitalized for less than 12 hours.

2.4.3 Property Damage Only

As the name suggests, no physical injury is produced in a Property Damage Only Accident. Loss is in terms of monetary terms only such as damage to vehicles or road facilities. Vehicle damage include cracked headlight, dents in the hood, fender or door, broken axles and bent or twisted frames. Car insurances will be helpful to cover for the damage incurred. Road infrastructure damages may affect street lights, electric poles, traffic signals, pavement surface, barriers, road signs etc.

2.5 International Studies

Internationally, a number of researches and studies have been conducted using ArcGIS software to analyze road traffic accidents some of which are as follows:

2.5.1 Turkey

The research project tiled, "Geographical information systems aided traffic accident analysis system case study: City of Afyonkarahisar" **(Saffet Erdogan,Ibrahim, et al. 2008)** aims at the identification of high rate accident locations and safety deficient areas on the highways in Turkey using ArcGIS software. In this study, the textual data available with the authorities was converted into tabular form which was used in geo-referencing using GIS. This tabular data was georeferenced onto the highways. Traffic hotspots were identified using Kernel Density analysis and repeatability analysis. Subsequently, accident conditions at these hot spots were examined with statistical analysis techniques.

2.5.2 United Kingdom:

Spatial patterns of RTAs in London and identification of road accident hotspots is studied in "Kernel density estimation and K-means clustering to profile road accident hotspots" **(Tessa K.Anderson 2008)**. The study was focused on visualizing the spatial patterns of injury related road accidents in London, the largest city of the U.K. and, secondly, to create a hotspot classification of RTAs. Data from 1999 to 2003 was used for K density estimation using GIS.

2.5.3 North Dakota, U.S.A:

In North Dakota state, fatal crash accident hotspots have been identified using GIS analysis techniques in a paper titled, "Geostatistical Approach to Detect Traffic Accident Hot Spots and Clusters in North Dakota" **(L. Stone, et al. 2014)**. Accident hot spots were clustered using ordinary kriging and Single Linkage Method (SAS) and a severity index was developed accordingly. A comparison of road crash fatalities has been performed which placed the state at the bottom, however, the ranking changes radically when fatality rates are based on Vehicle Miles Travelled (VMT).

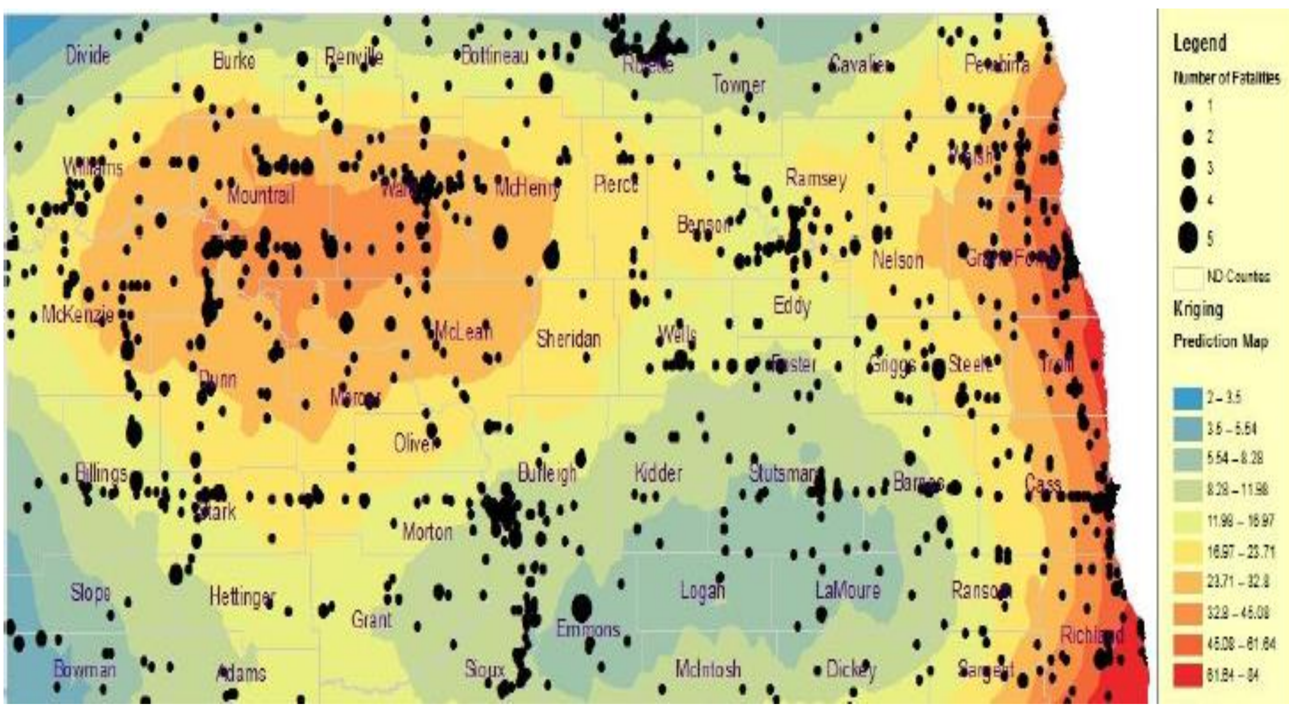


Figure 2.5.3: Hotspot Analysis using Ordinary Kriging for North Dakota State

2.5.4 Belgium:

The identification and clustering of road traffic accidents hotspots using ArcGIS software has been studied in the research paper titled, "Intra-urban location and clustering of road accidents using GIS" **(T. Steenberghen, et al. 2004).** The study has used traffic accident statistics and GIS technology to identify areas prone to RTAs in the urban road network of Belgium. One-dimensional (line) and two-dimensional (area) clustering techniques are used and then compared. Advantages and drawbacks are discussed in relation to network and traffic characteristics. The paper concludes that linear spatial clustering techniques are suited better when traffic flow is not diffused but rather show a well-defined movement pattern appear to be better suited when traffic flows can be clearly identified along certain routes.

2.5.5 India:

India, along with other South Asian nations, faces a burgeoning traffic problem; major cities like Mumbai and New Delhi are the worst affected by traffic woes. Many studies have been conducted in this regard. One such study, named, "Traffic Accident Analysis for Dehradun City Using GIS" **(Dr. S.K Ghosh, at al. 2004)** was launched in Dehradun, the capital of Uttaranchal State due to increasing number of accidents in this region. Accident data was collected from secondary sources like police stations for identification of black spots. In order to perform analysis related to road accident, a spatial database incorporating all the desired information was created. For this purpose, the existing road network was extracted from topographic and guide maps. The updating of road network was carried out with the help of IRS LISS III and IKONOS Satellite.

2.5.6 Saudi Arabia:

In Saudi Arabia a research titled, "A study of road traffic accidents in Saudi Arabia" **(Abdul Bari Bener, et al 1988)** was conducted. It thoroughly examined the RTA situation in Saudi Arabia which has become a major problem in the Kingdom and has compared their findings with other regional developing countries. Data was acquired from the Ministry of Interior which contained information such as Population, number of registered vehicles, number and nature of accidents, times and days of the accidents according to the days of the week, number of causalities and fatalities, causes and nature of accidents, ages of drivers and frequency of accidents. The paper recommended improvements in licensing system which was subsequently implemented by police. By this practice number of accidents were reduced.

2.5.7 Japan:

The paper, "Development of traffic accident analysis system using GIS" **(Masayuki Hirasawa, 2003)** had performed accident analysis in the region of Hokkaido where the road crash fatalities are the greatest than any other region in Japan. The Civil Engineering Research Institute of Hokkaido uses a traffic accident analysis system developed through GIS to monitor traffic. Relation between accident behavior and weather has been developed to understand the road crash problem. The traffic department can now retrieve information an all road sections through this GIS system.

Other studies have analyzed the spatial and temporal behavior of RTAs baes on specific attributes such as fatality rate, injury and property damage **(Gholamali Shafabakhsh, et al. 2017, Aning Isfandyari et al. 2015)** ethnicity and socioeconomic factors (**Jamie Hosking, el. at. 2013)** and others **(Ewen Eberhardt el at. 2013)**.

2.6 Studies Conducted in Pakistan

Many studies and researches have been conducted both on government level and individual researchers to analyze road accidents. The National Transport Research Institute (NTRI) is a public organization working as the Research and Development (R&D) wing of the government. A major bottleneck in conducting research in this ever important field is the lack of official databases.

In an article titled, “Strategies for Prevention of Road Traffic Injuries (RTIs) in Pakistan: Situational Analysis” the current work in injury preventions has been highlighted. It says that a surveillance system, Road Traffic Injuries Research Network (RTIRN), is established in Karachi which has proven effective for injury control. National Highway and Motorway Police Ordinance (2000) was one of the few legislative measure so far taken in Pakistan. The few laws in place are not well enforced **(Adeel Ahmed Khan and Zafar Fatmi, 2014)**

A research titled, “Road safety issues in Pakistan: A case study of Lahore” was carried out to identify the traffic trends in the city in particular. The paper has suggested institutional reforms and stressed upon the need of intensive traffic monitoring and law enforcement, along with conduction of road safety related research work**. (Zahara Batool, et al., 2011)**

Another study was performed by WHO titled, “Road traffic injuries in Rawalpindi city” **(U. Farooq, et al, 2010).** The primary focus was to evaluate RTAs reported in the city over one year (from 1 July 2007 to 30 June 2008) through surveillance techniques. The analysis revealed a total of 19,828 road related injuries. Gender and age wise distribution is shown in the flowing graph:

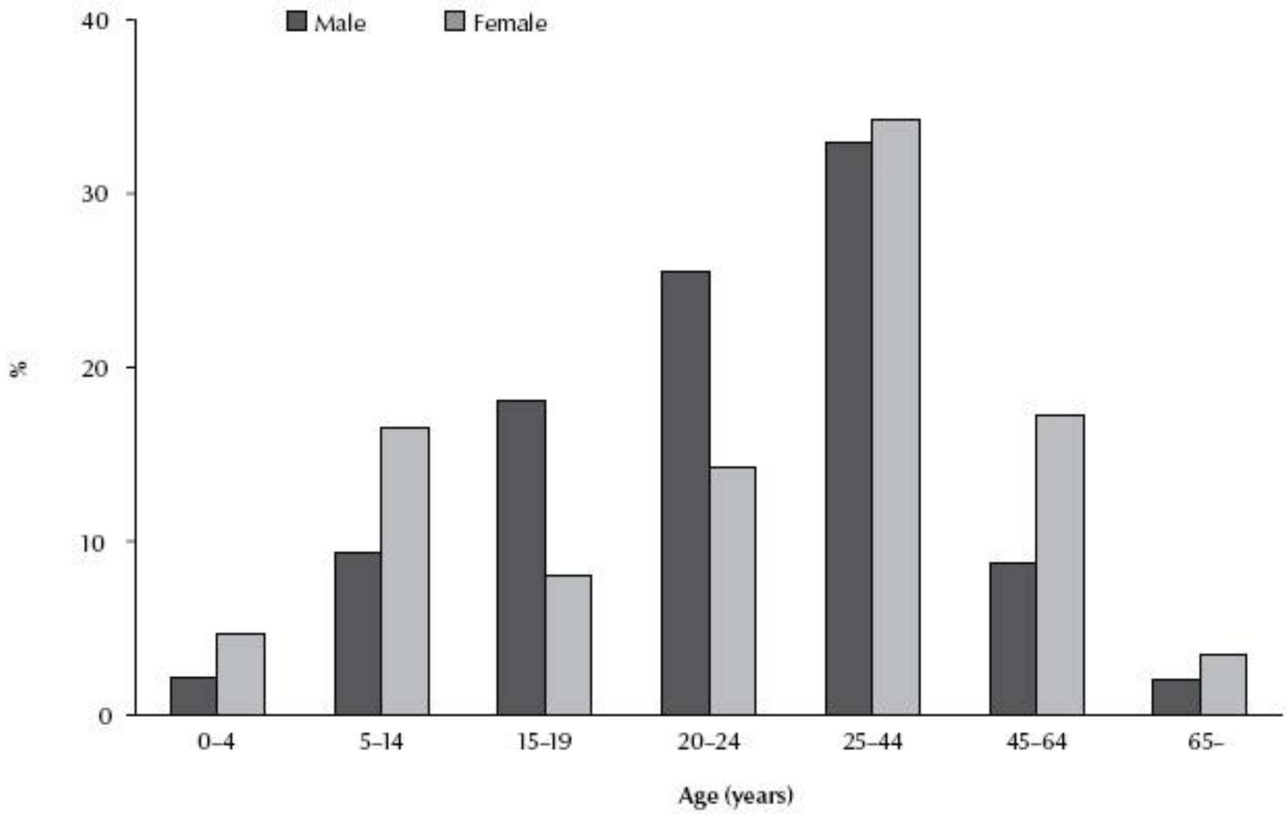


Figure 1 Age and sex patterns of road traffic injuries in Rawalpindi (July 2007–June 2008)

Figure 2.6: Age and gender wise injuries in Rawalpindi

Source: Road traffic injuries in Rawalpindi city, Pakistan (U. Farooq et al)

Chapter 3

Research Methodology

3.1 General

The methods that had been employed throughout the research are described in detail in this chapter. Literature available online and research papers were examined and studied in order to come up with an effective approach suitable for our own research analysis.

