

**T.C.
ISTANBUL GEDİK UNIVERSITY
INSTITUTE OF GRADUATE STUDIES**



TRAFFIC ACCIDENTS EVALUATION IN IRAQI ROADS

MASTER THESIS

Dhuha Khalid Hassooni HASSOONI

Civil Engineering Department

Master in Civil Engineering English Program

MAY 2023

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**Dhuha Khalid Hassooni HASSOONI
(211291014)**

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Thesis Advisor: Assoc. Prof. Dr. Redvan GHASEMLOUNIA

2. Advisor Assist. Prof. Dr. Miami M. HILAL

MAY 2023



T.C.
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- 1) Tez Danışmanı:** Doç. Dr. Redvan GHASEMLOUNIA
- 2) Jüri Üyesi:** Dr. Öğr. Üyesi Tuğbay Burçin GÜMÜŞ
- 3) Jüri Üyesi:** Dr. Öğr. Üyesi Yaşar MUTLU

To my family and friends,



DEDICATION

To the one who told me on the first day of my university journey before seven years, "You must study hard to prepare yourself to take a master's degree." As if he had foreseen for this day, or did he just believe in me? To the one who always takes pride in me and celebrates my achievements, to my first supporter and constant motivator, the beacon of light in my life, to the one without whose support and presence in my life, I would not have amounted to anything.

To my dear father "Khalid Hassooni"



PREFACE

In the name of God, the most gracious, the most merciful,

First and foremost, I would like to express my deepest gratitude, appreciation, and utmost respect to my esteemed supervisors, Assistant Professor Dr. Redvan Ghasemlounia and Assistant Professor Dr. Miami Muhammed. They have been guides throughout the entire process of writing this letter, providing me with guidance and advice for my research. I extend my sincere thanks, appreciation, and respect to both of them. I would also like to acknowledge and express my heartfelt gratitude to my family, who have always been my unwavering support and a constant source of motivation. To my father, Khalid, my mother, Yusra, my sisters, Buraq and Israa, my brothers, Mohammed and Nawaf, and my brother Ali and his wife Nour, as well as our little angel Layan, I am profoundly grateful for your continuous presence and support. To my second family, my friends, I want to express my deepest appreciation. Your unwavering presence and support throughout this journey have meant the world to me. Lastly, I am sincerely grateful to all those who believed in me, supported me, and assisted me during this research endeavor. Thank you all from the bottom of my heart.

May 2023

Dhuha Khalid Hassooni HASSOONI

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ABBREVIATIONS

ANOVA	: Analysis of Variance
DALYs	: The Disability-Adjusted Life Year
Df	: Degree of Freedom
HCM	: Highway Capacity Manual
ITS	: Intelligent Transport System
LOS	: Level of Service.
SD	: Standard Deviation
Sig	: Level of Significance
WHO	: World Health Organization

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TRAFFIC ACCIDENTS EVALUATION IN IRAQI ROADS

ABSTRACT

Traffic accidents are a major problem on the roads in Iraq. However, evaluation this problem in Iraq involves analyzing various factors related to the accident, such as the cause of the accident, road and weather conditions, driver behavior, vehicle condition. Here we show data on traffic accidents in Iraq used to address this problem where used the SPSS software was used in the statistical analysis process of the collected data and this case study was conducted in Iraq to identify the key factors causing the traffic accidents and sources of generate this problem in Iraqi roads and another information by using the questionnaire survey to propose the suitable treatments to reduce the traffic accidents by conducting the interview with experts. And to find the relationship between the main traffic accidents elements by reviewing the related records, gathering the required data from the government directorates, and making the correlation test.

Upon discuss the issue, it was found that the Iraqi governments of Baghdad, Basrah, and Al-Najaf have the highest incidence of traffic accidents. Additionally, the main contributing factors to these accidents on Iraqi roads are Driving reverse direction, poor road maintenance, a large number of subsidiary roads, and speeding beyond the prescribed limits.

Overall, addressing the problem of traffic accidents in Iraq will require a comprehensive and sustained effort, involving a range of different stakeholders and approaches. However, by taking these steps, it is possible to reduce the number of accidents on Iraq's roads, and improve the safety and wellbeing of all those who use them.

Keywords: *Traffic accidents, Source of accident, Cause of accident road, Weather, Vehicle, Fatality and injury.*

IRAK YOLLARINDAKİ TRAFİK KAZALARININ DEĞERLENDİRİLMESİ

ÖZET

Burada Irak'taki trafik kazalarına ilişkin verileri gösteriyoruz Bu veriler, bu sorunu çözmek için kullanıldı Toplanan verilerin istatistiksel analizi sürecinde SPSS programı kullanılmıştır.

Bu vaka çalışması, Irak'taki trafik kazalarına neden olan ana faktörleri ve kaynaklarını belirlemek için yapılmıştır.

Irak yollarında bu sorunun oluşmamasını, diğer trafik kazalarını azaltmak için ve uygun tedaviler önermek içinin anket kullanarak uzmanlarla görüşmeler oldu.

Büyük trafik kazası unsurları arasındaki ilişki, ilgili kayıtlar incelenerek, gerekli veriler devlet müdürlüklerinden toplayarak ve korelasyon testi yapılarak belirlenmiştir.

Konu tartışılırken, Bağdat, Basra ve Necefteki Irak hükümetlerinin en yüksek trafik kazası oranlarına sahip olduğu tespit edildi.

üstelik Irak yollarında bu kazalara katkıda bulunan ana faktörler, ters yönde sürüş, yetersiz yol bakımı, çok sayıda yan yol ve belirlenen limitleri aşan hızdır.

Genel olarak, Irak'taki trafik kazaları sorununu ele almak, kapsamlı ve sürekli çabalar gerektirecektir, Bu çabalar, bir sürü farklı paydaşlar ve yaklaşımlar içermesi gerekir.

bu adımları atarak, Irak yollarındaki kaza sayısını azaltmak ve bu yolları kullanan herkesin güvenliğini ve esenliğini iyi hale getirmek mümkündür.

Anahtar Kelimeler: *Trafik kazaları, Kaza kaynağı, Kaza nedeni, Hava durumu, Araba, Ölüm ve yaralanmadır.*

1. INTRODUCTION

1.1 Study Topic

Traffic accident injuries pose significant dangers and can be likened to contemporary terrorist operations. They represent a widespread menace that deeply worries and obsesses all members of society. This issue drains material resources, gives rise to social problems, and causes losses in human potential, thereby impacting essential aspects of communal life that rely on the human element as the foundation of society. For quite some time, we have endured the consequences of inadequate preparation and development of road infrastructure, insufficient segregation of traffic using tunnels and bridges, inadequate provision of parking facilities, insufficient implementation of traffic signs and adequate lighting on roads, among other contributing factors. World Health Organization. (2018).

International roads that link the governorates to each other are exposed to many accidents, whether the reason is the speed used during driving, the poor maintenance of the road, the condition of the road lighting, or the existence of an obstacle on the road, such as accident or concrete remains. International Road Safety Organization (IRSO). (2022).

There are several reasons for traffic accidents that occur on roads in Iraq, which can be related to the road itself. Some of these reasons include: Ministry of Interior - Traffic Police Directorate. (2019).

1. Road and bridge design: The design of the road and bridges may not be safe, which increases the risk of traffic accidents.
2. Road quality: The condition of the road can affect the safety of vehicles and road users, due to defects in asphalt, worn curbs, and other issues and as shown in Fig (1.1)
3. Quality of directional signs: Poor or unclear directional signs can contribute to traffic accidents.

4. Weak traffic signals: The lack of necessary traffic signals or unclear signals can endanger the lives of road users.

5. Intersections: Intersections between vehicles are a major cause of traffic accidents, especially if the intersection is not safe or lacks necessary signals.

To address these problems and improve the safety of road users, the following measures should be taken: World Health Organization. (2013).

1. Design and build roads and bridges safely and efficiently.

2. Maintain the road and bridges to improve their condition and preserve them.

3. Provide clear and safe directional signs and road signs.

4. Improve traffic signals and provide necessary signals in critical areas such as intersections and sharp curves.

5. Raise awareness among road users.



Figure 1.1: Poor Road Maintenance

Source: (Google Image)

There are other reasons for traffic accidents besides road factors as shown in Fig (1.2)

Among these reasons are: National Highway Traffic Safety Administration. (2017)

1. Reckless driving: Some people drive in an unsafe manner, which increases the risk of traffic accidents.

2. Non-compliance with traffic rules: Failure to comply with traffic rules, such as speeding or looking at a mobile phone while driving, increases the risk of traffic accidents.
3. Car condition: The condition of the car can affect driving safety, as brakes, tires, suspension systems, car lights, and other things should be in good condition.
4. Weather factors: Weather factors such as fog, heavy rain, or snow can affect drivers' visibility and vehicle control and increase the risk of traffic accidents.
5. Driving under the influence of drugs or alcohol: The use of drugs or alcohol increases the risk of traffic accidents, as the ability to drive and control vehicles is affected.



Figure 1.2: Traffic Accidents on Iraqi Roads Occur Due to Various Factors

Source: (Google image)

To reduce the risk of traffic accidents, drivers should comply with traffic rules and exercise caution and attentiveness while driving, and ensure the car is in good condition and maintained regularly. It is also important to provide appropriate safety measures on roads and raise awareness of the importance of complying with traffic rules.

However, traffic accident evaluation in Iraq involves analyzing various factors related to the accident, such as the cause of the accident, road, and weather conditions, driver behavior and vehicle condition. Data on traffic accidents in Iraq is

collected by various governmental and non-governmental organizations, including the General Traffic Directorate - Ministry of Interior Central Statistical Organization Ministry of Planning Department of Roads and Bridges - Ministry of Construction, Housing and Public Municipalities.

Based on a 2018 report from the World Health Organization, Iraq exhibited a road traffic death rate of 21.4 per 100,000 population, surpassing the global average of 18.2 per 100,000 population. The report highlighted that the primary causes of road traffic fatalities in Iraq were attributed to factors such as excessive speeding, failure to utilize seat belts and helmets, and driving under the influence of alcohol. World Health Organization. (2018)

While traffic accidents can occur in any province of Iraq, some regions may be more prone to accidents than others. For example, provinces with larger populations and more extensive transportation networks may have a higher incidence of accidents. However, more detailed information about the provinces that are most exposed to traffic accidents would require access to the most current data and analysis from experts in the field. Zalzala, A.M. and Mahmood, M.T. (2013).

Conducting a survey or discussing the causes of accidents or paying attention to road maintenance or directing the driver by placing signs for traffic directions along the road.

1.2 Purpose of Thesis

The main aim of this study is to evaluate the traffic accidents in Iraq, based on the general structure of the thesis as described, the objectives of the study are to:

1. Identify the causes and contributing factors of traffic accidents in Iraq.
2. Analyze the extent and severity of the traffic accident problem in different regions of Iraq.
3. Develop recommendations for addressing and reducing traffic accidents in Iraq.
4. Provide a comprehensive understanding of the traffic accident problem in Iraq, including its social and economic impacts.
5. Explain the relationship between traffic accidents and various factors, such as driver behavior, road infrastructure, and weather conditions.

1.3 Literal review

According to local and international research studies, no specialized study has been conducted yet to understand the relationships between the elements of accidents. Furthermore, no local study has been found that encompasses the key causes and sources leading to traffic accidents in Iraq. These aspects will be included in this research, where the groundwork has been laid through the study of numerous global and local research papers and the evaluation of general conditions. This study aims to analyze the data and reach valuable conclusions that can be utilized as quantitative analysis, and subsequently used to develop models capable of reducing the problem of traffic accidents at both the local and global levels.

1.4 Research Structure

This thesis is structured into five chapters, including the present chapter, which are outlined as follows:

Chapter One: Introduction

This chapter provides an overview of the traffic accident topic, the problem statement, and the research aim and objectives.

Chapter Two: Literature Review

This chapter presents a review of previous studies related to traffic accidents, including their findings, and how this study proposes a solution to the problem.

Chapter Three: Methodology

This chapter explains the study's methodology, including sample selection, data collection techniques, and analysis methods used to evaluate the traffic accident problem in Iraq.

Chapter Four: Data Analysis

This chapter presents the analysis of the collected data, including both dependent and independent variables, and the statistical analysis techniques used.

Chapter Five: Conclusions and Recommendations

This chapter provides the most important conclusions and recommendations for future work based on the findings of the study.

2. REVIEW OF LITERATURE

2.1 Purpose

In this chapter, the researcher aims to classify urban streets and evaluate their level of mobility in terms of traffic speed. The chapter also discusses the procedures for managing road infrastructure safety, with the goal of reducing the number of accidents and mitigating their impact. Additionally, the chapter covers the monthly distribution of road accidents in Iraq to ensure road safety and mentions previous studies in Iraq.

2.2 Urban Street

According to the Highway Capacity Manual (HCM) published in 2020, urban streets, including arterials and collectors, serve as the primary connectors between local streets and multilane highways in the transportation system. The classification of these streets is based on their function, the level of control measures in place, and the degree of development along the road. Arterial streets are designed to accommodate longer, through trips while also providing access to commercial and residential areas along the roadside.

The HCM emphasizes the importance of context-sensitive solutions for urban streets to ensure they meet the needs of both motorists and non-motorists. Design considerations such as speed limits, lane width, and the provision of sidewalks, bike lanes, and transit facilities are all critical factors in creating safe, efficient, and accessible arterial streets. The HCM also stresses the need to balance the needs of different modes of transportation, including cars, trucks, bicycles, and pedestrians, to ensure a harmonious and efficient transportation system.

One of the challenges in designing arterial streets is balancing the competing demands for space and resources. As urban areas continue to grow and evolve, the need for efficient and effective arterial streets will only increase. The HCM recommends using a performance-based approach to evaluate the effectiveness of

different design strategies, including traffic calming measures, intersection design, and multimodal facilities.