3.2 Research Methodology

A step-wise approach was followed for effective implementation of our research objectives. Data aquired was verified and sorted out using MS Excel prior to initiating our analysis. Since our research is software focused, we have made extensive use of ArcGIS software from ploting to thermal mapping to density mapping. Following a well focused methodology which is shown in figure 3.1, our research project was successful in meeting the required outcomes.

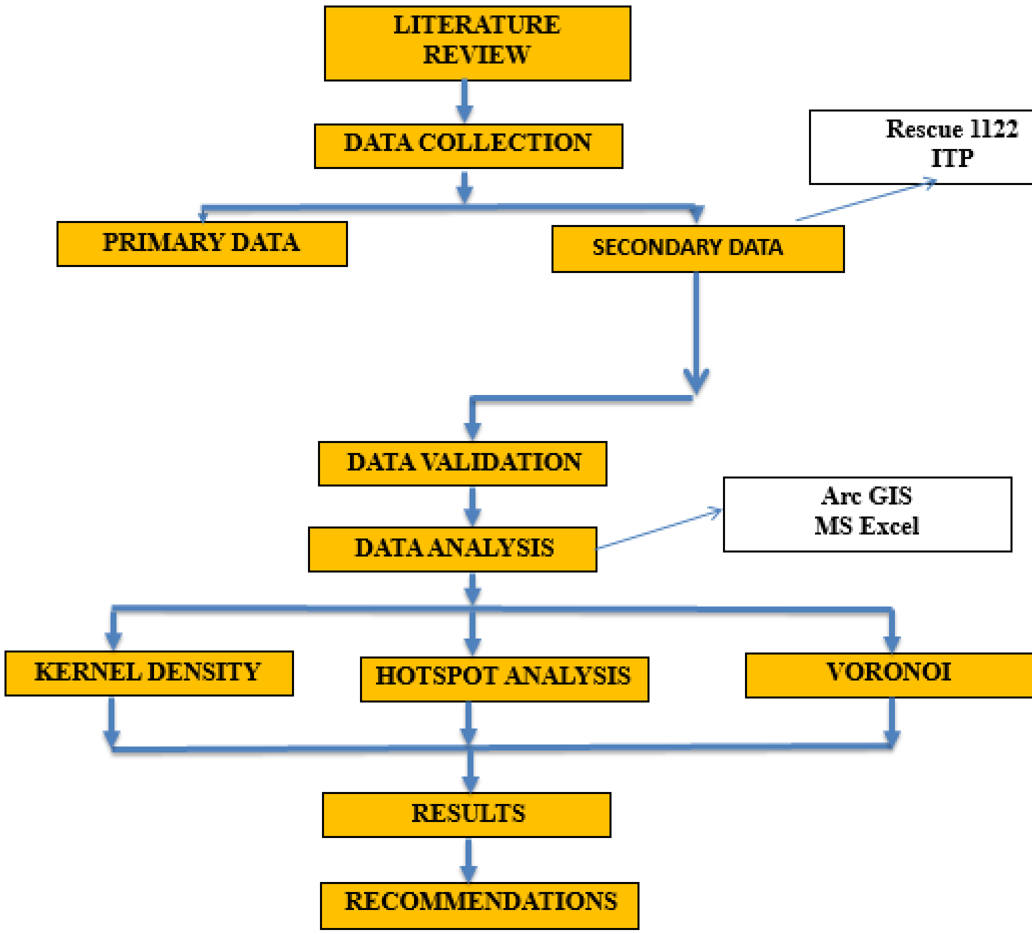


Figure 0.1: Flow Chart Showing Research Methodology

3.3 Road Traffic Accident Data

Traffic record is vital for proper road traffic managemnt and ensures smooth traffic operations. Most traffic departments keep updated records amd data of RTAs comprising relevent infromation. Unfortunately, in Pakistan we do not possess an extensive database of our traffic and driver popultion. Departments responsible for maintaing these records: provincial traffic departments, police, heath departments, lack crucial information regarding RTAs.

According to PBS data available online for the year 2002–2016, there have been around 61,000 road-related deaths recorded in Pakistan. This and other infromation has been compiled in table 3.1 given below:

Year	Accidents	Fatal	Non- Fatal	Killed	Injured
2002	9920	4413	5507	6623	10150
2003	9377	4045	5332	4813	10643
2004	10308	4184	6124	5199	12927
2005	9896	4250	5646	5112	12401
2006	9492	4115	5377	4868	11415
2007	10466	4535	5931	5465	12875
2008	10476	4610	5856	5615	12096
2009	9496	4145	5351	4907	11037
2010	9747	4378	5369	5280	11173
2011	9723	4280	5443	5271	11383
2012	9140	3966	5174	4758	10145
2013	8988	3884	5104	4719	9710
2014	8359	3500	4859	4348	9777
2015	7865	3214	4651	3954	9661
2016	9100	3591	5509	4448	11544
(2002-2016)	**142,353**	**61,110**	**81,233**	**75,380**	**166,937**

Table 0.1: Reported Data of RTAs in Pakistan

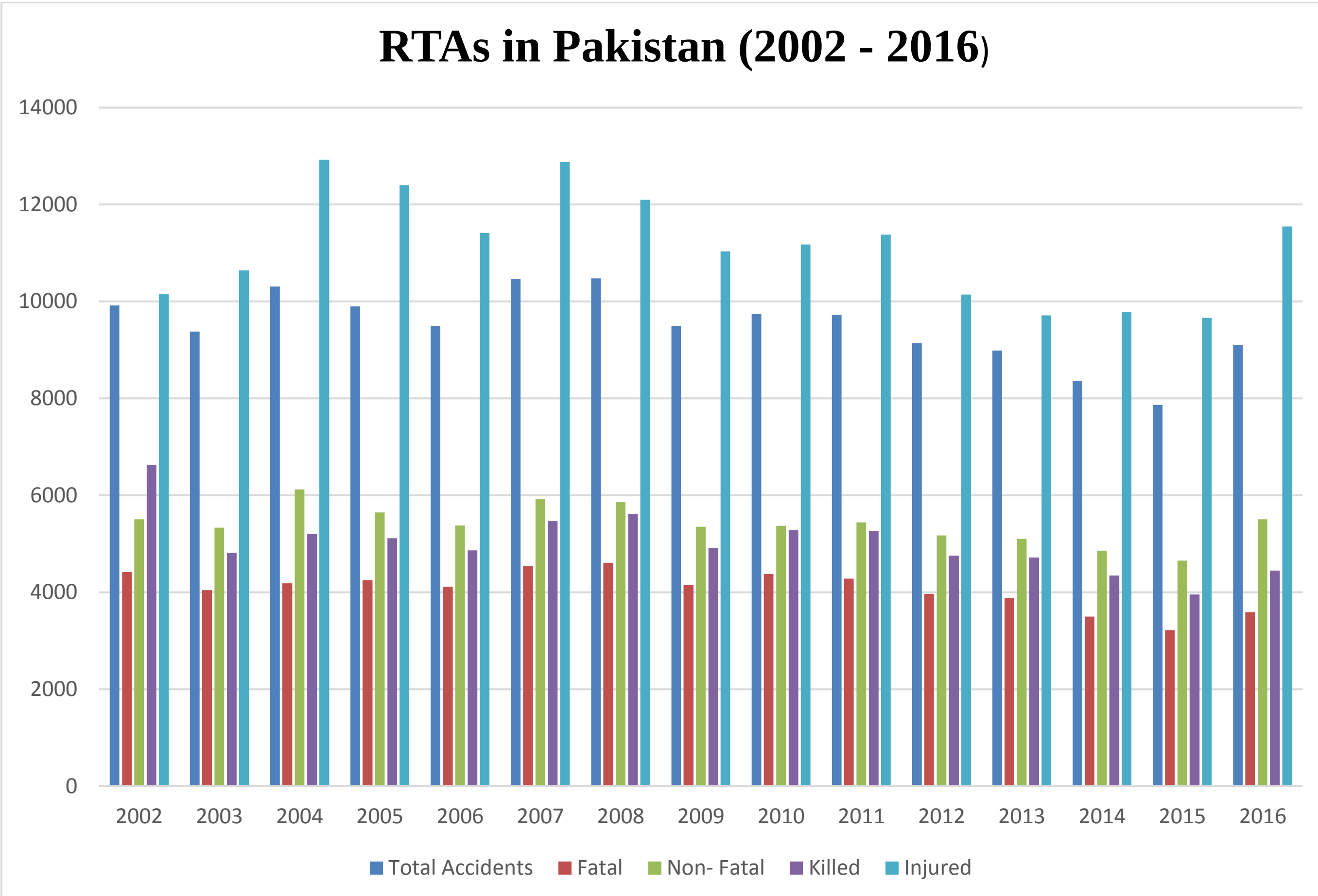


Figure 3.2: Bar Chart of RTAs

The data reveals random trend in RTAs i.e, they are higher for some years and lower for other years. It is interesting to note that accidents have not increased in proportional with increase in vehicles on our roads. This may be due to the fact that most accidents go unrecorded specially in remote and backward areas where there are no proper road and other public infrastructure available. Departmental insufficencies, negligence of traffic staff amd lack of resources may be the other factors that cause data descrepencies.

3.3.1 Data Acquisition

Data collection proved to be a time consuming task since most of our requests for data acqausitions were unanswered or ignored. Most departments complained about the non availability of detailed traffic related data.

Rescue 1122 is an emergency service run by the provintial governments of Punjab and Khyber Pakhtunkhwa provinces. The service responds to hazards such as road accidents, fire, floods, earthquakes etc and provide ambulences to patients in the cities where they operate. Our group managed to acquire RTA data from Rescue 1122 office located on Rawal Road, Rawalpindi through personal contacts. This data contained all the accidents recorded in the year 2017 and included following details of each accident:

1. Date and place of accident
2. Vehicle involved
3. Injury types
4. Victim's attributes such as age, gender

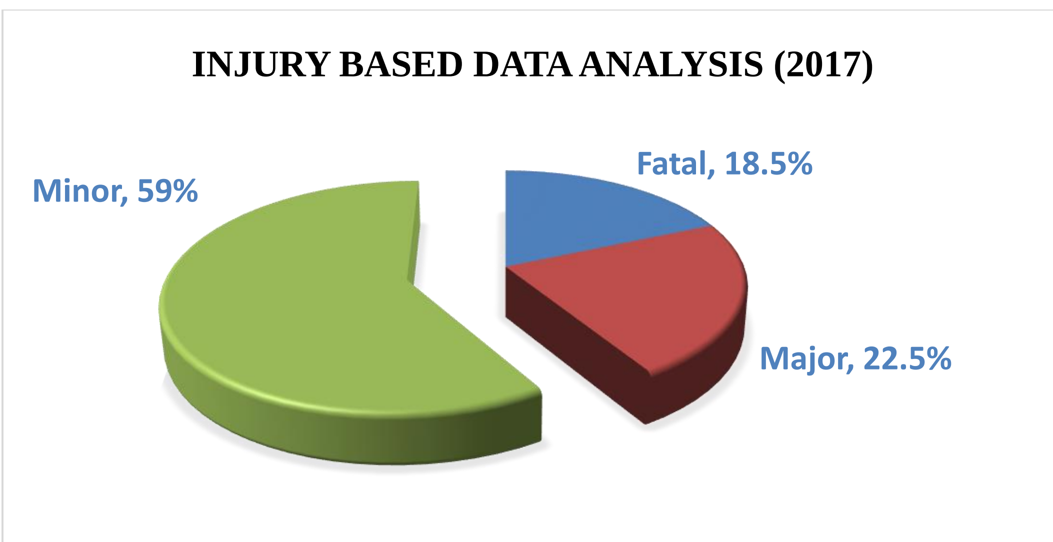


Figure 3.3.1.1: Accident proportion based on fatal, major and minor accidents

Figure 3.3.1.2 shows bikers/motorcyclist to be the worst affected by road crashes in Rawalpindi which is in line with the worldwide trend. They are mostly hit by passenger cars during dangerous maneauvers while changing lanes. Unfortunately, there are no dedicated bike lanes on any road in Rawalpindi which is a major reason for increasing crashes

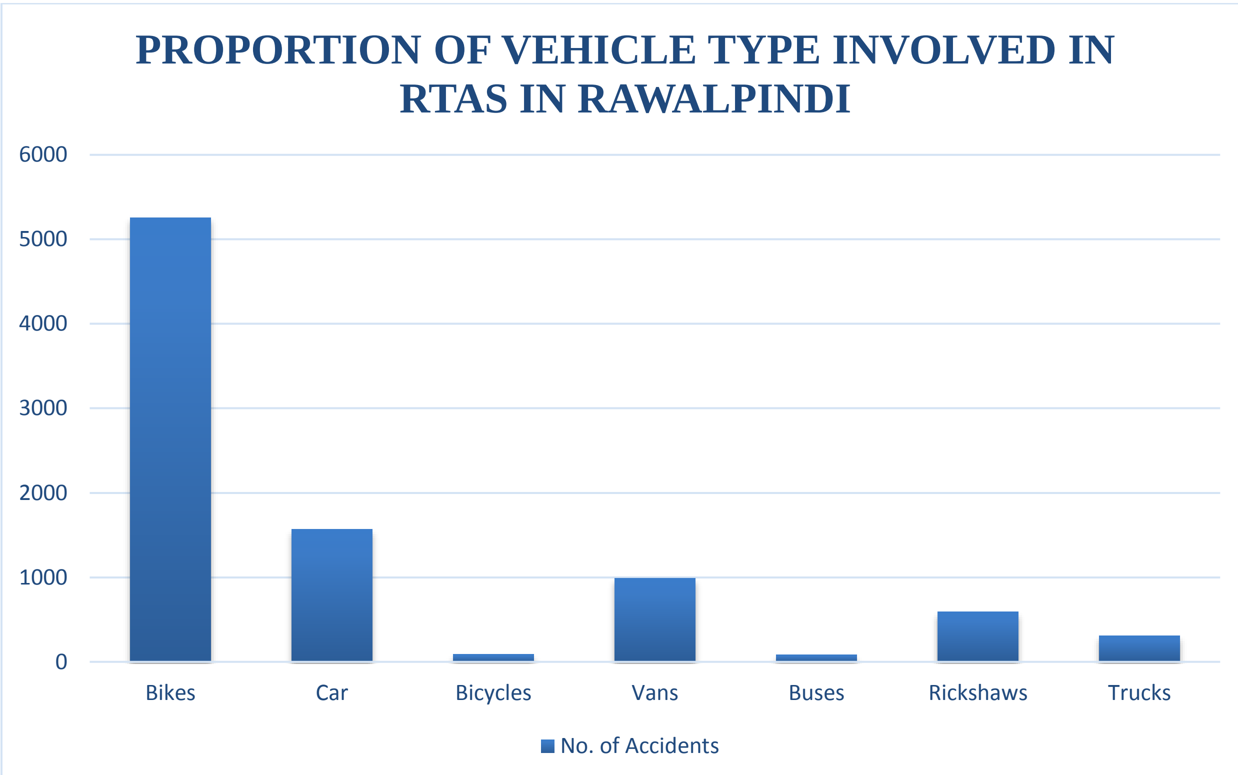


Figure 3.3.1.2: Number of Vehicles Involved (Rescue 1122, 2017)

3.3.2 Age wise distribution of Victims:

Victims age is recorded in Rescue 1122 data. It assisted us to determine the most vulnerable age group and whether under age driving is prevalent on the roads of Rawalpindi. 1688 approximately 18 percent of the victims were either 18 or below. This infers that the proportion of minors is alarmingly high. Age wise distribution has been shown in Figure 3.3.2

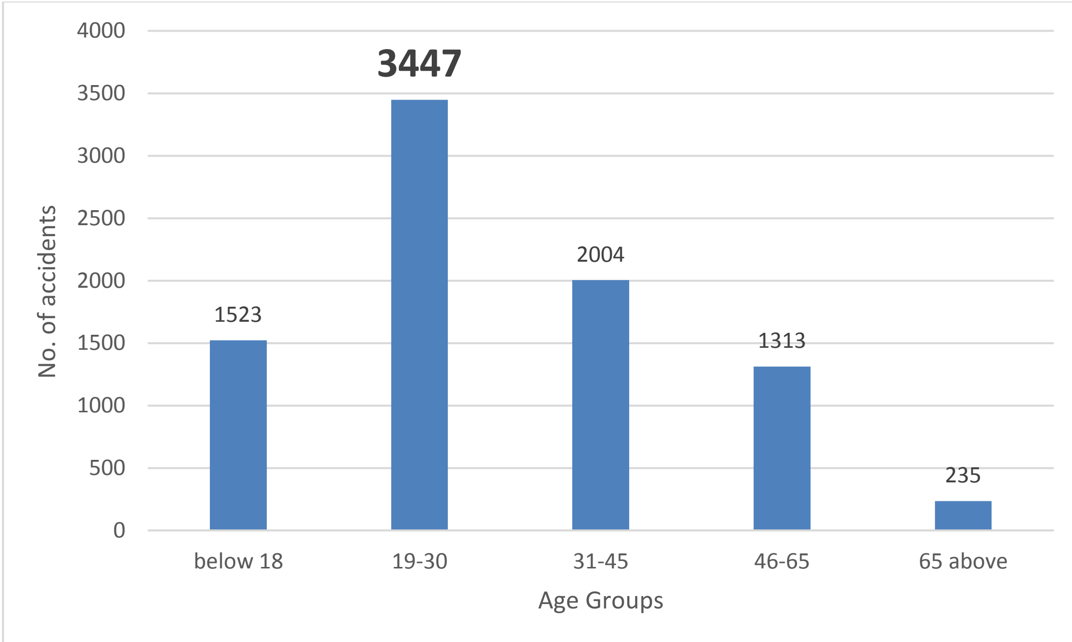


Figure 3.3.2: Age wise accident distribution (2017)

3.3.3 Data Validation:

Data provided by Rescue1122 had duplicate entries and spelling mistakes. Some of the accidents were recorded even thrice. MS Excel identified many duplicated data points. A total number of 1565 duplicate accident records were found and removed out of a total of 9,648 data entries. Hence, it was found that the total number of accidents were around 8083. Similarly, other issues were sorted out to make our information as accurate and reliable as possible using methods such as Moran's I. Once data validation was complete coordinates of accident locations were extracted from Google Map. This was done so that these locations can be plotted on Rawalpindi base map.

3.3.4 Data Analysis:

Data analysis is the next phase post verification and validation. Here, various analysis techniques were utilized using ArcGIS software to understand the pattern and behavior of RTAs in Rawalpindi District and identify the root causes in locations prone to frequent accidents. These techniques are described in detail.

3.3.5 Results and Recommendations:

Based on data analysis, conclusion and proposed recommendations for accident reduction have been discussed in detail in Chapter 5 titled," Conclusion and Recommendations".

Chapter 4

Data Analysis and Results

4.1 General

The main purpose of accident hotspot analysis is to acquire the information needed to assist in adopting suitable preventable measures accident frequency. On the other hand, GIS is valuable tool to predict future accident behavior on roads and therefore, it prove beneficial in taking necessary steps before hand. Spatial configuration of traffic accidents and results obtained are compatible with real situation on ground. The technical details of the datasets and methodology used in the analysis are detailed in the ongoing sections:

4.2 Data Collection:

Road collision data set used for the present study was obtained from the Rescue 1122 department Rawalpindi. The datasets represent accident locations for the year 2017, which are 8628 in number. The longitude and latitude of these locations were found out using google maps and are represented as geocoded x and y coordinates. These accident locations were attributed with detailed information such as place, time, vehicle type, reason, fatality etc.

4.3 Analysis Techniques:

Geo spatial mapping is important to understanding RTAs features based on specific properties. ArcGIS is a valuable tool for that reason since it has built-in functions for displaying accident data and also for modelling the temporal changes. Accordingly, knowing the behavior of road crashes and their likelihood for different zones prove crucial in finding out ways for accidents reductions. All spatial processing was completed utilizing ArcGIS 10.3.1. A Global Moran's I spatial autocorrelation test was completed for each kind of accident occurrence. Furthermore, a hot-spot analysis and Kernel density estimation were likewise done according to Getis-Ord Gi* statistics and Kernel density function **(Darcin Akin 2011).** Both of these were done utilizing ArcGIS's Spatial Statistics program (arcgis.com).Figure 4.1 shows the top view of accident locations georeferenced on Rawalpindi base guide.

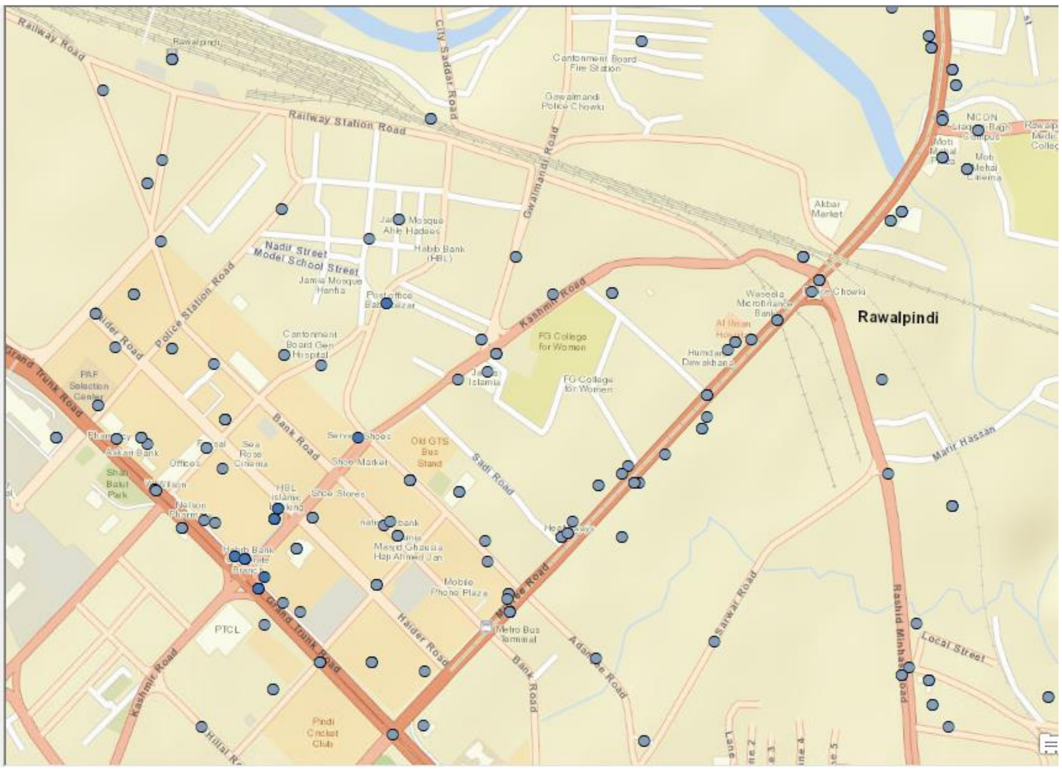


Figure 4.1: Road crashes as plotted on map

4.3.1 Spatial Autocorrelation: Moran's I method

Prior to performing hotspot analysis, the presence of clustering in the data set is required to be checked with techniques such as spatial autocorrelation; it will detect any clustering in the whole dataset. There are two methods for the purpose which are Moran's I (Global) and Getis-Ord General G (Global). Hotspot analysis requires clustering of data. These two strategies will return values, including a z-score which shows clustering, if there is any. Data is needed to be aggregated before conducting the spatial autocorrelation analysis.