In summary, urban streets, including arterials, are a critical component of the transportation system, serving as the primary connectors between local streets and multilane highways. Designing safe, efficient, and accessible arterials requires careful consideration of various factors, including speed, access, and multimodal needs. The HCM provides guidance on context-sensitive solutions to ensure that arterial streets meet the needs of all users in the rapidly evolving urban landscape. (Pai, C. W., & Kwon, E. (2019))

The mobility provided by urban streets is assessed by the travel speed of through-traffic streams. According to recent studies, three primary factors influence this speed, including the street environment (geometric characteristics, roadside activity, and land uses), vehicle interactions (traffic density, proportion of trucks and buses, and turning movements), and traffic control (signal and signs). The average travel speed for through vehicles along an urban street determines the level of service (LOS). The travel speed depends on the running speed between signalized intersections and the amount of control delay incurred at signalized intersections (Bhuyan et al., 2020).

Effective road infrastructure safety management procedures are essential for ensuring road safety throughout a road's entire service life, starting from the planning and design phase and continuing through the operational phase. To minimize the number and severity of accidents, it is crucial to conduct a safety ranking of the road network, identifying potentially dangerous sections that require safety improvement measures. The prioritization of these measures should be based on the severity of each section's risks. To prevent the emergence of new high accident concentration areas, safety ranking and road safety impact assessment procedures should consider not only historical accident data but also predictions of potential accidents (Liu, P., Liu, J., & Huang, H, 2021)

2.3 Traffic Accidents

Road traffic accidents, causing approximately 1.35 million deaths each year, remain a significant public health challenge worldwide and the leading cause of mortality among adolescents and young adults. Males continue to be the most commonly

affected group, with those aged between 15 and 29 being particularly vulnerable. Road traffic accidents are estimated to cost countries between 3 and 5 percent of their gross domestic product (GDP), emphasizing the need for effective interventions to prevent these incidents. (World Health Organization, 2018).

Despite only 60% of the world's vehicles being registered in developing countries, these countries still account for over 90% of global road traffic deaths, according to the World Health Organization. This highlights the urgent need for effective road safety measures in low- and middle-income countries. (World Health Organization, 2018). In actuality, as predicted by the WHO, the loss of DALYs due to traffic will rise from being the ninth important cause of DALYs in 1999 to the third essential cause by the year 2020, as indicated in Table (2-1). While high-income nations are seeing a decline in traffic fatalities, this is not the case in low- and middle-income nations. In high-end low-income countries, there is a significant difference in the rate of casualties. In contrast to low- and middle-income countries, where they continue to rise, mortality rates have been falling in high-income countries. Tragically, despite the fact that the rate of increase varies by region, Asia has seen the greatest increase.

Table 2.1: A Disease Load for the Top 10 Causes (DALYs Lost)

S.No	1998 Disease or Injury	2020 Disease or Injury
1	Lower respiratory contaminations	Ischaemic heart disease
2	HIV/AIDS	Unipolar major depression
3	Perinatal conditions	Road traffic injuries
4	Diarrhoeal diseases	Cerebrovascular disease
5	Unipolar major depression	Chronic obstructive pulmonary disease
6	Ischaemic heart disease	Lower respiratory infections
7	Cerebrovascular disease	Tuberculosis
8	Malaria	War
9	Road traffic injuries	Diarrheal diseases
10	Chronic obstructive pulmonary disease	HIV/AIDS

Source: (S K Singh, 2020)

2.3.1 Traffic accident trends in Iraq

With a total area of 438,317 square kilometers and a population of over 40 million, Iraq is one of the major Arabic nations situated in the Middle East region of Southwest Asia. The majority of the population, around 70%, resides in urban areas. The latitude and longitude of Baghdad, the capital city of Iraq, are 33° 20' N and 44° 26' E, respectively. Other major cities in Iraq include Mosul, Basra, and Sulaymaniyah. Road transportation is the primary mode of transportation for people

and goods, with a total of 6.4 million registered motor vehicles and over 63,000 kilometers of paved roads in the country. (Al-Taei et al., 2021).

For many years, Iraq has faced serious road safety challenges, particularly with the rapid increase in automobile ownership and use. Without proper management and safety measures, this problem may continue to contribute to potentially fatal accidents. (Al-Hadithi et al., 2020).

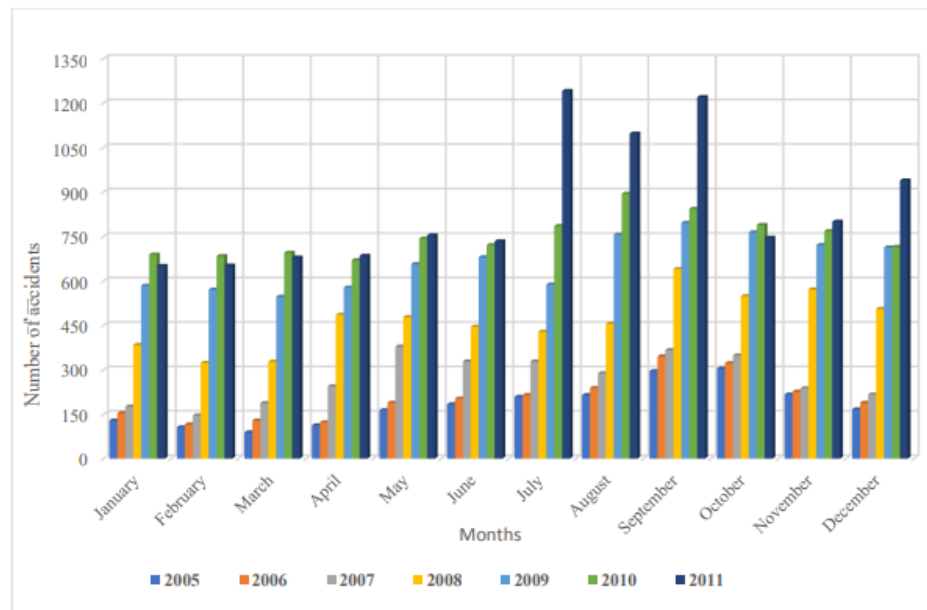


Figure 2.1: Illustrates the Distribution of Road Accidents in Iraq on a Monthly Basis

Source: (Baratian et al., 2014)

According to Fig (2.1), although there was not a significant monthly fluctuation in traffic accidents, August through September and October through November and December had a disproportionately high number of crashes. Since Iraq experiences relatively hot weather in August and September, this is related to the extreme weather and could have an impact on traffic accidents.

In Iraq, drivers are affected by high temperatures on a psychological as well as a physical level. As a result of increased irritability, fatigue, and attention deficits brought on by the high temperature, people are less able to handle unpredictable situations on the roads and are more likely to lash out at others (A.A. Mohammed, M.H. Jassim, & Z. Abdulhussein, 2020).

Due to high temperatures during the summer months in Iraq, road traffic accidents tend to increase, particularly in July. A study conducted in 2021 by S. Al-Hadithi and M. Al-Hasnawi found that road accidents in Iraq had a seasonal pattern, with the

highest incidence occurring in July and August. However, the frequency of accidents was lower in September compared to July and August. (Al-Hadithi & Al-Hasnawi, 2021).

Despite the decrease in the number of accidents in December 2021 compared to the previous month, the overall rate of accidents was still higher than in previous months. This could be attributed to the fact that cloudy weather in December caused poor road visibility in some areas of the country, especially in North Iraq. In cloudy conditions, individuals tend to drive a little more slowly, and it is more challenging to maintain a safe distance from the car in front of them. The reduced visibility caused by hazy weather has been shown to increase the risk of accidents (Baratian et al., 2022).

Additionally, the high number of students using major and branch roads to get to schools and universities in July resulted in an increase in traffic accidents. Figure (2-2) shows the cumulative percentages of time-wise distribution of traffic accidents in Iraq. It unmistakably demonstrates that there is a notable variation in traffic accidents occurring at different times of the day. Accidents were generally consistent and reached a peak between 6:00 am and 6:00 pm, but decreased in the early hours of the morning. It does not, however, prove that driving during the day is more dangerous than driving at night. In Fig. (2-3), the number of accidents for each of Iraq's fifteen governorates from 2005 to 2011 is depicted. Among Iraq's fifteen governorates, there is a glaring disparity in accident risk ratio. Anbar saw 71 occurrences in 2010, Baghdad saw 987 accidents, Babil saw 1441 accidents, Al Najaf saw 1173 accidents, and Basrah saw 1154 accidents.

In 2011, Baghdad, Babil, Najaf, Qadisyah, Dhi Qar, Wasit, and Basrah had a higher fatality risk compared to the average fatality risk for that year. In fifteen governorates, the number of accidents climbed significantly between 2005 and 2011. However, Baghdad City came out on top in terms of traffic fatalities, followed by Babil, Najaf, and Basrah. Iraq had a 20.2 percent death rate from traffic accidents in 2013. Iraq is ranked 113th in the world by the WHO, and its mortality rate is slightly higher than the 17.4 percent global average. Road accidents in Iraq have had a negative impact on public health and the overall security of the Iraqi population. Both Figure (2.2) and Figure (2.3) illustrate the severity.

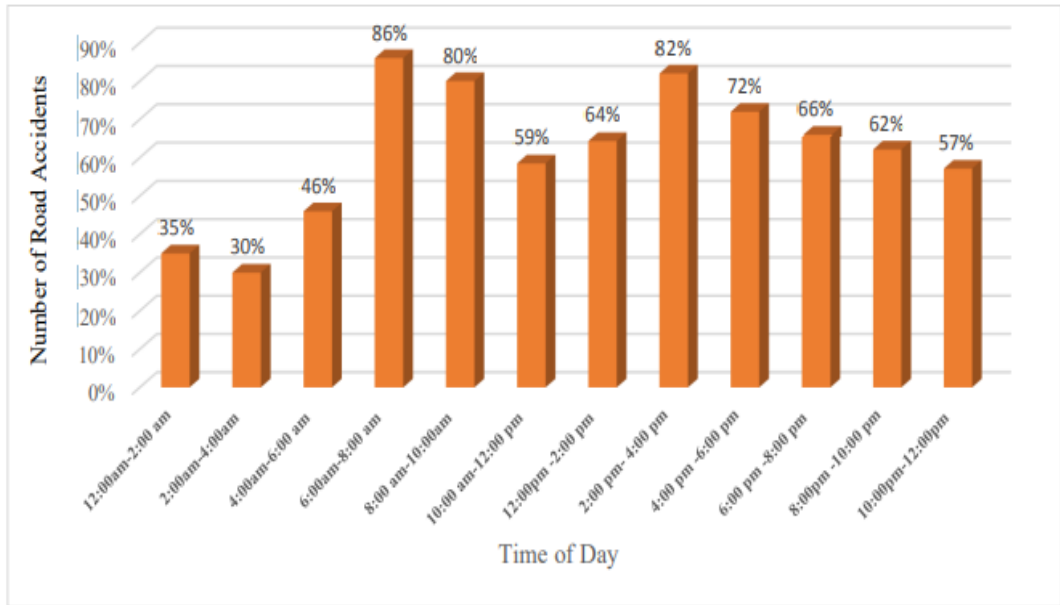


Figure 2.2: Number of Road Traffic Accidents by Time of Occurrence from 2005 to 2011: Cumulative Percentages

Source: (Mohammed and K Ambak, 2018)

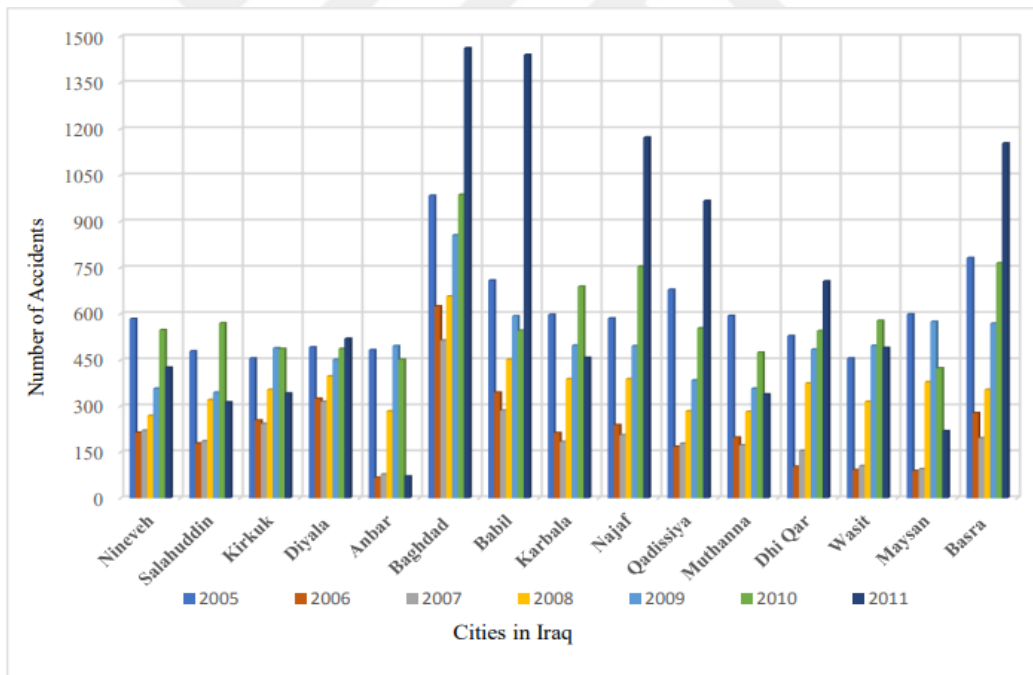


Figure 2.3: Risk of fatal road accidents in Iraq from 2005 to 2011

Source: (Ismail, A. 2012)

Human error remains the primary cause of automobile accidents in Iraq, with adverse weather conditions and related factors being secondary factors. Examples of such secondary factors include fog, rain, sandstorms, and high temperatures during the

summer. According to recent studies, human error is the main cause of automobile accidents in Iraq, with over 80% of accidents caused by human error (Al-Mosawi et al., 2019). The roads are filled with reckless drivers who disregard traffic laws intentionally or due to a lack of knowledge (Ismail, A. 2012.).

2.3.2 Serious traffic infractions in Iraq

In Iraq, reckless driving and violation of traffic laws are the leading causes of road accidents. A study by Abbas et al. (2019) found that the most common traffic violations in Iraq include speeding, driving under the influence of drugs or alcohol, and using mobile phones while driving. Also founded that drivers in Iraq tend to disregard traffic signals and road signs, and often fail to use seat belts or child restraints. Furthermore, pedestrians and other vulnerable road users are at greater risk due to inadequate infrastructure and insufficient pedestrian crossings (Al-Bayati and R. A. 2020).

In Iraq, poor road conditions and inadequate maintenance of vehicles are major contributors to road accidents. According to a study conducted by Al-Jumaili et al. (2021), road factors accounted for 24% of accidents, while vehicle factors accounted for 16% of accidents. Improper vehicle maintenance and overloading of commercial vehicles were identified as contributing factors. The study also highlighted the need for more effective road infrastructure and vehicle maintenance programs to reduce the number of accidents on Iraq's roads (Al-Jumaili, 2021).

However, vehicle failure is one of the main contributing factors to traffic accidents in Iraq, accounting for over 10% of incidents (Al-Jumaili et al., 2021). This highlights the need for proper vehicle maintenance and regular inspections to ensure roadworthiness. The General Traffic Directorate in Baghdad holds frequent consultations and discussions with traffic officers to identify underlying problems in Iraq's traffic system, raise awareness of safety concerns, and enhance the effectiveness of the country's accident prevention mechanisms (Al-Jumaili, A. A., 2021).

One of the weak points of the traffic system in Iraq is the lack of proper accident investigation and analysis. According to a study by Al-Qaisi et al. (2018), there is a lack of standardized procedures for collecting and analyzing accident data, leading to inaccurate and incomplete information about the causes and consequences of

accidents. This can result in ineffective road safety policies and interventions. Additionally, inadequate road infrastructure, including poor lighting, lack of road signs, and narrow roads, can contribute to the high rate of accidents in Iraq. The study emphasizes the need for a comprehensive approach to road safety, including better accident investigation and analysis, improved road infrastructure, and increased public awareness of safe driving practices (Al-Qaisi et al., 2018).

Figure (4.2) illustrates the inadequate planning for the traffic system on a typical street without traffic signals or signage. Additionally, a rise in traffic accidents is correlated with a decrease in public understanding of the significance of traffic regulations. In addition, the width of the streets in Iraq has been reduced by the construction of concrete barriers. This would undoubtedly result in more traffic accidents as there are more vehicles on the road because it is illuminated in Fig. (2.4) and Fig. (2.5)



Figure 2.4.: Iraq's Traffic System's Inadequate Planning

Source: (Google Images)



Figure 2.5: Iraqi Roadways Will Have Concrete Barriers Built and Vehicles Will Be Shifted Accordingly

Source: (Google Images)

The greatest accident ratio, which was found to be 36% for Baghdad city and involved 2379 accidents, was found to be caused by the driver. While there were just 586 accidents reported in Nineveh City, which represents a 22% decrease. The results of traffic accident analysis, based on the type of vehicle involved, indicate that saloon vehicles were responsible for a higher rate of traffic accidents, accounting for up to 26.3% of all accidents. In comparison to the other cities, Baghdad had a larger ratio; there were 1234 accidents there compared to 425 accidents in Al-Anbar city (Bassam et al., 2018).

A study conducted in Arbil City aimed to analyze the factors contributing to traffic accidents and recommend management countermeasures for common accident locations on major urban streets. The study used statistical analysis techniques, questionnaire surveys, and self-observation studies to collect and analyze traffic accident data, geometric condition data, and traffic condition data connected to the Arbil Street network. Statistical models were built to predict the chance of an accident at a specific area based on various variables. The study found that some geometry and traffic circumstances were responsible for the majority of traffic accidents, and identified five components that contribute to traffic accidents: the road, the road user, the vehicle, the environmental variables, and other components. The study recommended building and developing roadways in accordance with

international standards and implementing coordinated educational awareness programs to raise the level of traffic awareness among all road users (Ali and Khaqan, 2020).

2.3.3. Types of traffic accidents

Traffic accidents can be caused by various factors and can lead to different types of accidents. Some of the most common types of traffic accidents in Iraq include vehicle collisions with other objects, such as trees, power poles, pedestrians, and animals. These accidents can result in different types of collisions, such as rear-end collisions, side-impact collisions, head-on collisions, sideswipe collisions, and vehicle rollover incidents. The severity of injuries and damage to vehicles can vary depending on the type of collision and the safety features of the vehicles involved. (Al-Zubaidi 2018)

Single-car accidents are also common in Iraq and can occur due to driver fatigue or brake malfunction. Multiple-vehicle pile-ups are considered one of the deadliest types of accidents on the road and can result in significant damage and loss of life. It is challenging to identify the exact cause of multiple-vehicle collisions, and passengers are at an increased risk of serious injuries and fatalities due to the number of vehicles involved (T. M. Moham, 2020).

2.4 Previous Local Studies

The issue of road accidents and their severity in Iraq has been a significant concern for highway safety for many years. The ownership and use of vehicles have been on the rise since 2003, which has become a potentially catastrophic problem (Al-Ani et al., 2018).

In recent years, Iraq has experienced a rise in the number of road accidents, with serious implications for road safety. The increase in car ownership and usage, coupled with inadequate road infrastructure and weak law enforcement, has contributed to this issue. A study conducted in 2019 found that the most common types of accidents in Iraq were collisions with other vehicles and with pedestrians, as well as rollovers and crashes into fixed objects such as barriers and poles (Al-Quraishi et al., 2019). Furthermore, the study identified excessive speed, reckless driving, and driver fatigue as the main causes of accidents in Iraq. To improve road

safety, the authors of the study recommended the implementation of effective traffic laws and regulations, the construction of better roads and infrastructure, and the provision of driver education and training programs. (Al-Quraishi et al., 2019) (21,22).

Traffic accidents in Iraq have been a long-standing issue, with limited studies conducted due to challenges in obtaining relevant data. The police department is responsible for reporting accidents, which are typically recorded if they result in a fatality or hospitalization. However, property damage accidents may go unreported if drivers involved agree not to report them. This has led to a lack of accurate accident data. To address this issue, an accident prediction model using the empirical Bayes criterion has been developed to identify hazardous sites and predict the likelihood of accidents occurring at specific locations. Al-Dulemi (2022) conducted a study that revealed higher accident frequency on Kurdistan and Zakho streets compared to other areas. The study collected data from traffic surveys, the General Police Directorate, and questionnaires to examine the correlations between fatal accident rates, accident density on rural roads, and variables such as driver behavior, vehicle speed, and route shape. Correlation matrices were used to determine statistical significance, and multiple linear regression analysis was conducted using SPSS software. The study found that the overall accident rate is strongly correlated with lane markers, as well as shoulder width and other factors (Al-Dulemi, M. R. (2022)).

In the metropolitan region of Duhok City, a study conducted by Al-Taei (2022) analyzed 473 accidents that occurred at 20 crossroads and segments. The study examined the critical accident rate per million vehicles to identify the most dangerous intersections and segments. According to the analysis, Al-Shuhada, Uper Malta, Duhok-Super Market, and Ashti were identified as the four most dangerous intersections, while the Malta-Sayrangah segment was the only identified dangerous site. The study highlighted Al-Shuhada crossroads as the most hazardous, emphasizing the need for a thorough analysis and comprehensive diagnosis to enhance safety measures in the future. Similarly, the Malta-Sayrangah stretch of the Duhok City urban street network was identified as the most dangerous segment, emphasizing the importance of conducting a detailed analysis by highway and traffic engineers to improve safety (Al-Taei, B. (2022)).

The same study's findings led to the creation of an accident strip map for Duhok City to display Hazardous Accident Locations (HALs) (Hardy, 2020). In a research conducted by Hardy (2020) in Sulaimany City, road accident reports from 2002 to 2005 were analyzed, resulting in a dataset of 1546 accidents. Fieldwork and on-site inquiries were conducted to collect traffic and geometry data. The analysis revealed that 62.16% of accidents occurred on main streets, 18.86% at intersections, 9.51% on local streets, and 8.47% in unidentified locations. The accidents resulted in 2286 instances of property damage, 822 injuries, and 63 fatalities (Hardy, J. (2020)).

A study conducted by Al-Nuaimi et al. (2021) focused on the impact of road infrastructure on road traffic accidents in Iraq. The study aimed to assess the relationship between different infrastructure characteristics and the occurrence of accidents. The researchers analyzed accident data from various regions in Iraq and examined factors such as road design, signage, lighting, and road surface conditions.

The study found that inadequate road infrastructure, particularly poor road conditions and insufficient signage, played a significant role in the occurrence of road traffic accidents. Roads with improper geometry, lack of clear markings, and inadequate lighting were associated with a higher incidence of accidents. Additionally, the study identified specific road sections and intersections that exhibited a higher frequency of accidents, highlighting the need for targeted infrastructure improvements in those areas.

The findings of a study underscore the importance of investing in road infrastructure improvements as a crucial strategy for enhancing road safety in Iraq. By addressing deficiencies in road design, signage, and maintenance, it is possible to create safer road environments and reduce the risk of accidents (Al-Nuaimi (2021)).

A study conducted by Ali H. Khudhair and Dhuha Al-Dabbagh in 2021 examined the prevalence and patterns of distracted driving among Iraqi drivers. The study found that distracted driving, particularly due to mobile phone usage, is a significant problem in Iraq. The researchers conducted surveys and interviews with drivers in several cities across Iraq and found that a high percentage of drivers admitted to using their mobile phones while driving, which significantly increased the risk of accidents.

The study emphasized the need for stricter enforcement of laws regarding distracted driving, along with educational campaigns to raise awareness about the dangers of using mobile phones while driving. Implementing measures such as hands-free devices, mobile phone restrictions, and promoting responsible driving behavior can play a crucial role in reducing the prevalence of distracted driving and improving road safety in Iraq (Khudhair (2021)).

A study conducted by Al-Shamsi et al. (2022) focused on the evaluation of driver behavior and its impact on road traffic accidents in Iraq. The study aimed to understand the role of various behavioral factors in contributing to accidents and to identify potential interventions for improving road safety.

The researchers collected data through surveys and observations of drivers in different regions of Iraq. They examined factors such as speeding, aggressive driving, failure to use seatbelts, and driving under the influence of alcohol or drugs. The study also explored the relationship between driver behavior and accident severity.

The findings of the study highlighted several alarming trends. It was revealed that a significant number of drivers engaged in risky behaviors such as excessive speeding and aggressive maneuvers on the road. Additionally, non-compliance with seatbelt usage and incidents of driving under the influence were prevalent among a subset of drivers.

Based on the analysis, the researchers recommended a multi-faceted approach to address driver behavior and improve road safety. They emphasized the importance of implementing strict enforcement measures, increasing public awareness campaigns, and providing driver education programs that focus on promoting responsible behavior and adherence to traffic regulations. By addressing driver behavior and promoting a culture of safe driving, it is possible to reduce the incidence of road traffic accidents in Iraq and create a safer environment for all road users (Al-Shamsi (2022)). According to research conducted by Bashaer Diah et al. (2017), a higher proportion of mortalities were reported due to road traffic injuries (RTIs) during the period of 2010-2014. The trend of RTI fatalities reached its peak in 2012 and declined in the following two years. According to Nahla Hafidh Jawad's 2017 study, the three-time series (dead accidents, number of deaths, and number of injuries) are

projected to increase significantly in the planning periods. However, the time series related to non-dead accidents shows a stable trend along the projection periods, as indicated by the magnitude of residuals and the studied indicators. The general mean line supports this finding (Optimal Statistical Models (2017)).

2.5 Accidents ratio in Iraq

The direct effect on the accident rate in Iraq can be influenced by several factors:

2.5.1. Road user's behavior

The driver was found to be the primary cause of accidents, with a ratio of 36% in Baghdad city where the total number of accidents was 2379. The study found that driver behavior, such as speeding, disregarding traffic signs, and failing to use seat belts, was a major cause of accidents. Additionally, the study identified road infrastructure deficiencies, such as poorly designed intersections and lack of lighting, as contributing factors to accidents. The study recommends improving road infrastructure, enhancing traffic law enforcement, and increasing public awareness of road safety by Sajjad Ali Mangi, Luqman Ehsan Ullah, and Nadeem Abbas (2021). Road traffic accidents are a serious problem worldwide, causing a significant number of deaths and injuries every year. Many studies have been conducted to understand the causes of road accidents, with a particular focus on road user attributes such as age, gender, education level, and driving experience. In Iraq, as in many other countries, young male drivers with low levels of education and driving experience are the most involved in road accidents. Improper use of safety belts, high speed, and reckless driving have been identified as major causes of these accidents. To address this issue, researchers have recommended measures such as improving road infrastructure, enforcing traffic laws, and increasing public awareness of road safety. These studies are essential in providing insight into the factors that contribute to road accidents and in formulating effective strategies to prevent them. (Ali Al-Gburi and Imad Abdulameer Ali (2021). In a study published in the International Journal of Injury Control and Safety Promotion in 2018, Ali S. Hadi and May Al-Khafaji aimed to analyze the patterns and trends of pedestrian crashes in Iraq, while also evaluating the impact of daylight savings time on such crashes. The findings of the study suggested that pedestrian accidents were more frequent in urban areas and during peak traffic hours, and the implementation of daylight savings time led to a

noteworthy decrease in pedestrian crashes. The study also emphasized the significance of enhancing road safety measures for pedestrians, including safer pedestrian crossings, better street lighting, and more extensive public awareness campaigns. Abduljabar Kadhim Al-Obaidi and Alaa S. Abood conducted an analysis of road traffic accidents in Iraq, as published in the International Journal of Engineering and Technology in 2017. The study aimed to identify road user attributes that were associated with accidents, such as age, gender, and education level. The study found that young male drivers with lower levels of education were more frequently involved in road traffic accidents. Additionally, the study revealed that improper use of safety belts, high speed, and improper turning were identified as the primary causes of crashes. (Hadi 2018, Al-Obaidi, 2017).