The Spatial autocorrelation (Moran's I method) checks whether the data is clustered , random, or dispersed by comparing value of a given variable with that of all variables located at other locations and can be represented as:

$$I = \frac{N \sum_i \sum_j W_{i,j} (X_i - \bar{X})(X_j - \bar{X})}{(\sum_i \sum_j W_{i,j}) \sum_i (X_i - \bar{X})(X_j - \bar{X})^2} \qquad (1)$$

In the equation above, N is the number of cases, Xi is the variable value at a specific location, Xj is the variable value at another location, X is the mean of the variable, and Wij is a weight applied to the comparison between location i and location j. Wij is a weight matrix **(V. Prasannakumar et al. 2011).**

The Spatial Autocorrelation (Global Moran's I) tool shows result in five values: the Moran's Index, Expected Index, Variance, z-score, and p-value. The spatial pattern analysis tool in the ArcGIS calculates the Moran's I Index value and a Z score, which indicate statistical significance. In general, a Moran's Index value near +1.0 indicates clustering whereas a value near -1.0 indicates dispersion. In case of Spatial Autocorrelation tool, the null hypothesis developed states that the road accident data is randomly distributed in the study area and that it does not form any dense locations where probability of accidents is higher. The null hypothesis stands rejected as when the Z score is either large or small enough and falls outside the desired limit. When the any value of higher or lower than the desired significance means that the null hypothesis is rejected and Moran's I is analyzed to check for clustering. Moran's I index greater than 0 shows clustering of given set of features whereas non clustering/ dispersion occurs when the value is less than 0.

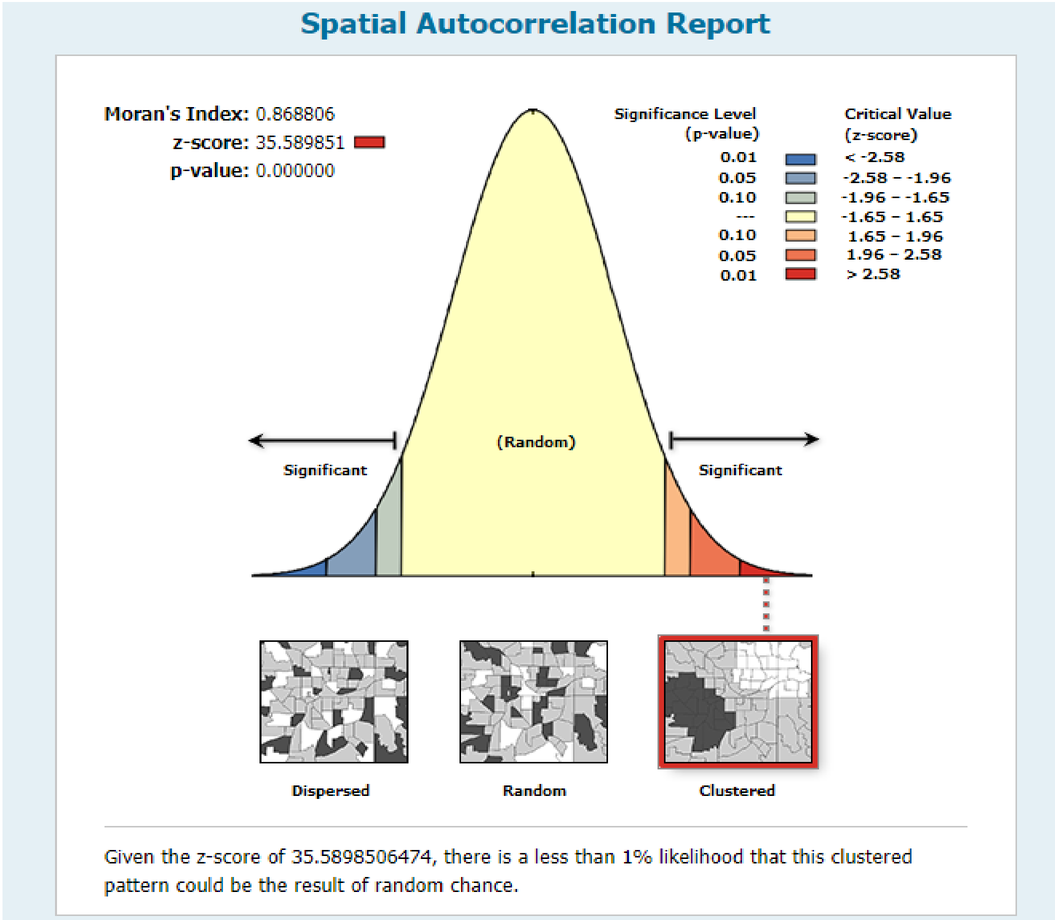


Figure 4.2: Spatial autocorrelation showing clustering of Rescue 1122 data

Figure 4.2 shows the result of spatial autocorrelation indicating the clustering tendency of RTAs data. Here, p- value is zero meaning that there is no randomness in the data set. Therefore, the null hypothesis which states that data is random and not clustered is rejected because Z-score has a higher value i.e. 35. Higher positive Z-score indicates greater probability of hotspots. A greater proportion of road crash data lies in the hotspot region showing the level of severity of accidents in the city.

4.3.2 Hot Spot Analysis

Hotspot is defined as an area where the probability of road crashes is higher than average and users are highly at risk of being a victims of accidents. Simply put, it is an area where the occurrence of accidents is higher is called a hotspot. Other name that is also frequently used is blackspot.

Hotspot technique amasses data points into polygons according to the proximity of these points to each other with respect to calculated distance. Based on their statistical significance, higher and lower clustering is initiated and a pattern of hot spots and cold spots is developed. High or low values of spatial data are grouped. A high value indicates a hotspot whereas low value shows that the feature is a cold spot. Polygons on map are actually the boundaries of administration.

ArcGIS uses Getis-Ord Gi* statistic to calculate hot and cold spots in a clustered data. Analysis Field, in this case, is the number of accidents. The probability of spatial clustering within analysis field is checked thereon. For RTAs, the locations where there is high incidence of road crashes are of interest. In addition, certain locations within the study having higher proportion of accident than other locations can also assist in the analysis process. Given an input feature class, this tool produces an output feature class with a p-value and z-score for that feature (Esri ArcGIS)

Hotspot analysis involves three processes which are as follows:

1. Collection of events
2. Mapping based on clustering
3. Kernel density estimation

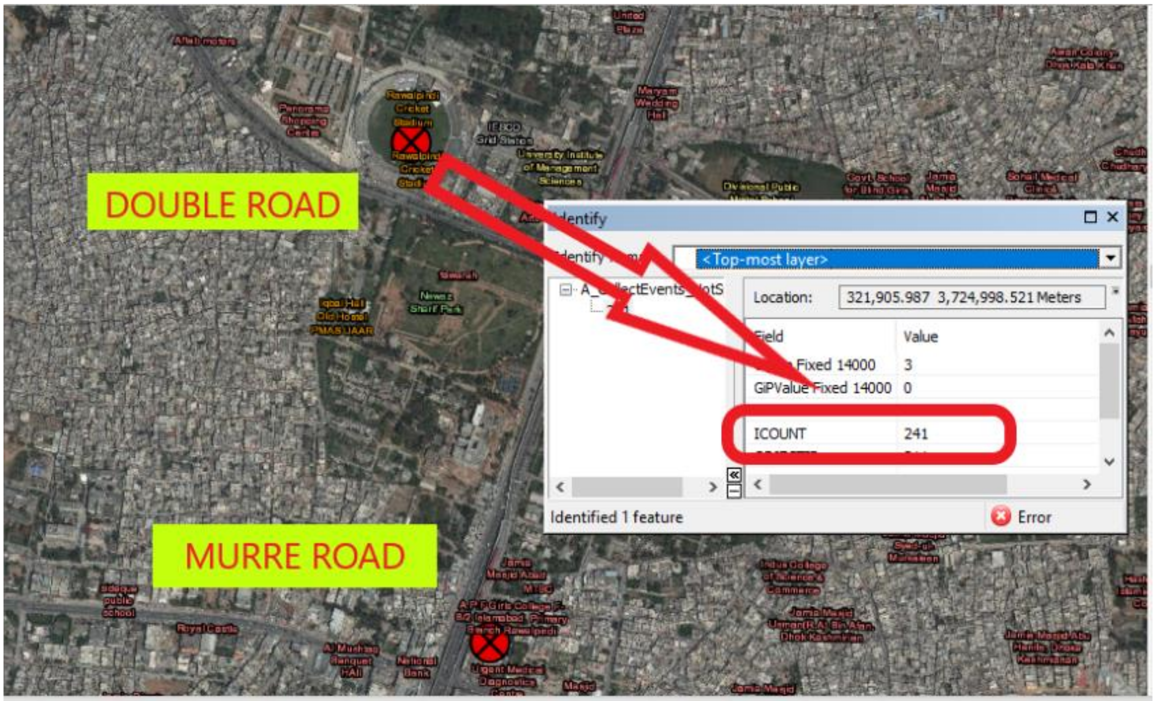


Figure 4.3: A traffic hotspot on Double Road near Rawalpindi stadium stating the recorded number of accidents at the specific location

4.3.2.1 Getis-Ord Gi:

Hotspot Analysis is also known as **Getis-Ord Gi*** (G-I-star). The tool scans each feature in the dataset in relation to neighboring features of that dataset. It is possible that a feature is not a significant hot spot although it has a high value. Hence, a high value shall be bounded by other high value features in order to be a significant hotspot.

A **z-score** and a **p-value** are returned for each feature in the dataset. The feature is a significant hotspots if both of these values are high. Similarly, the feature is a significant cold spot if z- score is negative and p-value is small. A higher or lower value of z-score indicate that clustering will be dense. A zero z-score or a near 0 z-score shows that there is no spatial clustering. Moreover, the surrounding features also should give high values.

The Getis-Ord local statistic is given as:

$$G_i^* = \frac{\sum_{j=1}^{n} w_{i,j} x_j - \bar{X} \sum_{j=1}^{n} w_{i,j}}{S \sqrt{\frac{\left[n \sum_{j=1}^{n} w_{i,j}^2 - \left(\sum_{j=1}^{n} w_{i,j} \right)^2 \right]}{n-1}}} \qquad (1)$$

where x_j is the attribute value for feature j, $w_{i,j}$ is the spatial weight between feature i and j, n is equal to the total number of features and:

$$\bar{X} = \frac{\sum_{j=1}^{n} x_j}{n} \qquad (2)$$

$$S = \sqrt{\frac{\sum_{j=1}^{n} x_j^2}{n} - \left(\bar{X}\right)^2} \qquad (3)$$

The G_i^* statistic is a z-score so no further calculations are required.

Figure 4.4: Getis-Ord Gi* calculations for hotspot analysis

The output of the analysis tells you where features of either high or low values cluster spatially. Figure 4.4 shows the statistical calculation involved. Hot spot analysis can be utilized to help traffic police identify areas with high accident rates, the types of accidents, and the best way to respond to these accidents.

Spatial statistic tool has a collect-event function that performs clustering operation. This function convert the accident data into a weighted point data. Data entries that are in close proximity are clustered into one whole. It gives a value known as ICount. An ICount is the number of accident locations that are clustered to give a single hotspot location in a particular zone. For

Example, in Figure 4.3 the number of accidents that have actually happened at the specific location (Rawalpindi Cricket Stadium, Double Road) is 241; it is the total number of accidents that have been combined to give a single hotspot. The closer the accident location are to each other the more concentrated accidents are at those locations thereby defining the magnitude of hotspots. This weighted point feature was used as the input for running the hotspot function (Getis-Ord GI*) to identify whether features with high values or features with low values tend to cluster in the study area. This tool works by looking at each feature within the context of neighboring features. If a feature's value is high, and the values for all of its neighboring features is also high, it is a part of a hot spot. Sum for a feature and its neighbors is compared proportionally to the sum of all features; when the local sum is much different than the expected local sum, and that difference is too large to be the result of random chance, a statistically significant Z score is the result. The statistical equation for calculating Gi* is shown below:

$$Gi^*(d) = \frac{\sum j \; W_{ij}(d)\, x_j - W^*_i \overline{x}^*}{s^* \left\{\left[\left(nS^*1i\right) - W_i^{*2}\right]/(n-1)\right\}^{1/2}} \qquad (2)$$

where 'Wij (d)' is a spatial weight vector with values for all cells 'j' within distance d of target cell i, W* i is the sum of weights, S* 1i is the sum of values. For squared weights and s* is the standard deviation of the data in the cells. The Gi* statistics gives a Z score. Higher z-score value in Gi* statistics indicate dense clustering of high values i.e. hot spots while low z-score shows clustering of low values i.e. cold spots.