2.5.2 Roads conditions

The effect of road and street conditions on the occurrence and severity of accidents is widely recognized, as reported in various studies. Poor road conditions are considered a crucial risk factor for accidents. For instance, studies have established a proportional relationship between hourly traffic volume or stopped time delay at intersections and the number of traffic conflicts, which is a proxy for crashes. Traffic density also has a significant impact on collisions. Intersection geometry has been found to affect conflict rates as well. Moreover, excessive speeding has been shown to be a significant contributor to both the occurrence and severity of collisions. However, one study suggested that in urban areas, the mortality rate is not significantly linked to the traffic and geometric features of the roads. (Khalid A. Al-Sultan and Ali H. Al-Khafaji (2019).

2.5.3. Weather conditions

A bustling city in Iraq, where cars and motorcycles zip through the streets, and pedestrians rush to get to their destinations. With so much activity on the roads, accidents can happen at any moment. To better understand the factors contributing to these accidents, researchers have conducted studies on road safety in Iraq. One such study, published in the Journal of Traffic and Transportation Engineering in 2019 by Ali Al-Gburi and Imad Abdulameer Ali, focused on the relationship between weather conditions and road traffic accidents. Their findings revealed that while clear weather was the most common condition at the time of accidents, certain weather factors such

as rain and dust storms significantly increased the risk of collisions. The study also showed that weather conditions had a greater impact on accidents involving pedestrians and motorcycles. This research highlights the need for road safety measures to be adapted to different weather conditions, especially in areas with high pedestrian and motorcycle traffic. By taking into account the effects of weather on road safety, we can work towards reducing the risk of accidents and promoting safer road use for all. (Ali Al-Gburi (2019)).

2.5.4. Vehicle's conditions

A recent study conducted by Ali and Abbas (2021) investigated the impact of vehicle conditions on road traffic accidents in Iraq. The study found that four-wheel vehicles, particularly passenger cars, were involved in a significant proportion of collisions, with vehicles contributing to approximately one-quarter of all accidents. The study also highlighted the importance of periodic maintenance for reducing the occurrence of crashes, and emphasized the need for drivers to use technological safety measures such as seat belts and airbags to reduce the risk of injury and mortality. Additionally, the study suggested the adoption of an Intelligent Transport System (ITS) pre-crash system to remotely monitor vehicle speeds and warn drivers and monitoring centers of potential crashes. The findings of this study highlight the need for continued efforts to improve vehicle conditions and promote the use of safety measures to reduce the number of road traffic accidents in Iraq (Ali, S., (2021)).

2.6 Development of a Computer System That Provides Domain of Highway Safety

In Iraq, the issue of highway safety is compounded by a lack of expertise and limited practical experience in the field. Qualified highway safety personnel are in short supply, and their distribution across the country is inadequate. This situation underscores the urgent need for the development of a computerized system that can offer professional advice and guidance in the realm of traffic safety. The primary objective of a recent study by Al-Jameel, H. A. 2022, was to create an innovative expert system specifically designed to address the prevailing highway safety challenges in Iraq.

The expert system comprises two distinct phases that work in tandem to enhance highway safety. The initial phase, known as the diagnostic phase, involves posing a

series of concise and targeted questions to the user. These questions are designed to facilitate the identification of specific issues, enabling the system to provide informed insights into the likely causes. The subsequent phase, referred to as the cure phase, centers around the selection of appropriate measures and defenses for each identified cause. This process is supported by a comprehensive methodology that encompasses the identification of thirteen accident patterns, including but not limited to right-angle collisions, rear-end collisions, left-turn collisions, and right-turn collisions. The collaboration of two specialist groups, namely operators and engineers, is instrumental in developing the system. Moreover, the incorporation of specialized references ensures a comprehensive approach to tackling this complex issue.

Analysis of accident statistics reveals that Baghdad experiences the highest incidence of accidents compared to other cities in Iraq. Furthermore, in comparison to other countries, Iraq witnesses an alarming number of fatalities resulting from accidents. Thus, the pressing need for an effective and practical solution to enhance highway safety is evident. The developed expert system serves as a valuable tool, particularly for inexperienced site engineers and operators who may lack access to seasoned professionals. It empowers them to make prompt and accurate decisions, even in the absence of an experienced engineer. Through rigorous evaluation, the system has demonstrated a remarkable level of effectiveness, reliability, and efficiency, instilling confidence in its potential to significantly improve highway safety in Iraq (Al-Jameel, H. A. (2022).)

3. METHODOLOGY AND STUDY AREAS

3.1 Purpose

The purpose in this chapter clarification of ways and tools that are used to study and analyze the problem of traffic accidents in Iraq based on the summary of the theoretical study that was reached.

3.2 The Research Methodology

The research methodology for the present study is a qualitative approach. The General Traffic Directorate - Ministry of Interior Central Statistical Organization - Ministry of Planning Department of Roads and Bridges - Ministry of Construction, Housing and Public Municipalities were used to collect data. The SPSS software will be use in the statistical analysis process of the collected data and this study was conducted in Iraq. The purpose of the present study is:

1. To identify the key factors causing traffic accidents and sources of generating this problem in Iraqi roads and other information by using the questionnaire survey.
2. To propose suitable treatments to reduce traffic accidents by conducting experts' interviews.
3. To find the relationship between the main traffic accident elements by reviewing the related records, gathering the required data from the government directorates, and making the correlation test.

3.3 The Study Area

Iraq is divided into 19 provinces (with Halabja governorate), and these provinces as shown in Figure (3.1), in turn, are divided into districts. There are 120 districts in Iraq. Baghdad Governorate, which includes the city of Baghdad, is the most populous governorate in Iraq with 7,600,000 people, while Muthanna Governorate is the least populous with no more than 775,000 inhabitants. Anbar province is the largest province in Iraq with an area of 138,500 square kilometers, while the smallest

province is Baghdad province, with an area of 4,555 square kilometers. In this study, we focus on three out of the nineteen provinces that have a high level of traffic accidents.



Figure 3.1: Iraq Map with Provinces distribution

Source: (Google Images)

3.3.1 Baghdad

- Location: Baghdad is located in the middle of Iraq along the Tigris River. It is the capital of Iraq and is the largest city in the country.
- Population: The estimated population in 2023 was around 7-8 million people.
- Weather: Baghdad has a hot desert climate, with very hot summers and mild winters. Temperatures can reach over 40 degrees Celsius in summer.
- Road Conditions and Traffic Accidents: As of 2023, road conditions in Baghdad were generally poor due to conflict and lack of maintenance. Traffic accidents were relatively common, partly due to poor road conditions and lack of adherence to traffic rules.

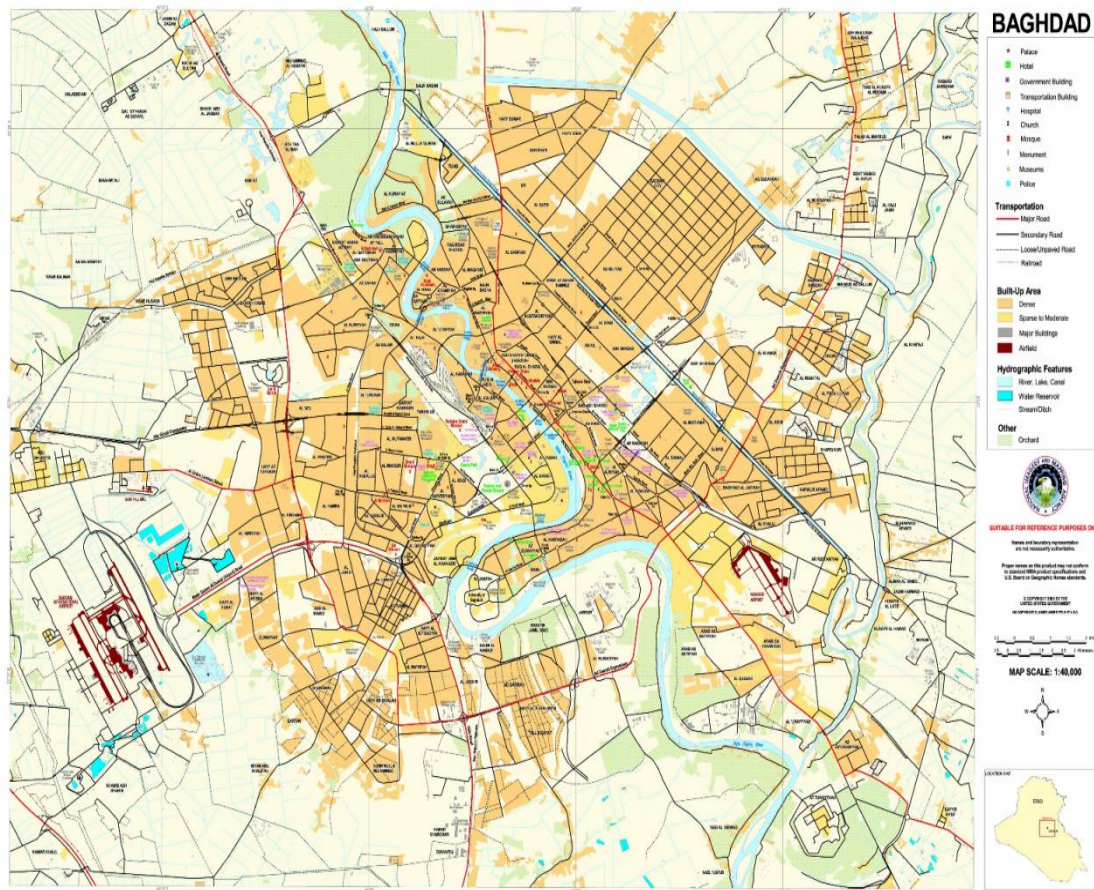


Figure 3.2: Large Detailed Road Map of Baghdad City

Source: (Map Island)

3.3.2 Basrah

- Location: Basrah is located in the southern part of Iraq, near the border with Kuwait. It is the principal port of Iraq.
- Population: The estimated population in 2023 was around 2.5 million people.
- Weather: Basrah also has a hot desert climate, with extremely hot summers and mild winters. Temperatures often exceed 50 degrees Celsius in summer.
- Road Conditions and Traffic Accidents: As depicted in Figure (3.3) road conditions in Basrah, as with many parts of Iraq, were variable as of 2023. As a busy port city, traffic can be heavy, and accidents are common.

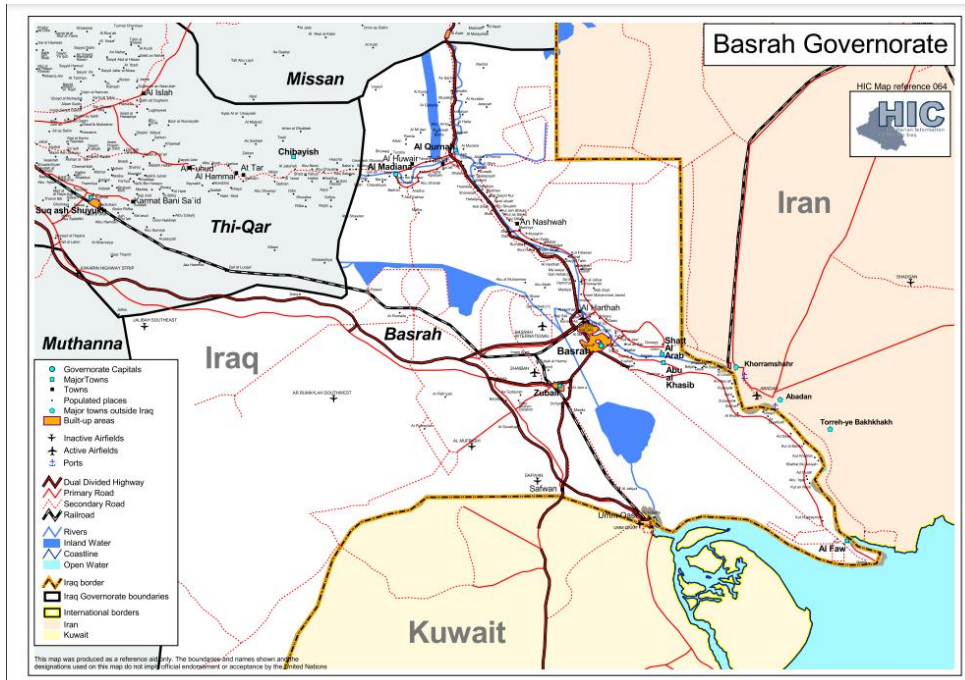


Figure 3.3: Map of Basrah City Roads

Source: (ecoi.net)



Figure 3.4: Major Streets in Al-Najaf City

Source: (Al-Jameel, H., 2017)

3.3.3 Najaf

Figure (3-4) shown the map of roads network of roads in Al-Najaf

- Location: Najaf is located in south-central Iraq. It is an important spiritual and political center for Shia Muslims.
- Population: The estimated population in 2023 was around 1.5 million people.
- Weather: Najaf has a desert climate, with hot summers and cool winters. Summers can be extreme, with temperatures often exceeding 40 degrees Celsius.
- Road Conditions and Traffic Accidents: As of 2023, road conditions in Najaf were variable. Najaf, being a city of religious significance, sees significant traffic, particularly during religious events, and traffic accidents are unfortunately a common occurrence.

3.4 Conducting Questionnaire Survey

The questionnaire survey is an important source of acquiring field information about traffic accident problems in Iraq. The questionnaire includes the following steps and illustrated in Figure (3.5):

1. Designing the questionnaire form and establishing the lines of questions.
2. Distributing the questionnaire form to the study sample, then collecting the questionnaire forms
3. Performing the statistical analysis.

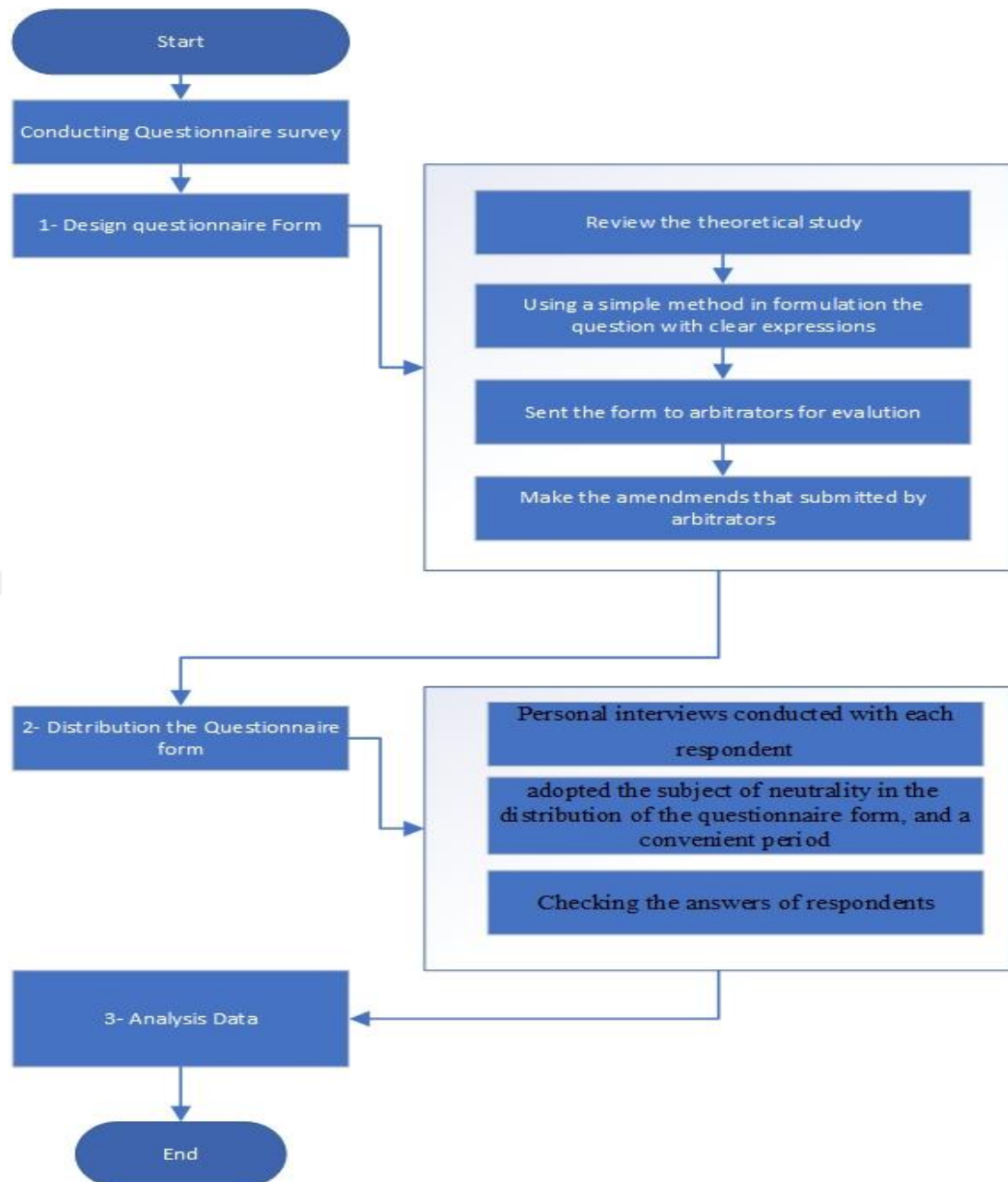


Figure 3.5: A Flowchart for the Questionnaire Survey Process

3.4.1 Designing the Questionnaire Form

Based on the summary of the theoretical study in Chapter Two (which highlighted the elements of traffic accidents), the questionnaire form was designed with a simple method with clear managerial expressions, which enable all the respondents to answer the questions easily. The questionnaire form was sent to three arbitrators to evaluate the purpose; they have long experience not less than 20 years in project management. Table (3.1) shows the information about arbitrators.

Table 3.1: Arbitrators' Personal Information

Arbitrators	Experience (Years)	Work Sector	Scientific degree
Number 1	22	Public	Ph.D
Number 2	26	Public	Ph.D
Number 3	36	Public	B.Sc

The amendments were made along with the additional recommendation submitted by the arbitrators, and the questionnaire was developed in its final form. The version of the questionnaire form that was distributed among the respondents was in the Arabic language. The questionnaire form includes the following parts:

- Part One: general information about sample size.
- Part Two: Information related to traffic accidents in Iraq.

3.4.2 Distributing and Collecting the Questionnaire Form

One hundred thirty questionnaire forms were distributed to engineers working in the construction industry in Iraq, under some of the following actions:

- 1- Personal interviews were conducted with each respondent (face to face and by Google form) to resolve any misunderstanding regarding the questions of the questionnaire.
- 2- The researcher adopted the subject of neutrality in the distribution of the questionnaire form, and a convenient period was given to each respondent to complete the form answer.
- 3- Each respondent submitted his answers, which were checked thoroughly to ensure that the questionnaire form was completed.

One hundred twenty-four questionnaires were answered; six of these questionnaires that have errors were excluded.

3.4.3 Mathematical and statistical methods that using in questionnaire analysis

The next step is to find a specified method for statistical analysis and procedures to perform calculations, this study adopted the following procedures:

- 1- Calculate the arithmetic mean for ranking the answers.
- 2- Perform the validity and reliability test, on the questionnaire questions, which were used in data collection.

- 3- The Chi-square test, shows whether there are statistically significant differences between the responses of the sample or not.

3.4.3.1 Calculating the arithmetic mean

To quantify data analysis and calculate the arithmetic mean, it is required to identify a hypothetical weight value (WV), for each answer of the five-scale Likert that was adopted in this survey, as illustrated in Table (3.2). So, the length of the interval to move from the arithmetic mean level to other five-scale Likert is $(4/5 = 0.8)$ where 4 is the number of intervals between options, and 5 is the number of options.

Table 3.2: Weight Value of Descriptive Frequencies

<i>Descriptive Frequency</i>	<i>Class Interval</i>	<i>Weight Value (WV)</i>
<i>Very low</i>	$1 \leq \text{Class Interval} \leq 1.8$	1
<i>Low</i>	$1.8 < \text{Class Interval} \leq 2.6$	2
<i>Medium</i>	$2.6 < \text{Class Interval} \leq 3.4$	3
<i>High</i>	$3.4 < \text{Class Interval} \leq 4.2$	4
<i>Very high</i>	$4.2 < \text{Class Interval} \leq 5$	5

3.4.3.2 Validity and reliability test

Based on the previous studies, validity has many definitions to reflect the questionnaire content required measuring it according to relative weights for making sure from the validity of the tool, where the achievement of validity is more important than the achievement of reliability because the test may be characterized by reliability but it is not with validity. By sending the questionnaire form to a panel of experts for evaluation, the validity of the questionnaire was verified. The researcher then implemented the revisions and additions suggested by the arbitrators. Reliability of the questionnaire means giving the questionnaire the same results when re-applying several times on the same sample under the same conditions, in other words, the reliability of the questionnaire means stability in its results that do and does not change significantly as a result of re-distributed several times in the sample during the periods certain. Frequently the coefficient of alpha was used to measure the reliability of scales that measure the trends as a scale of Likert, coefficient of alpha gives the minimum limit for the value estimate of the reliability coefficient, If the value of alpha is high (close to one), this already indicates the high reliability of the questionnaire. The alpha coefficient expresses the degree of internal consistency

of the scale that ranges between 0 to 1 (Rao, and Culas, 2014), and the coefficient of Cronbach Alpha is supposed to be not less than 0.70 (Varghese, and Varghese, 2015).

The reliability of the study tool was checked by calculating (α) using the program of statistical package for social sciences (SPSS V. 19).

Table (3.3) illustrates the reliability coefficient (Cronbach's Alpha α) equal to 0.99 for Fifteen causative factors of traffic accidents in Iraq, and 0.984 for the nine sources of traffic accidents in Iraq. The researcher next ran validity and reliability tests on each component of the questionnaire. The reliability coefficients' findings are positive across the board, and the study tool's reliability coefficients are all high, demonstrating that the questionnaire's questions have a high degree of stability in addition to validity.

Table 3.3: The Reliability Coefficient (Cronbach's Alpha α) for the Causative Factors and Sources of Traffic Accidents

Reliability Statistics	Cronbach's Alpha	N of Items
The causative factors	0.990	15
The sources of Traffic accidents	0.984	9

3.4.3.3 The chi-square test

The Chi-square test was used to find the effect of the factors causing a traffic accident in Iraq. The Chi-square value was obtained by using equation (3-1) and calculated Chi-square value of the table method with the degree of freedom (DF = n-1), and the level of significance equal (0.05) (Kibrom, A., & Kifle, M. (2019).

$$\text{Chi square } (\chi^2) = \sum_{i=1}^k \frac{(O_i - E_i)^2}{E_i} \quad (3.1)$$

Where:

χ^2 : The Chi-square Value; O_i : the observed data; E_i : the expected data.

To find out whether the causative traffic accidents factors extracted from the questionnaire have statistically significant differences between the responses of the sample or not, the following hypotheses were utilized (Lord, D., & Mannering, F. (2017):

Null hypothesis (H_0): There are no statistically significant differences between the responses of the sample if the value of Chi-square is calculated < value of Chi-square by the table.

Alternative hypothesis (H_1): There are statistically significant differences between the responses of the sample if the value of Chi-square is calculated greater than the value of Chi-square by the table.

The results showed that the all values of the Chi-Square calculated for all factors are larger than the value of the Chi-Square obtained from the table. So, the decision is made to reject (H_0) and accept the alternative hypothesis (H_1), meaning that there are statistically significant differences between the responses of the sample and all the factors causing traffic accidents on Iraqi roads. Then the Chi-square test was conducted for the sources of traffic accidents in the questionnaire form, the result also accepts the alternative hypothesis (H_1) and rejects the null hypothesis (H_0) (de Ona, J., Mujalli, R. O., & Calvo, F. J. (2021)).

3.4.4 Analysis and discussion of the questionnaire form

The analysis of the questionnaire form is divided into two parts, as follows:

- 1- Part One: General Information.
- 2- Part Two: Information related to traffic accidents on Iraqi roads

3.4.4.1 Part one: general information

This part contains questions related to the study sample characteristics; the answers had analyzed according to the following:

Figure (3.6) shows the work sector of the sample size. While the academic degree, and work experience years are given in Figures (3.7 and 3.8) respectively.