4.4: Kernel Density Analysis:

Kernel density hotspots with the populated field as GiZScore were performed with the point density calculator function available with the spatial analyst tool. It calculates the magnitude per unit area from each hot spot features using the populated GiZScore field. For the entire Rawalpindi District, zones of 500 sq. m were selected and density of road accidents calculated thereafter. The output of the Kernel density function is a raster file displaying the areas of high and low clusters of accident occurrence across the entire district (Figure 4.5). The outcomes revealed following vulnerable locations/roads that had the highest accident rates:

1. Saddar
2. Peshawar Road
3. Double Road
4. Murree Road
5. Mall Road
6. Committee Chowk
7. Sixth Road
8. Adiala Road
9. Ayub Park
10. Airport Road

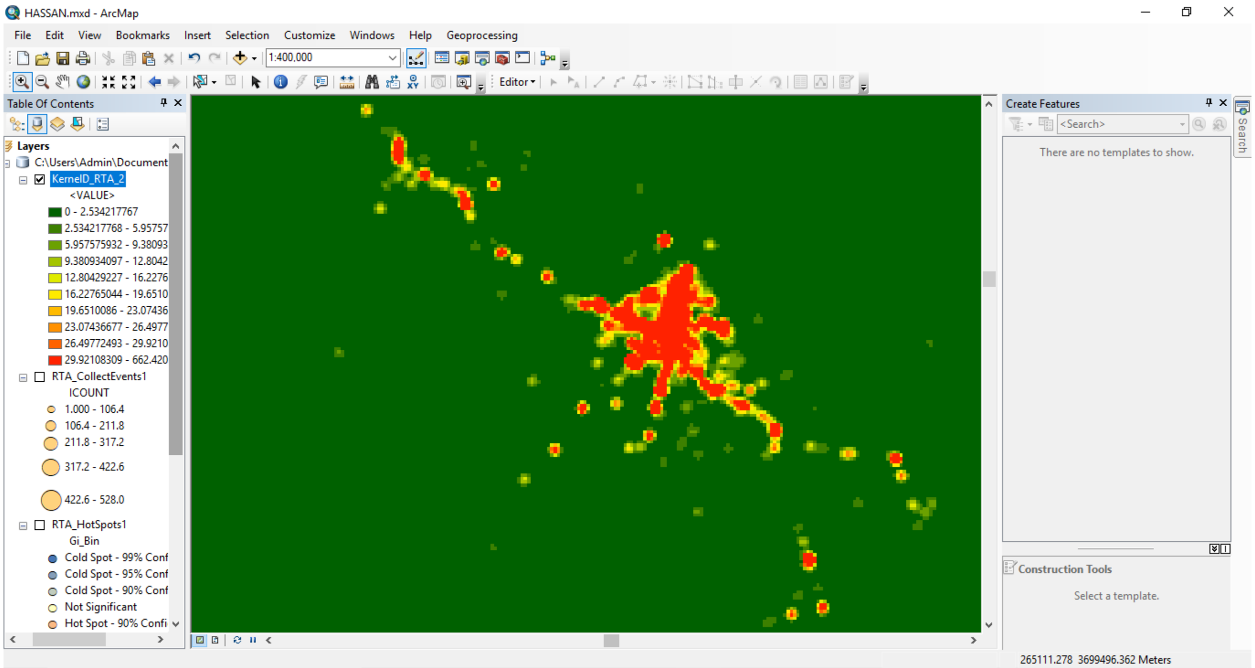


Figure 4.5: Accidents magnitude per square Kilometer in Rawalpindi

Next, similar procedure was adopted to identify accident hotspots based on maximum number of fatalities. Wah Cantt. on GT Road proved to be the most fatal for motorists and other road users where in 2017, approximately 80 deaths were attributed to RTAs (Figure 4.6).

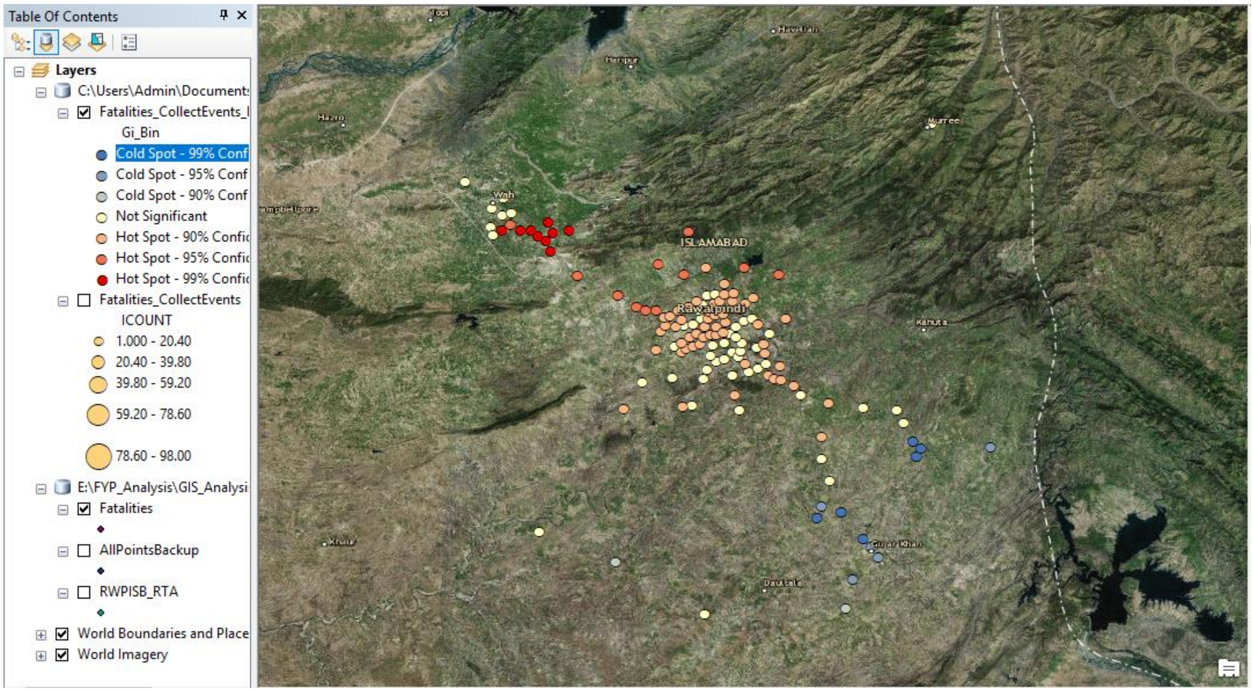


Figure 4.6: Hot spots and Cold spots locations in Rawalpindi

4.5 Mapping:

Geospatial analysis on the basis of age group shows that victims of RTAs were between the ages of 19 to 30. Figure 4.7 illustrates the locations where the majority of these victims met road accidents.

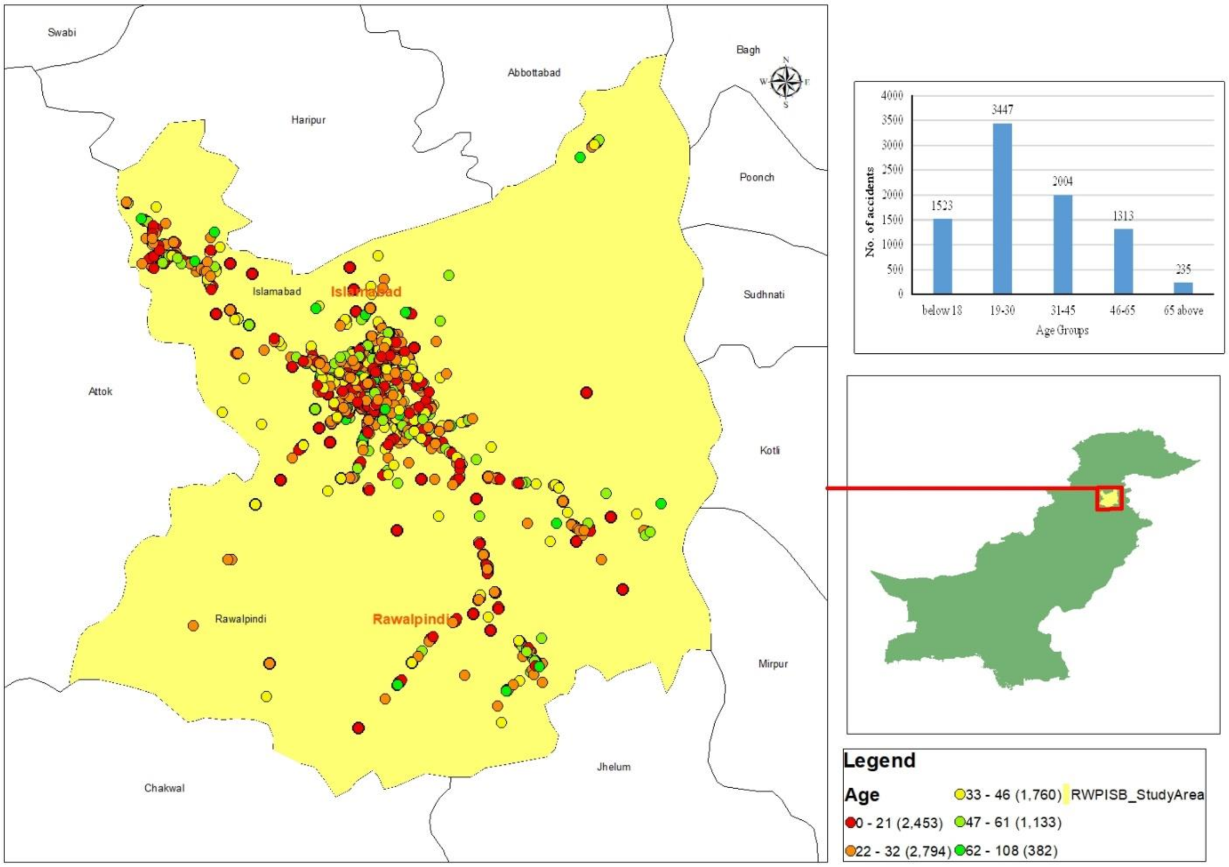


Figure 4.7: Age wise accidents plot (2017)

Furthermore, another attribute i.e. injury type was mapped as well which is shown in figure 4.8. Severity of accidents is higher for most regions in the district particularly in the northern part while south has larger frequency of less severe accidents.