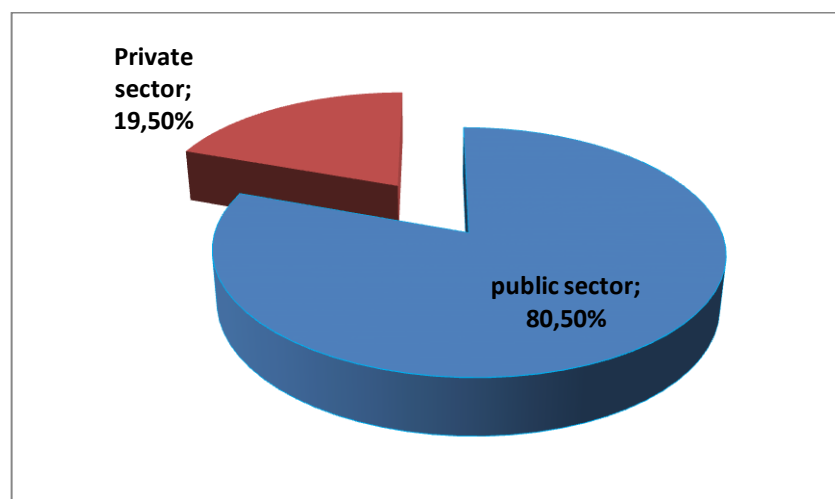


Figure 3.6: Percentage of Study Sample About Public and Private Sectors

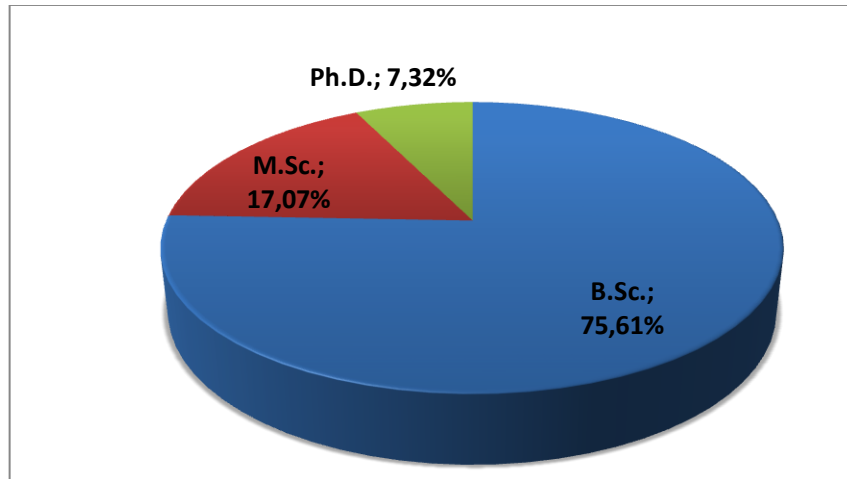


Figure 3.7: Percentage of the Study Sample of the Academic Degree

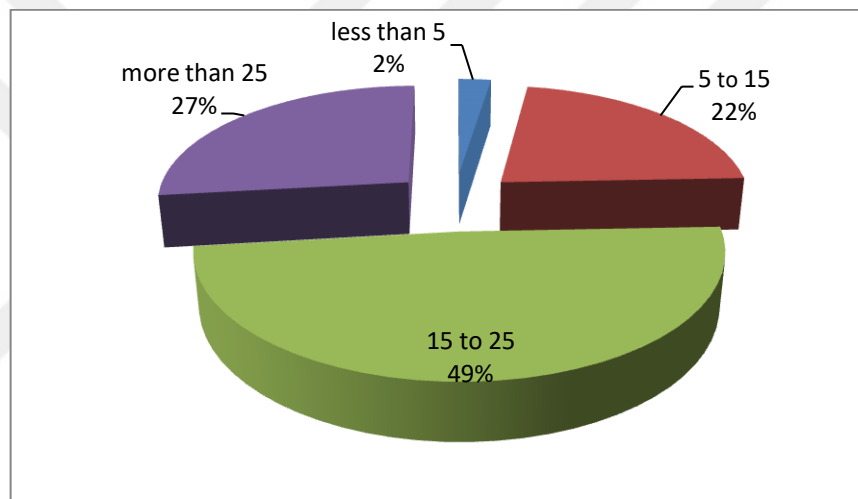


Figure 3.8: Percentage of Study Sample of Experience Years

3.4.4.1.1 Conclusion from part one results

The results of part one show that the selected sample size is an appropriate representation of the roads sector in Iraq, due to the variation in the years of experience and the academic degree. This indicates that the results of the field study will be as realistically closer to the truth on the subject of research.

3.4.4.2 Part Two: Information related to traffic accidents on Iraqi roads

This part aims to study traffic accidents problems (causes, sources, solutions, and others), the questions concerning this part were answered as the following:

Q.1 What is the impact of the following factors on the causing of traffic accidents in Iraq?

According to the participants' opinions and after the use of the statistical program (SPSS) to calculate the arithmetic mean (AM), the standard deviation (S.D), and the value of Cronbach Alpha (α) for the list of factors causing the traffic accidents that obtained from the theoretical study and the field visits. The results of this question are illustrated in Table (3.4).

To identify the key causative factors of traffic accidents in Iraq, the research is focused on the factors that have a very high and high impact to occur traffic accidents in Iraqi roads. So, it was concluded from the statistical analysis results that Nine factors have a very high and high impact as shown in Figure (3.9) and Table (3.5).

The researcher will gather the related information and records for these key causative factors in chapter four.

Table 3.4: The Results of Statistical Analysis for Causative Factors of Traffic Accidents in Iraq

No.	ID	Causes	N	Mean	SD	Degree of Impact
1.	F1	Road's maintenance	124	3.8710	1.12595	High
2.	F2	The presence of concrete barriers (castings)	124	2.6694	0.98544	Medium
3.	F3	Driver's age, driver's gender (man or woman)	124	2.6935	1.23089	Medium
4.	F4	Driving under the influence of drugs	124	4.2339	0.90265	Very high
5.	F5	Driving reverse direction	124	4.5081	0.82142	Very high
6.	F6	Effect of Weather	124	3.4010	1.02384	High
7.	F1	Road's maintenance	124	3.8710	1.12595	High
8.	F2	The presence of concrete barriers (castings)	124	2.6694	0.98544	Medium
9.	F3	Driver's age, driver's gender (man or woman)	124	2.6935	1.23089	Medium
10.	F4	Driving under the influence of drugs	124	4.2339	0.90265	Very high
11.	F5	Driving reverse direction	124	4.5081	0.82142	Very high
12.	F6	Effect of Weather	124	3.4010	1.02384	High
13.	F7	Noncompliance with the traffic signal	124	3.6694	1.20785	High
14.	F8	Increased branching on main roads	124	3.201	1.00389	Medium

Table 3.4: (Cont.) The Results of Statistical Analysis for Causative Factors of Traffic Accidents in Iraq

No.	ID	Causes	N	Mean	SD	Degree of Impact
15.	F9	Driving without License	124	3.629	1.10039	High
16.	F10	Out allowed roundness	124	2.8145	1.10701	Medium
17.	F11	Lack of attention	124	3.5645	1.09872	High
18.	F12	Street lighting	124	3.9194	1.01690	High
19.	F13	The driver does not wear a seatbelt	123	3.1301	1.15204	Medium
20.	F14	High speed	124	3.9516	0.96991	High
21.	F15	The wrong pass	124	2.9032	1.14352	Medium

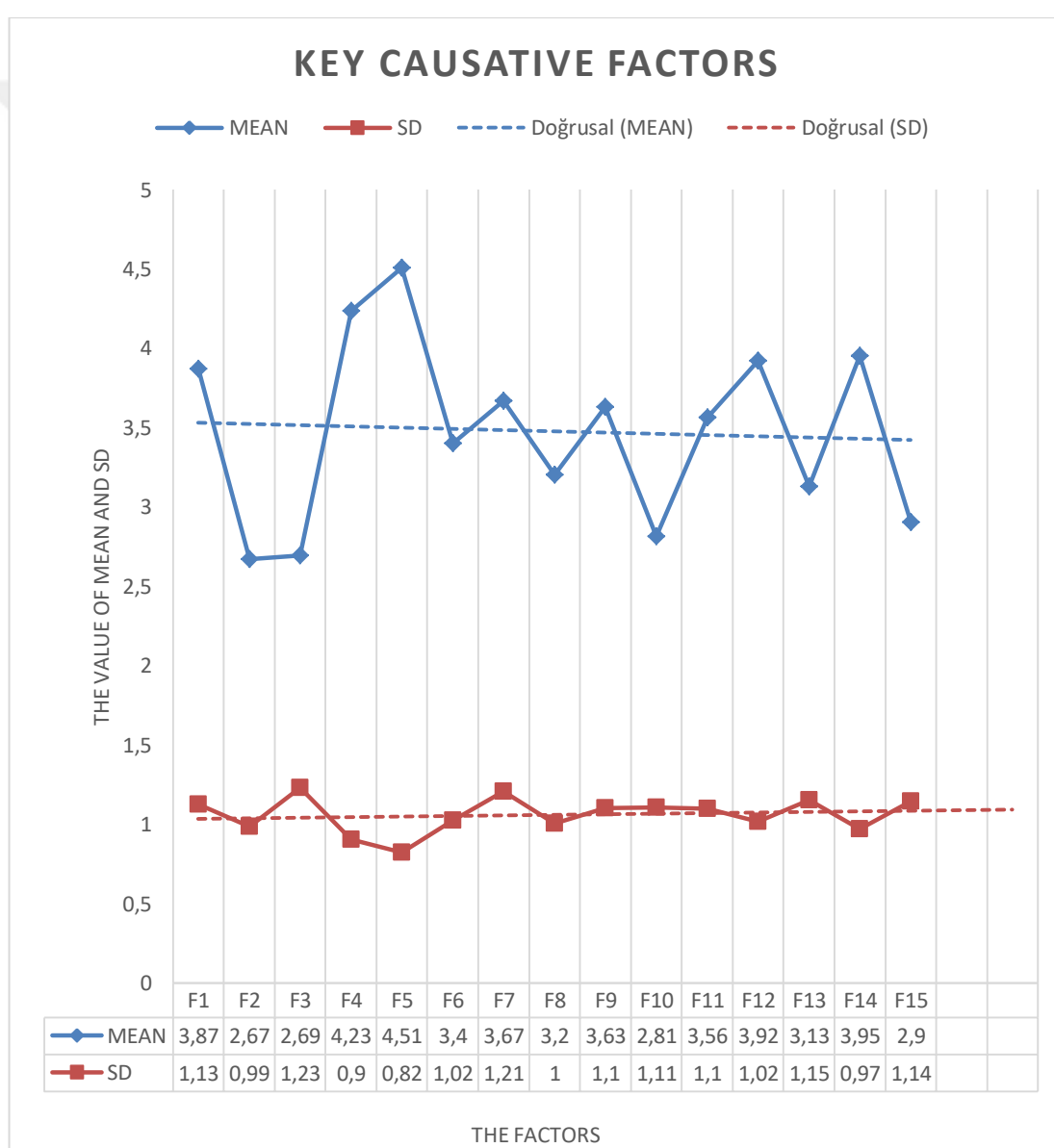


Figure 3.9: Indicators of Key Causative Factors for Traffic Accidents

Table 3.5: The Key Causative Factors for Traffic Accidents Problem

No.	ID	Causes	N	Mean	SD	Impact
1.	F5	Driving reverse direction	124	4.5081	0.82142	Very high
2.	F4	Driving under the influence of drugs	124	4.2339	0.90265	Very high
3.	F14	High speed	124	3.9516	0.96991	high
4.	F12	Street lighting	124	3.9194	1.01690	high
5.	F1	Road's maintenance	124	3.8710	1.12595	high
6.	F7	Noncompliance the traffic signal	124	3.6694	1.20785	high
7.	F9	Driving without License	124	3.6290	1.10039	high
8.	F11	Lack of attention	124	3.5645	1.09872	high
9.	F6	Effect of Weather	124	3.4010	1.02384	high

Q.2 What are the sources/origins of the traffic accidents problem?

The collected data from participants for identifying the sources of traffic accidents were analyzed using a statistical program (SPSS) for computation of the arithmetical mean (AM) and standard deviation (S.D) with high accuracy. Table (3-6) is summarized the results of the arithmetical mean and standard deviation for the sources of traffic accidents problem in Iraq.

These results show that all sources of traffic accidents having a mean value of more than 3.4 (as mentioned in Table 3.2) So, this refers to acceptable importance with a range from medium to very high degree.

Table 3.6: The Results of Statistical Analysis for Sources/Origins of Traffic Accidents in Iraq

No.	ID	Sources	N	AM	SD	Degree
1.	S1	A car moving very fast	124	4.4113	0.80660	Very High
2.	S2	A car parked in a place other than the designated parking place	124	3.7984	0.91935	High
3.	S3	The presence of an electricity pole in the main streets or installed in an inappropriate location on the street	124	3.4032	1.01948	High
4.	S4	Crossing an animal from the roads designated for the movement of vehicles	124	3.4355	1.10609	High

Table 3.6: (Cont.) The Results of Statistical Analysis for Sources/Origins of Traffic Accidents in Iraq

No.	ID	Sources	N	AM	SD	Degree
5.	S5	Motorcycles driving near vehicles and without a safety distance	124	4.1613	0.94040	High
6.	S6	The presence of a fence in the street that obstructs the movement of the vehicle	124	3.3548	1.00562	Medium
7.	S7	The progress of the fence of the house on the street (exceeding its area and crossing the street)	124	3.3710	1.12234	Medium
8.	S8	Train route	124	3.4516	0.98240	High
9.	S9	Others	124	3.4274	1.16990	High

Table (3.7) describes the sources of traffic accident ranked from the very high to least important. The source of " A car moving very fast" has a very high importance with arithmetical mean equal (4.4113), and followed by the source of " A car parked in a place other than the designated parking place" has a high importance with mean value equal 3.7984, as shown in Figure (3.10).

Table 3.7: The Key Sources of Traffic Accidents Problem

No.	ID	Sources	N	AM	SD	Degree
1.	S1	A car moving very fast	124	4.4113	0.80660	Very High
2.	S5	Motorcycles driving near vehicles and without a safety distance	124	4.1613	0.94040	High
3.	S2	A car parked in a place other than the designated parking place	124	3.7984	0.91935	High
4.	S8	Train route	124	3.4516	0.98240	High
5.	S4	Crossing an animal from the roads designated for the movement of vehicles	124	3.4355	1.10609	High
6.	S9	Others	124	3.4274	1.16990	High
7.	S3	The presence of an electricity pole in the main streets or installed in an inappropriate location on the street	124	3.4032	1.01948	High
8.	S7	The progress of the fence of the house on the street (exceeding its area and crossing the street)	124	3.3710	1.12234	Medium
9.	S6	The presence of a fence in the street that obstructs the movement of the vehicle	124	3.3548	1.00562	Medium