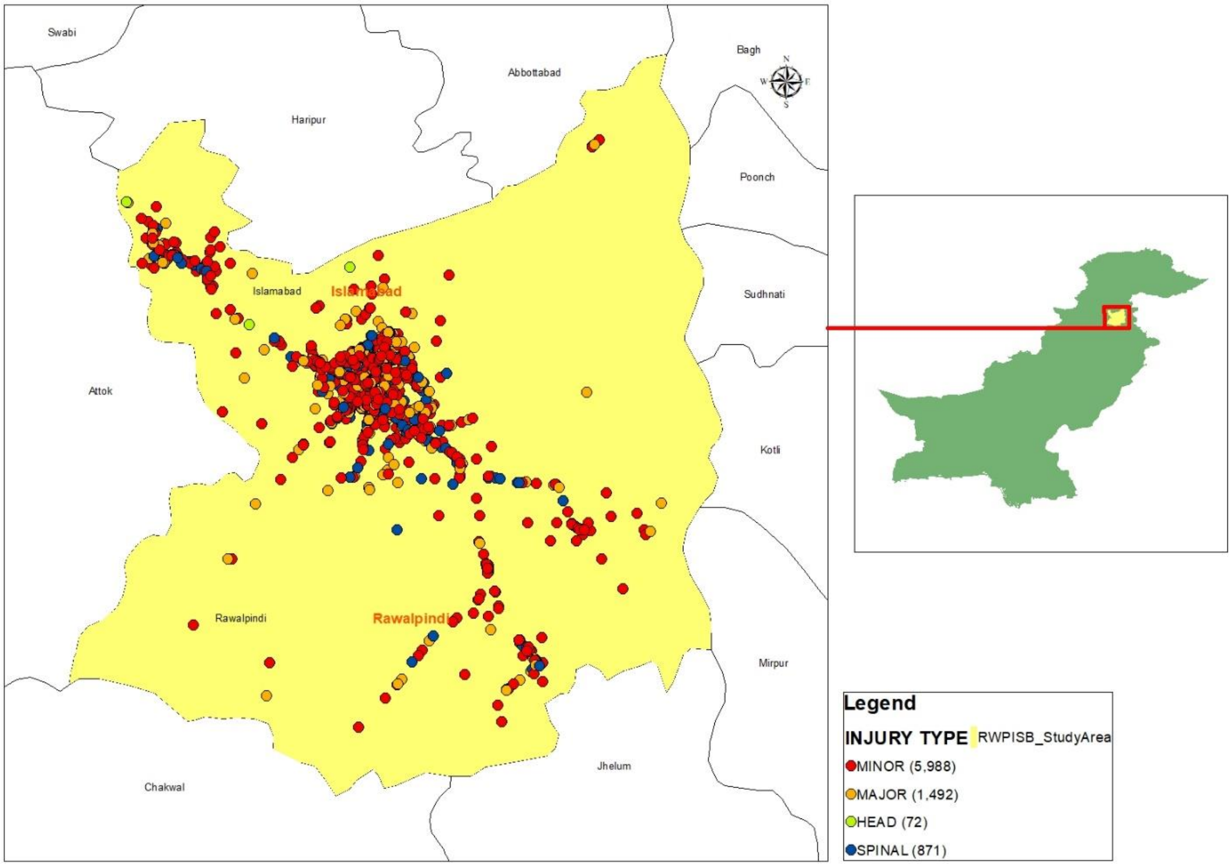


Figure 4.8: Injury type accident plot

4.6 Voronoi Diagram:

A Voronoi diagram is a graphical method to divide a selected plane into polygons of various sizes and areas based on the nearest distance to certain sets of points. In Figure 4.9, an area has been divided into various polygons of different sizes (Figure 4.9).

ArcGIS' Voronoi mapping tool is accessed for mapping road accident clusters along roads using Microsoft excel spreadsheet. The points represent proximity of various hotspots.

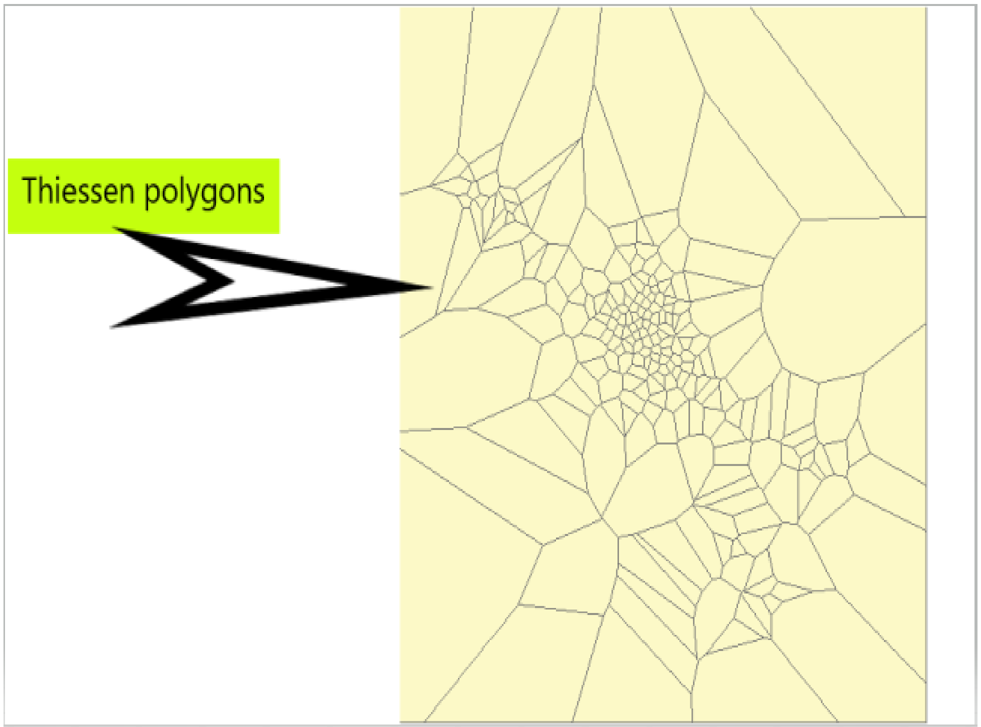


Figure 4.9: Voronoi map showing division of an area into varyingly sized polygons.

In our case we needed to identify the ideal locations with close proximity to accident hotspots; areas near an accident hotspot that can be immediately accessed from all direction within that polygon. This means that for a certain polygon, every location will be closer to that hotspot enclosed within the polygon. Vornoi tool in ArcGIS was used to develop Voronoi map so that provision of emergency services is ensured close to road accident locations. Mean values were calculated from polygons/cells and their neighbours and the mean value were assigned to each polygon. Figure 4.10 shows such mapping for Rawalpindi. They show how far an emergency service can be situated from a hotspot so timely rescue services can be provided. The results of this analysis is thus helpful in reducing injuries and fatalities (**Ladi, S et al. 2019).**

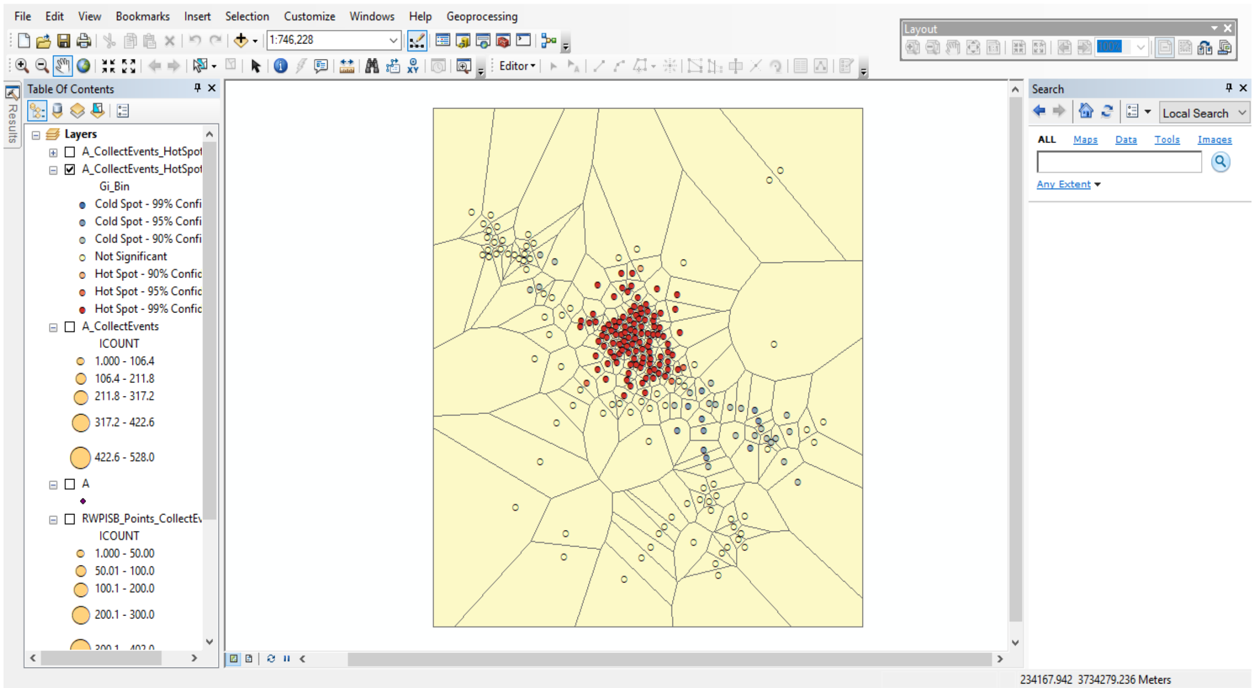


Figure: 4.10 Voronoi mapping based on accident hotspots

Chapter 5

Conclusion and Recommendations

5.1 General

After detailed analysis of data, we were able to draw conclusions and suggest recommendations to mitigate the current traffic scenario. This research project shed light on the grim state of RTAs in Rawalpindi since almost not a single road was accident free or had less severe accidents. Data of all major roads showed substantial damages both in terms of human lives and property.

Saddar and Murree roads, which are amongst the busiest in Rawalpindi, have proved to be dangerous for drivers and pedestrians alike.

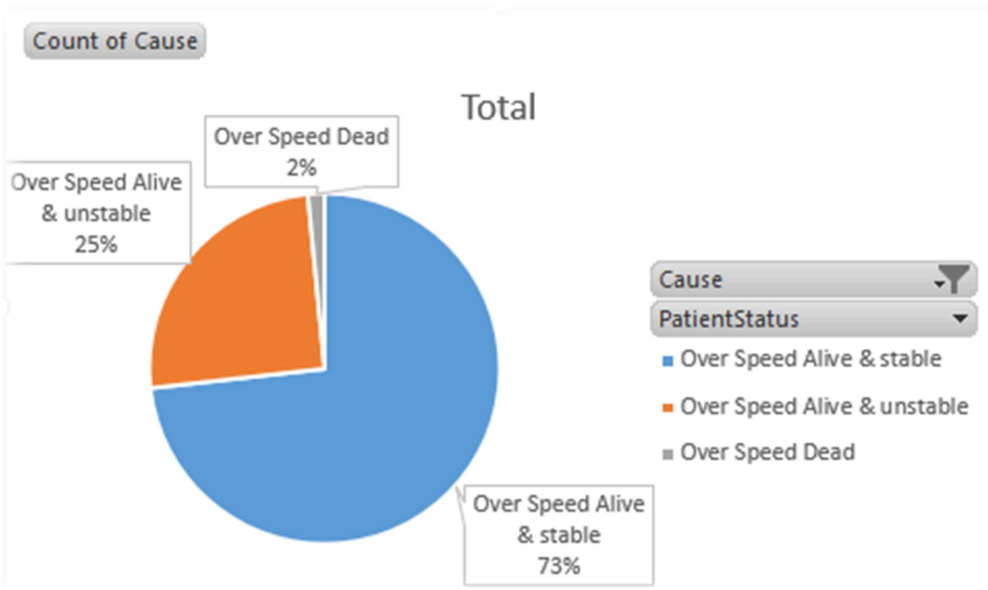
5.2 Conclusions

Many of accident hotspots had more or less the same causes; insufficient road width was a problem at places with lower highway classification such as a minor road. Nevertheless, major arterials traversing the city, having six lanes or more, were nowhere near the zero accident rate mark. Upon a closer look at the root causes of innumerable road crashes on these roads, one might not struggle to realize that poor implementation of traffic rules is where the problem lies. This is the reason why so many road accidents claim lives of so many people even at places where road characteristics such as geometry are better. Apart from road geometry, there are several other factors such as the behavior of the road user that contributes to the occurrence of road collisions. Some of these causes along with the accident statistics are shown in the following tables and charts:

5.2.1 Over Speed

Row Labels	Count of Cause
⊟ Over Speed	5649
Alive & stable	4137
Alive & unstable	1426
Dead	86
Grand Total	5649

(a)



(b)

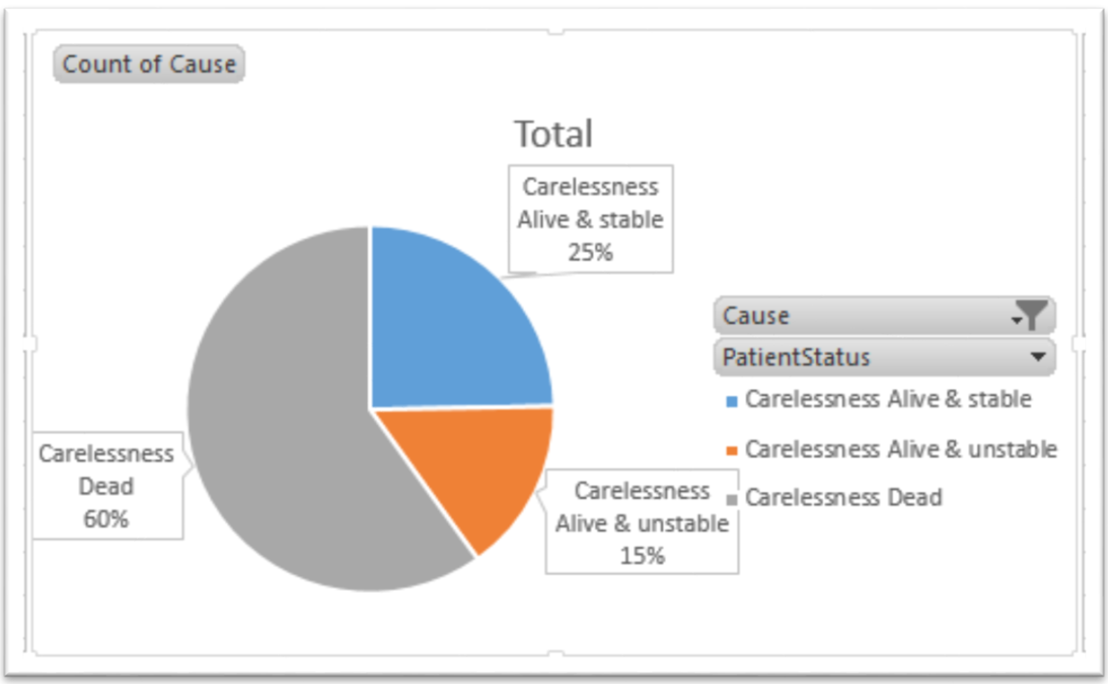
Table 5.1 (a, b): Victim status for accidents caused by over speeding

A large number of accidents occurred due to over-speeding. It was the most prevalent cause on main roads where roads are wider such as Peshawar Road.

5.2.2 Carelessness

Row Labels	Count of Cause
Carelessness	2465
Alive & stable	609
Alive & unstable	379
Dead	1477
Grand Total	2465

(a)



(b)

Table 5.2 (a, b): Victim status for accidents caused by carelessness

Carelessness and inattention on the part of drivers and other road users is also a leading cause of road crashes. In fact, carelessness has caused more deaths (1477 deaths) than any other factor. It includes unsafe driving actions that put the lives of others and the driver itself in dangers path: reckless/aggressive driving, speeding, excessive honking, falling asleep while driving, running a red light and, talking on phone. Although both careless and reckless driving implies dangerous driving, yet, reckless driving is more severe of the two. In legal terms, careless driving is a less severe behavior of a driver whereas reckless driving involves a complete disregard for the lives of other road users and also the traffic rules. All these illegal actions can be controlled by strictly enforcing traffic rules. Carelessness is a punishable crime in some countries of the world. Many states in the US charge high penalties, driving licenses suspension, and a jail term that can go up to one year.

5.2.3 U Turn

Row Labels	Count of Cause
U Turn	**172**
Alive & stable	126
Alive & unstable	43
Dead	3
Grand Total	**172**

(a)

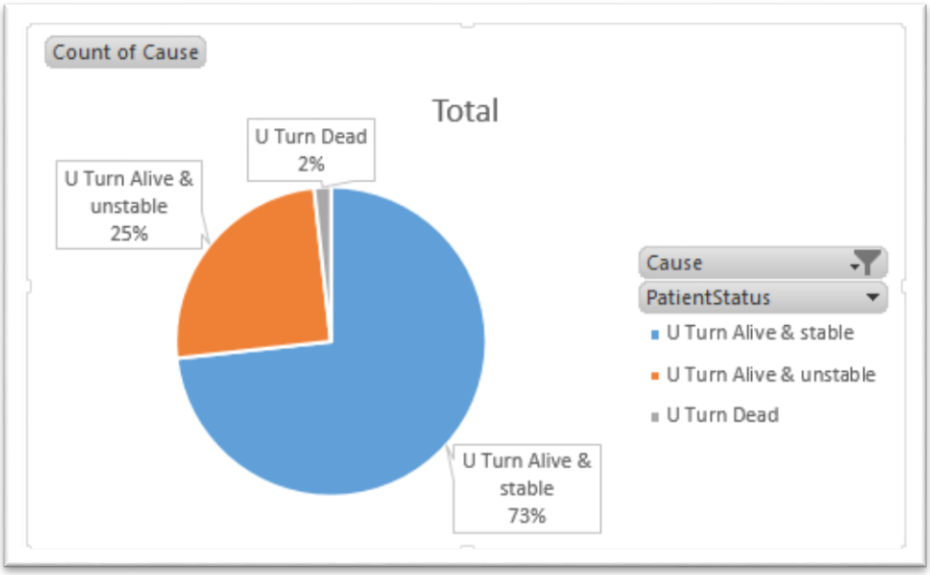
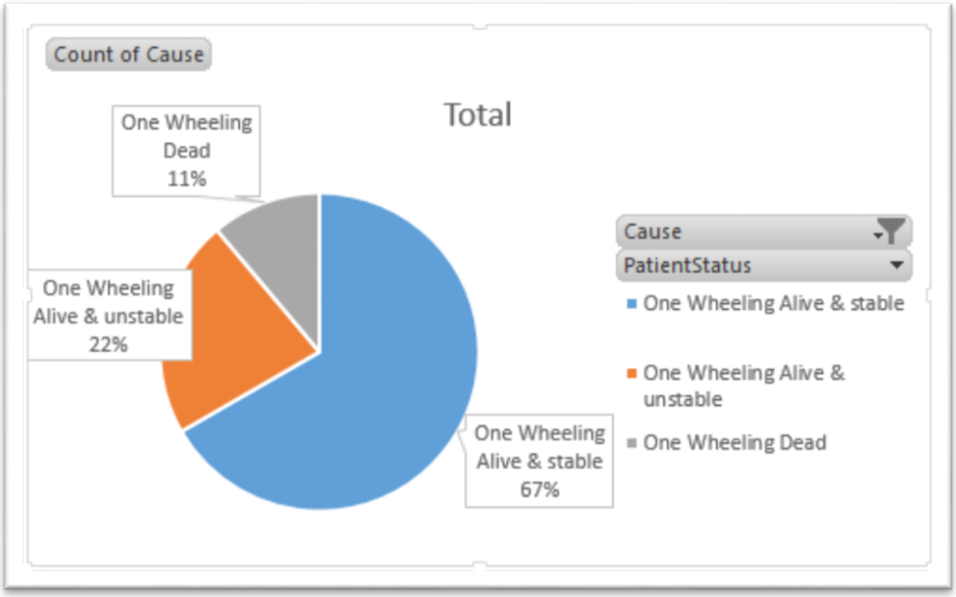


Table 5.3 (a, b) Victim status for accidents caused by U Turns

5.2.4 One Wheeling

Row Labels	Count of Cause
One Wheeling	**18**
Alive & stable	12
Alive & unstable	4
Dead	2
Grand Total	**18**

(a)



(b)

Table 5.4 (a, b): Victim status for accidents caused by one wheeling

Dangerous maneuvers on the road by bikers has also caused a number of accidents. One wheeling is common amongst the youth population that usually resort to such practices when law enforcement is lax.

5.2.5 Tire Burst

Row Labels	Count of Cause
Tyre Burst	80
Alive & stable	38
Alive & unstable	42
Grand Total	80

(a)

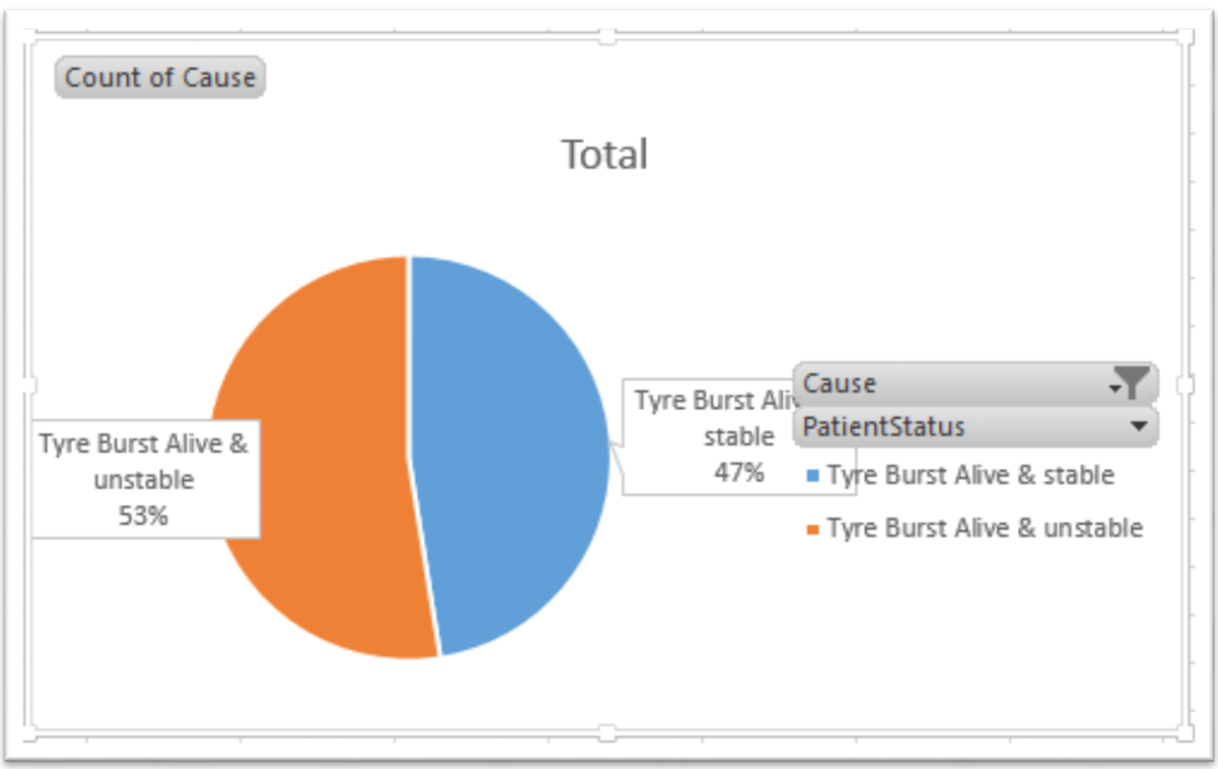


Table 5.5 (a, b): Victim status for accidents caused by tire bursts

A reconnaissance survey of Saddar Bazaar and the adjoining Murree Road revealed many lapses in road traffic safety that endanger the lives of many people. Despite several attempts by the local administration to improve traffic situation, road crashes are a daily occurrence. Here, the major problem is the sheer traffic violations by motorists and bikers, especially during afternoon and evening traffic peak hours.

Figure 5.6 Parking area near Metro Station, Saddar. The other parking area located in front of Food Street has been removed

Some signalized intersections, for example the one at Marrir Chowk metro station, were found be ill-timed whereas unsignalized intersections faced gridlocks during rush hours. Furthermore, these unsignalized intersections lacked any mandatory or other signs (Figure 5.4). Car parking on road sides is another major hurdle in smooth traffic operations. It is a common sight to see road sides covered by large number of vehicles illegally parked cars despite the availability of a limited number of parking areas (Figure 5.2). One parking area located near Tahzeeb Bakers has been removed to make way for a construction project.

Figure 5.7: Illegally parked vehicles on the two-lane Bank Road, Saddar.