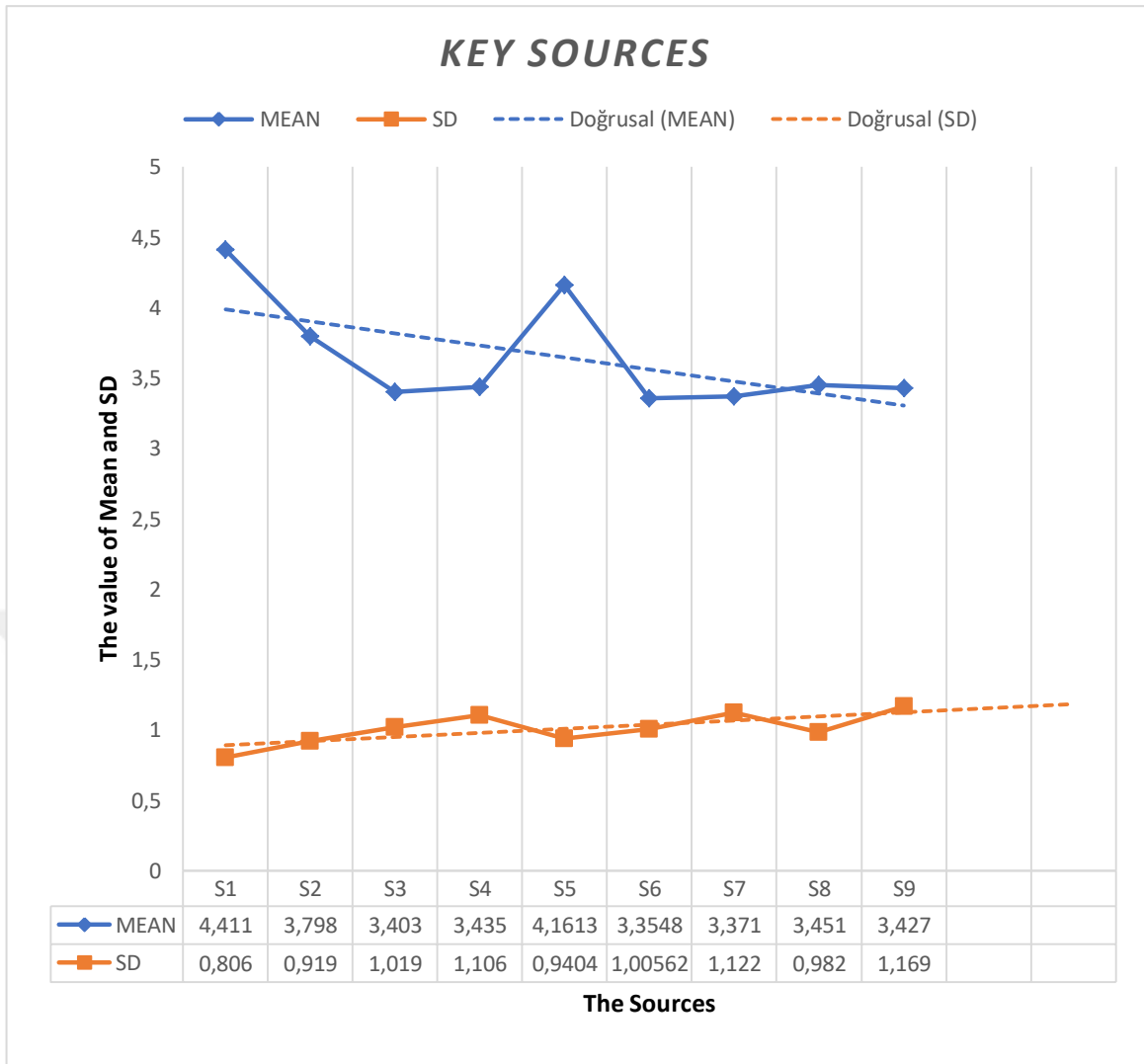


Figure 3.10: Indicators of Key Sources of Traffic Accidents

Q.3 Other Information Related to Traffic Accidents

After analyzing the collected answers of participants, the researcher concluded that there is no real effective system to manage the process of road maintenance.

Also, there is a lack of knowledge by the competing directorates about the ad-hoc systems for the maintenance of the roads and the safety of drivers and people.

The results also referred to 20 % of drivers in Iraq not having a driver's license, as shown in Figure (3.11), so this indicator considers one of the main causes of traffic accidents in Iraq.

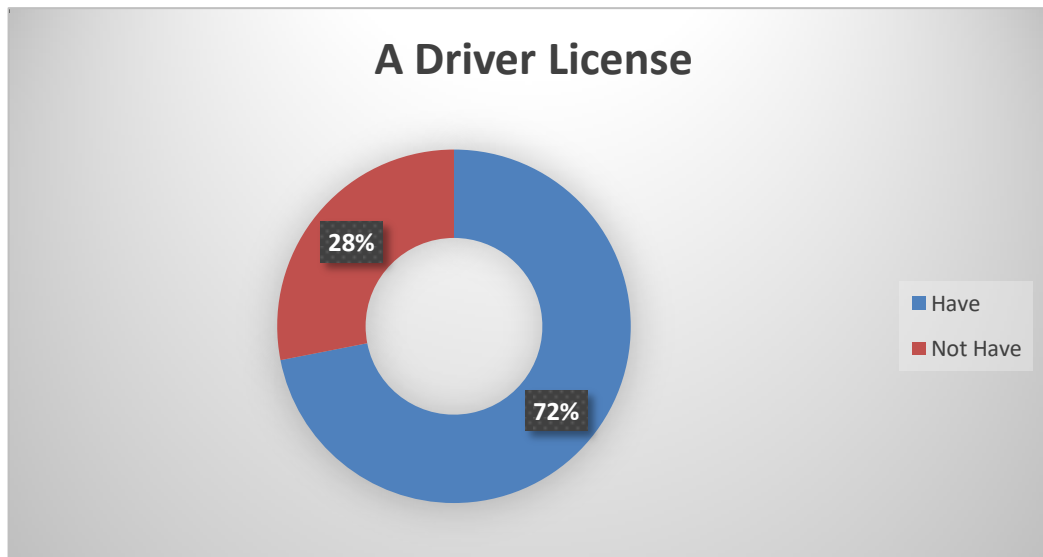


Figure 3.11: A Rate of Having a Driver's License in Iraq

3.5 Experts Interviews

To gather more information about the problem of traffic accidents on Iraqi roads, personal interviews were conducted with a group of experts, who have more than fifteen years of experience in the design and construction of roads and traffic systems. They are working in the competent departments in the Iraq government, such as: (the Mayoralty of Baghdad, the National Center for Engineering Consultancy, Bridges & Roads Directorate, Hamorabi Company for Construction Contracting), as well as a range of private sector companies.

Based on the following criteria, a group of experts was chosen to offer recommendations on the best way to reduce/avoid traffic accidents on Iraqi roads:

1. They have extensive working experience in the construction industry in Iraq.
2. They are involved in the management of construction projects in Iraq.
3. The willingness to take part in this process.

Twenty people in total were invited to take part. The purpose of the study was stated in the invitation, and it was made plain to the experts that they may select to receive the survey via email or directly. Sixteen respondents, including four from the private sector and twelve from the public sector, gave their permission to participate. The academic degrees, field of specialization, and work sector for the experts are given in Figures (3.12, 3.13, and 3.14) respectively.

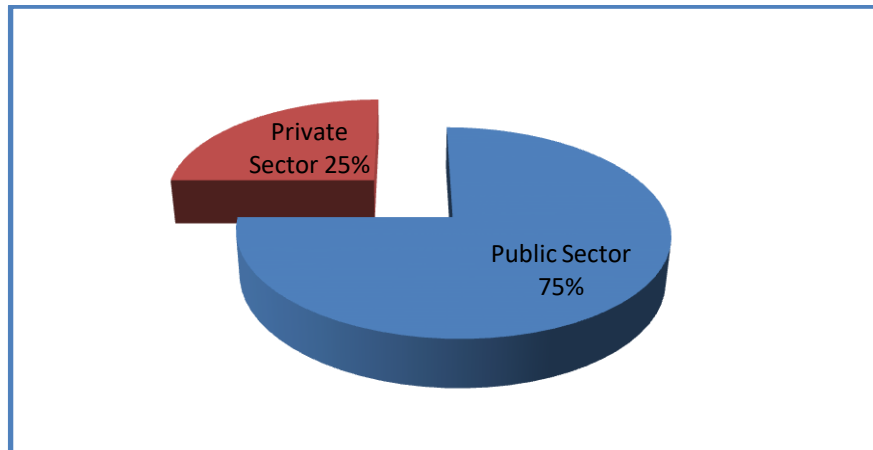


Figure 3.12: Experts from Work Sector

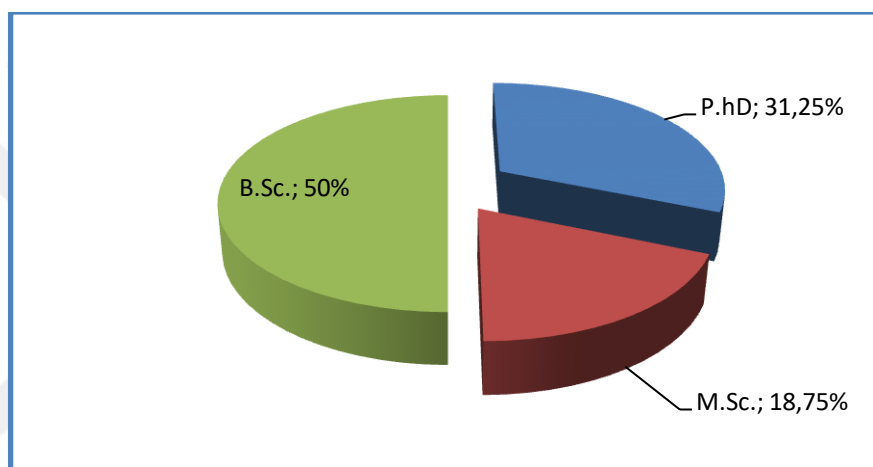


Figure 3.13: Expert's Academics Degree

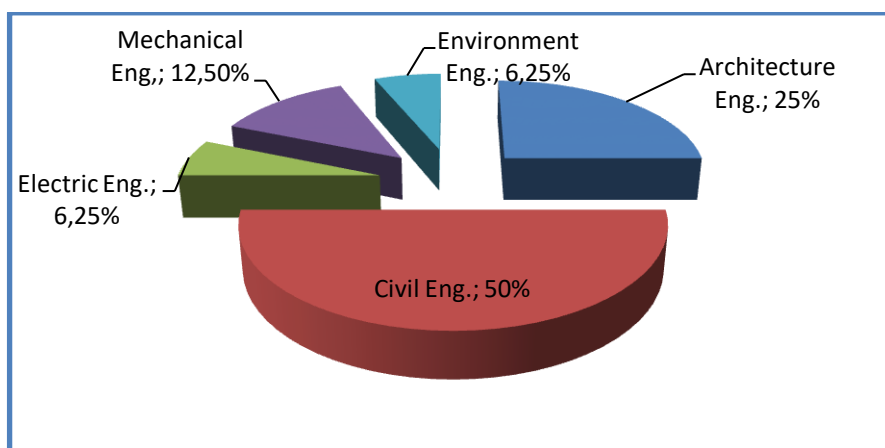


Figure 3.14: Field of Specialization for Experts

The results from these interviews identified a list of proposed solutions to avoid the traffic accidents problem on Iraq roads as shown in Table (3-8). In addition, it contributed to helping the researcher of this study understand the problem and give a roadmap for the next chapter.

Figure 3.15: A list of Proposed Solutions to Avoid/Reduce Traffic Accidents in Iraq

No.	The Proposed Solution
1.	Follow-up of people driving underage and over speeding
2.	Attention while driving.
3.	Road development and maintenance and enforcement of harsh traffic law
4.	The most important are lighting, street planning, and a phosphorous sign on both sides of the road
5.	Educating the community, making laws for all, and improving public streets
6.	The presence of cameras in the streets and radar devices, determining the speed of driving in the streets, imposing high fines in order not to repeat mistakes
7.	Attention to paving roads, reducing the number of cars, providing the necessary lighting and traffic signs, organizing driving courses
8.	Motorcycles and tuk-tuks are not allowed to walk in the streets without numbers and a driving license, as well as activating traffic lights in the main and secondary streets
9.	Restructuring the roads and constructing new streets under new and regular standard specifications. monitoring the street with radar, speed control, and the deployment of traffic signs
10.	Every driver must get a driver's / road repair license
11.	Abide by all traffic laws
12.	Activating surveillance cameras and fining anyone who violates the laws and activating traffic lights
13.	Activating the supervisory and penal role.

4. EMPIRICAL RESULTS AND DISCUSSIONS

4.1 Purpose

The purpose in this chapter clarification of the empirical results and ways that are used to study and analyze the problem of traffic accidents in Iraqi roads based on the summary of the theoretical study that was reached. The methodology followed in carrying out this chapter involves the collecting and analyzing of the data obtained from the related governorate institutions, in addition, to the discussion of the results.

4.2 Data Acquisition

For identifying the size of traffic accidents problem in Iraq and collect the details information on the problem, the relevant data were collected on the traffic accidents problem from each province by visiting the General Directorate of Traffic, Ministry of Construction, Housing, and Public Works, and Mayoralty of Baghdad. The visits included reviewing of the records of accidents, meeting with project managers and specialized engineers, the monthly reports, and study the methodology followed in execution the solutions.

The network of roads and highways has a total length of 59,623 kilometer. For each of the country's 43.53 million inhabitants, this corresponds to 1.37 meters. This puts Iraq in 190th place in the global ranking. The national road classification (practical study)

1. Expressway with length 1,084 kilometer.
2. Arterial roads with length 11,000 kilometer.
3. Rural roads with length 10,000 kilometer.
4. Secondary roads with length 15,200 kilometer.
5. Border roads with length 11,000 kilometer.

Table (4.1) shows the number of traffic accidents that occurred in each province during the five years (2017 to 2021), Al Basrah province was recorded the highest

rate of traffic accidents during this duration and followed by Baghdad province and followed by Al-Najaf province as shown in Figure (4.1). According to these results, the size of the problem in Iraq considers a high.

So, this study is depended on the following provinces (Basrah, Baghdad, and Al-Najaf) in making the correlation test between the nature of accidents and type of road as shown in the next paragraph.