Figure 5.8 Marrir Chowk intersection

Figure 5.9: A cross-walk in Saddar without an operational pedestrian traffic signal

Peshawar Road near Kohinoor Mills is another vulnerable area where a whopping 574 accidents were reported in 2017. This road is heavily congested since vehicles of all type ply on this busy road daily. Heavy traffic passing through Rawalpindi also has to pass through this road due to the absence of a city bypass road. As a result, accidents are also frequent and motorcyclists and pedestrians are mostly the victims. Motorcyclists meet accidents because of some very unfortunate causes such as: dangerous maneuvers on the road, over speeding, overloading, obstruction in tire etc. most of such accidents could have been provided had there been proper traffic education and traffic rules were strictly followed. On the other hand, absence of pedestrian overhead bridges at some locations such as at Kohinoor Mills is found to be the cause of many accidents. Reckless driving by local transport drivers is another reason who are emboldened by weak traffic enforcement.

Similar conclusions were also drawn for other accident hotpots which are:

1. Over speeding is, by and large, the most common cause of RTAs accounting for almost **66 percent** of the accidents.
2. Around **19 percent** accidents were fatal causing **1,785 deaths**. Wah Cantt. was the most fatal accident location with 77 deaths recorded.
3. Majority of RTAs were concentrated along **major population centers** such as the Murree Road.
4. Emergency services are **insufficient** to provide timely aid to the victims.

5.3 Recommendations

Although improvement would require considerable time, yet short term improvement can be achieved by updating the database of our city's traffic department. This will ensure maximum availability of information to relevant officials who can then focus their immediate attention to the most vulnerable areas. Latest traffic management software could provide a major boost to the performance and enhance traffic management as well. It is high time for traffic administration to develop their database systems on modern lines and adopt geospatial techniques to effectively overcome traffic problems:

Following are recommendations to ease traffic woes at particular locations across Rawalpindi

- Unfortunately, existing traffic rules are not implemented in true spirit and very often they are violated. These rules are enforced on certain roads such as Peshawar Road, Mall Road, and Murree Road etc. by traffic police, however, rest of the roads lack enforcement. The adjoining capital has not only put strict traffic rules in place but they are also fully followed due to active traffic enforcement and hefty fines for violations. Seatbelts and helmets are made compulsory. Hence it is suggested to impose the same traffic rules on all roads in Rawalpindi for better traffic management and accident reductions. Traffic rules implementation will reduce the severity of injury in addition to a reduction in the overall accident number,
- At present, no comprehensive RTAs data is available with any public or private institution. Reported number of accidents are a small proportion to the actual number of accidents taking place all over the country. This has made academic research a difficult task. Lack of government record has led to uncontrolled increase in the number of accidents as evident by various statistics. Thus, it is important to develop an integrated central database system comprising traffic and health departments such as Rescue 1122, public and private hospitals, NTRC, NHA, and traffic police

departments. GIS is an ideal tool for developing a reliable database system to enhance the operational capabilities of these institutions and improve the road safety measures.

- Road safety measures are needed at accident hotspots. Busy places such as marketplaces, roads near educational institutes, bus stands etc. all need to have sufficient safety provisions. For instance, pedestrian crosswalks with signals should be created at Saddar, other busy intersections such as Marrir Chowk, Sixth Road, Rawal Road, Double Road, Kacheri Chowk, and other similar locations. Moreover, traffic signs, both mandatory and guide, should be installed at appropriate locations.
- Traffic calming techniques are required on all major roads. These methods include constructing speed humps, cushions, traffic islands/refuge, Kerb extension, necking of road width etc. there are some intersections such the one near Honda Center on Peshawar road, where left/right turning traffic are protected. If these turning movements are removed, traffic congestion at these locations will be considerably lowered. As an alternative these movements should be diverted at some other intersections.
- Cost Benefit Analysis is essential to understand the potential effect of any project. For the given study, such analysis can be performed to determine the practicality of adopting traffic calming techniques.
- The entry of vehicles at congested, busy bazaars should be banned for either certain time of day or completely. This approach has been successfully implemented at Saddar, Peshawar and, therefore, the same model can be applied here without much effort. Places such as Saddar, Raja Bazaar etc. require an efficient traffic management. Banning certain vehicles from plying on certain road sections of these bazaars will significantly improve the situation.

- Road safety awareness campaigns should be launched on a regular basis throughout the year to educate the general public about traffic rules and transform them into responsible road users.
- Appointment of professional persons in traffic department for effective road management will certainly enhance the productivity of traffic police. Road safety and training programs should be initiated in the department to turn our traffic police into a professional force with public friendly attitude.
- Effective legislation is a crucial step to reduce road accidents. WHO has commended Pakistan for road safety legislation. Yet there still is a long way to go before these laws are enacted. Moreover, there is no legal definition of fatal accident in Pakistan and instant crash deaths are only considered fatal. There are chances when the victims die some hours after the crash but it will not be reported as a fatal accident. In short, the country should pass legislations which clear these ambiguities.
- Commuters should be encouraged to use public transportation to reduce traffic congestion. This is not only help in minimizing the number of vehicles on the road but also decrease fuel costs of people driving Single Occupancy vehicles (SOVs). Moreover, feeder buses should be procured for select locations that could take commuters to metro bus stations. This will increase the ridership and encourage those people who prefer their own personal vehicles to reach their destinations within the city.
- Since traffic engineering is an ever expanding field with innumerous applications particularly areas of public safety and road accidents preventions, it is necessary to perform research studies to come up with ingenious solutions to our modern traffic problems. Further

studies on this subject will be helpful in reduction of traffic crashes not for our specific case study but also worldwide.

- The next phase of the project should focus on practical implementation of the proposed measures for road accidents reduction. Collaboration with government departments such as Rescue 1122 and district hospitals should be considered.

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APPENDIX-I

Recue 1122 Data Sample (2017)

Year	Call Time	Injury Type	Reason	Cause	Patient Status	Bicycle Involve	Bikes Involved	Bus Involved	Cars	Carts	Rickshaw	Tractor	Truck	Vans	Emergency Area
2017	5:10 PM	Minor/ F/Aid	Bike hit the Pedestrian and Runaway	Carelessness	Dead	1	0	0	0	0	0	0	0	0	IN FRONT OF AMC COLLEGE KIYANI ROAD RWP.
2017	9:45 PM	Minor/ F/Aid	Car hit the Bike	Over Speed	Alive & stable	1	0	1	0	0	0	0	0	0	N/r 8 No Chungi Band Khana Road T/w Khannapul Jhaz ground stop rwp
2017	8:03 AM	Minor/ F/Aid	Bike hit Mehran	Over Speed	Alive & stable	1	0	1	0	0	0	0	0	0	Near Attock Pump,Kalma Chowk,Dhamial Road,Rwp,Cantt
2017	12:15 PM	Minor/ F/Aid	Unknown vehicle hit bike and escaped	Over Speed	Alive & stable	1	0	0	0	0	0	0	1	0	Infront of koh e Noor Mills towards Pindi GT road Rwp
2017	12:19 PM	Minor/ F/Aid	Vehicle hit bike and runaway	Over Speed	Alive & stable	1	0	0	0	0	0	0	1	0	Near Airport PAF signal, Airport road Rwp
2017	6:36 PM	Minor/ F/Aid	Bike Slip	Over Speed	Alive & stable	1	0	0	0	0	0	0	0	0	Infront Hardive Bakers And Mobi Plaza Haider Road Sadder Rwp
2017	7:16 PM	Minor/ F/Aid	bike hit Car	Over Speed	Alive & stable	1	0	1	0	0	0	0	0	0	Bahria town phase 4 interace, Main Gt road, t/w rawat, u turn ,rwp
2017	2:07 PM	Minor/ F/Aid	Bike Slipped due to Rain	Over Speed	Alive & stable	1	0	0	0	0	0	0	0	0	Infront of punjab college 6th road rwp
2017	10:49 AM	Minor/ F/Aid	Van hit Rickshaw	Over Speed	Alive & stable	0	0	0	0	1	0	0	1	0	Kacheri chowk near warden choki,jehlum road,Rwp
2017	11:04 AM	Minor/ F/Aid	Bike Slipped	Over Speed	Alive & stable	1	0	0	0	0	0	0	0	0	6th road infront punjab college,Rwp

2017	10:17 AM	Minor/ F/Aid	Bike slipped due to rain	Carelessness	Alive & stable	1	0	0	0	0	0	0	0	0	Pirwadhai morr near pull towards saddar,peshawar road,Rwp
2017	10:46 AM	Minor/ F/Aid	Bike Slipped due to Rain	Carelessness	Alive & stable	1	0	0	0	0	0	0	0	0	Infront of liaqat bagh,liaqat road,Rwp
2017	11:38 PM	Minor/ F/Aid	bike slip due to damage Road	Carelessness	Alive & stable	1	0	0	0	0	0	0	0	0	Near kahuta mor,yusra medical centre,gt road rwp
2017	11:38 PM	Minor/ F/Aid	same	Carelessness	Alive & unstable	1	0	0	0	0	0	0	0	0	Near kahuta mor,yusra medical centre,gt road rwp
2017	10:04 PM	Minor/ F/Aid	Rickshaw hit Electric Pole	Over Speed	Alive & stable	0	0	0	0	1	0	0	0	0	Infront of zildar house, gulraiz II high court road rwp
2017	10:04 PM	Minor/ F/Aid	same	Over Speed	Alive & unstable	0	0	0	0	1	0	0	0	0	Infront of zildar house, gulraiz II high court road rwp
2017	9:14 AM	Minor/ F/Aid	Van hit the Pedestrian	Carelessness	Dead	0	0	0	0	0	0	0	1	0	Infront of bawli hotel main g.t road t/w rwp near mandra
2017	6:25 PM	Minor/ F/Aid	Same	Over Speed	Alive & stable	2	0	0	0	0	0	0	0	0	Main Airport Road Before Dhoke Hafiz Signal U Turn Towards Koral Rwp.
2017	6:25 PM	Minor/ F/Aid	Two Bikes Collided	Over Speed	Alive & stable	2	0	0	0	0	0	0	0	0	Main Airport Road Before Dhoke Hafiz Signal U Turn Towards Koral Rwp.
2017	6:12 PM	Minor/ F/Aid	Suzuki turn over during saving bike	Over Speed	Alive & stable	1	0	0	0	0	0	0	1	0	Infront Mandra Police Station Toward Pindi GT Road Mandra
2017	2:34 PM	Minor/ F/Aid	Bike hit by Taxi	Over Speed	Alive & stable	1	0	1	0	0	0	0	0	0	Near Bank Alfalah,Towards22,Main Mall Road,Saddar,Rwp
2017	1:32 PM	Minor/ F/Aid	bike collision one runaway	Over Speed	Alive & stable	2	0	0	0	0	0	0	0	0	Infront of AWT Plaza Near Pia Building Main Mall road Rawalpindi

2017	3:33 PM	Minor/ F/Aid	bike hit With Car	Over Speed	Alive & stable	0	0	1	0	0	0	0	0	0	Near Fatima Jinnah Unversity Over Head Bridge Main Kachri Toward Mareer Rashid Minhas Road RWP
2017	8:35 AM	Minor/ F/Aid	Bike Slip due to rain and hit bike	Carelessness	Alive & stable	2	0	0	0	0	0	0	0	0	Opp Nawaz Sharif Park T/W Faizabad Murree Road Rwp.
2017	8:35 AM	Minor/ F/Aid	same	Carelessness	Alive & stable	2	0	0	0	0	0	0	0	0	Opp Nawaz Sharif Park T/W Faizabad Murree Road Rwp.
2017	6:42 AM	Minor/ F/Aid	Carry hit bike and Runaway	Over Speed	Alive & stable	1	0	0	0	0	0	0	1	0	KRL Road N/r KoKhar Market Rahat Bakery Rwp
2017	10:15 AM	Minor/ F/Aid	Shawal Came in Bike Tire	Carelessness	Alive & unstable	1	0	0	0	0	0	0	0	0	Charring cross signal towards saddar,peshawar road,Rwp
2017	7:35 AM	Head Injury	Damper hit Bicycle	Over Speed	Alive & stable	0	0	0	0	0	0	0	0	2	Bahtar More,GT Road,Bahtar
2017	10:30 AM	Minor/ F/Aid	Hiace hit Bike and Run	Over Speed	Alive & stable	1	0	0	0	0	0	0	1	0	Peshawer Road Bohar Masjid Service Road OppNadra OfficeT/W Sadar Rwp.