Table 4.1: Number of Traffic Accidents in Iraqi Provinces

Province	Number of Traffic Accidents					Total Number
	2017	2018	2019	2020	2021	
Nineveh	0	191	205	232	324	952
Saladin	162	164	180	228	320	1054
Kirkuk	232	228	244	259	382	1345
Diyala	679	774	953	631	874	3911
Al - Anbar	0	298	377	416	612	1703
Baghdad	1015	1023	1193	871	1145	<u>5247</u>
Babylon	830	945	1127	830	916	4648
Karbala	570	587	537	409	405	2508
Al - Najaf	1057	1041	1148	778	1078	<u>5102</u>
Al-Qadisiyah	869	897	902	587	681	3936
Al-muthanna	401	397	370	341	368	1877
Dhi-Qar	796	847	821	575	739	3778
Wasit	756	763	889	708	911	4027
Missan	277	252	346	298	328	1501
Basrah	1180	1445	1461	1023	1576	<u>6685</u>
Total	8824	9852	10753	8186	10659	48274

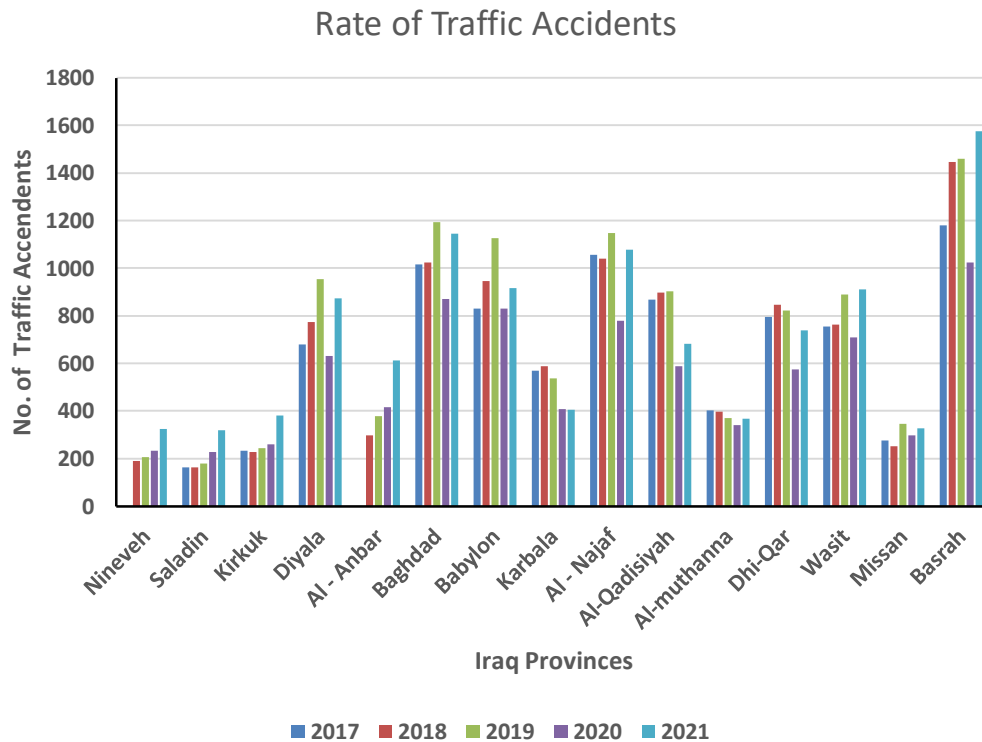


Figure 4.1: The Rate of Traffic Accidents in each Iraqi Provinces

4.3 Data Analysis

4.3.1 Relationship between the nature of accident and type of road

For the purpose of gathering more information about the traffic accidents problem in the Iraqi roads, the cause-and-effect diagram was used to show the causes of traffic accidents problem as shown in Figure (4.2). Then, the correlation test was conducted to examine the correlation between the nature of accident and type of road by using the SPSS software. The researcher adopted the following steps in conducting the correlation test the three identified provinces:

- 1- Make a test of normality
- 2- Make a linear regression test (ANOVA)
- 3- Bivariate correlations test

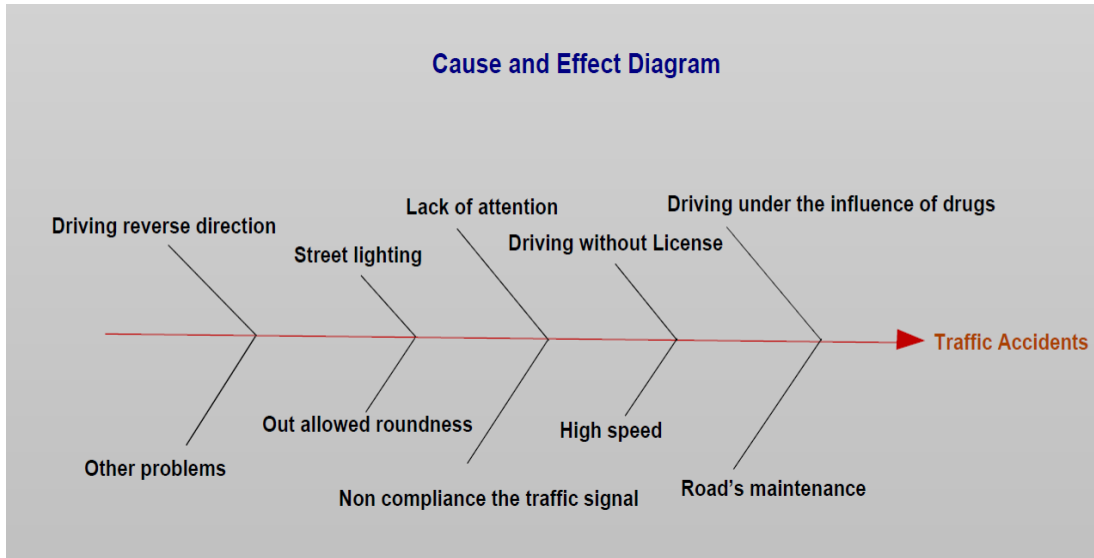


Figure 4.2: Cause and Effect Diagram for the Origins of Traffic Accidents Problem

First: In Basrah Province:

The results of applying these steps in Basrah province showed that the variables are distributed normally as shown in Table (4.2).

Table 4.2: The Results of Normality test in Basrah Province

	Shapiro-Wilk		
	Statistic	df	Sig.
Nature-BASRA	0.896	4	0.412
Type-BASRA	0.711	4	0.016

Where:

- The Shapiro–Wilk test is a test of normality. It was published in 1965 by Samuel Sanford Shapiro and Martin Wilk.
- Df: refers to the degree of freedom (n)
- Sig.: refers to the level of significance (0.05)

While the figure (4.3) and Table (4.3) are illustrated the results of the linear regression test (ANOVA).

Table 4.3: The results of ANOVA Test in Basrah Province

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	152766.194	1	152766.194	0.772	0.472 ^b
	Residual	396019.806	2	198009.903		
	Total	548786.000	3			

a. Dependent Variable: Type-BASRAH
b. Predictors: (Constant), Nature-BASRAH

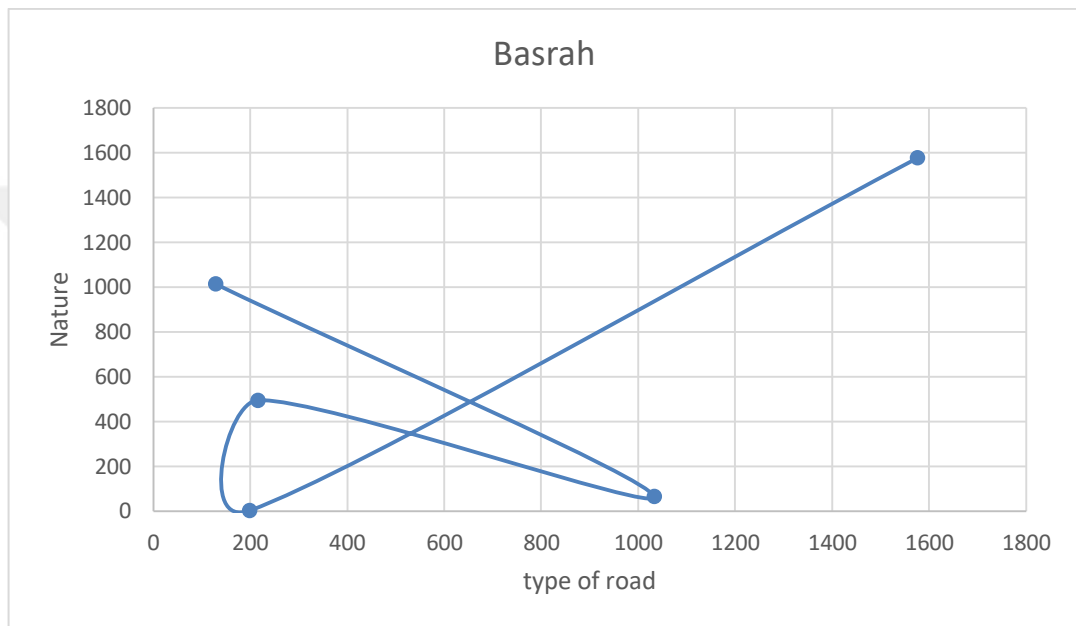


Figure 4.3: The Relationship between Nature of Accident and Type of Roads in Basrah Province

The results of Bivariate correlations and ANOVA test between the Nature of accidents and type of road variables in Basrah province showed that there is a medium Inverse relationship between these variables as illustrated in Table (4.4) and this mean that the negative correlation here indicates two variables that tend to move in opposite directions.

Table 4.4: The Results of Bivariate Correlations between Variables in Basrah Province

		Nature-BASRAH	Type-BASRAH
Nature-BASRAH	Pearson Correlation	1	-0.528
	Sig. (2-tailed)		0.472
	N	4	4
Type-BASRAH	Pearson Correlation	-0.528	1
	Sig. (2-tailed)	0.472	
	N	4	4

❖ **Second: In Al-Najaf Province:**

The results of applying the identified steps in Al-Najaf province showed that the variables are distributed normally as shown in Table (4.5).

Table 4.5: The results of normality test in Al-Najaf province

	Shapiro-Wilk		
	Statistic	df	Sig.
NatureNAJAF	.866	4	.284
TypeNAJAF	.844	4	.208

While the figure (4.4) and Table (4.6) are illustrated the results of the linear regression test (ANOVA) in Al-Najaf province.

Table 4.6: The results of ANOVA Test in Al-Najaf Province

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	26107.3	1	26107.36	0.185	0.709 ^b
	Residual	281645.6	2	140822.81		
	Total	307753.0	3			
a. Dependent Variable: TypeNAJAF						
b. Predictors: (Constant), NatureNAJAF						

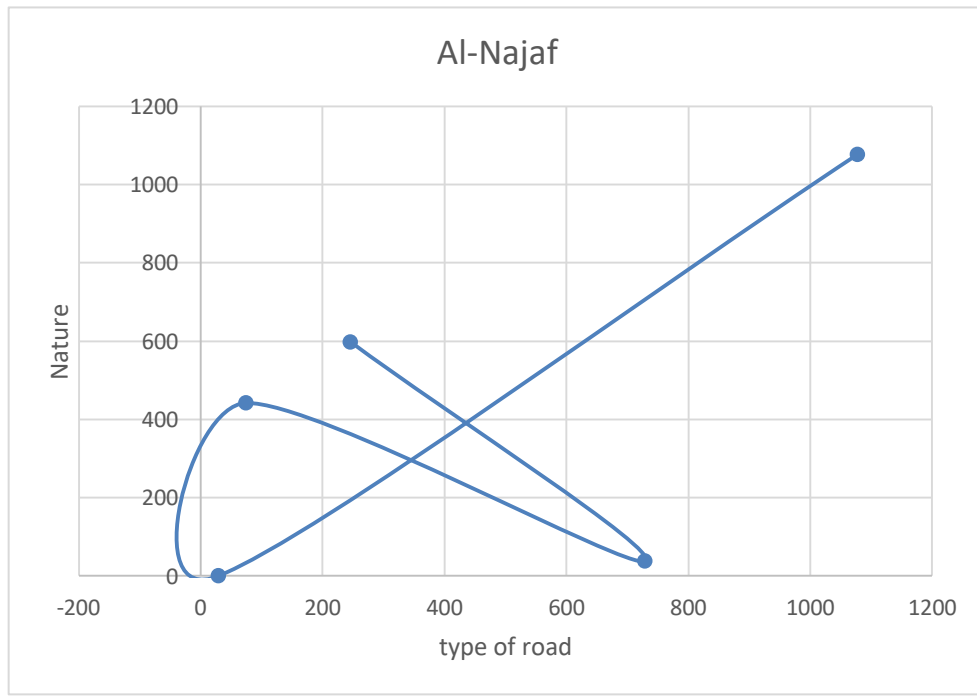


Figure 4.4: The Relationship between Nature of Accident and Type of Roads in Al-Najaf Province

The results of Bivariate correlations between the Nature of accidents and type of road variables in Al-Najaf province showed that there is a medium Inverse relationship between these variables as illustrated in Table (4.7). Also, this mean that the negative correlation here indicates two variables that tend to move in opposite directions.

Table 4.7: The Results of Bivariate Correlations between Variables in Al-Najaf Province

		NatureNAJAF	TypeNAJAF
NatureNAJAF	Pearson Correlation	1	-0.291
	Sig. (2-tailed)		0.709
	N	4	4
TypeNAJAF	Pearson Correlation	-0.291	1
	Sig. (2-tailed)	0.709	
	N	4	4

❖ **Third: In Baghdad Province:**

The results of applying the identified steps in Baghdad province showed that the variables are distributed normally as shown in Table (4.8).

Table 4.8: The Results of Normality Test in Baghdad Province

	Shapiro-Wilk		
	Statistic	df	Sig.
NatureBAGHDAD	0.808	4	0.116
TypeBAGHDAD	0.914	4	0.501

While the figure (4.5) and Table (4.9) are illustrated the results of the linear regression test (ANOVA) in Baghdad province.

Table 4.9: The results of ANOVA Test in Baghdad Province

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10032.021	1	10032.021	0.247	0.669 ^b
	Residual	81346.729	2	40673.364		
	Total	91378.750	3			
a. Dependent Variable: Type-BAGHDAD						
b. Predictors: (Constant), Nature-BAGHDAD						

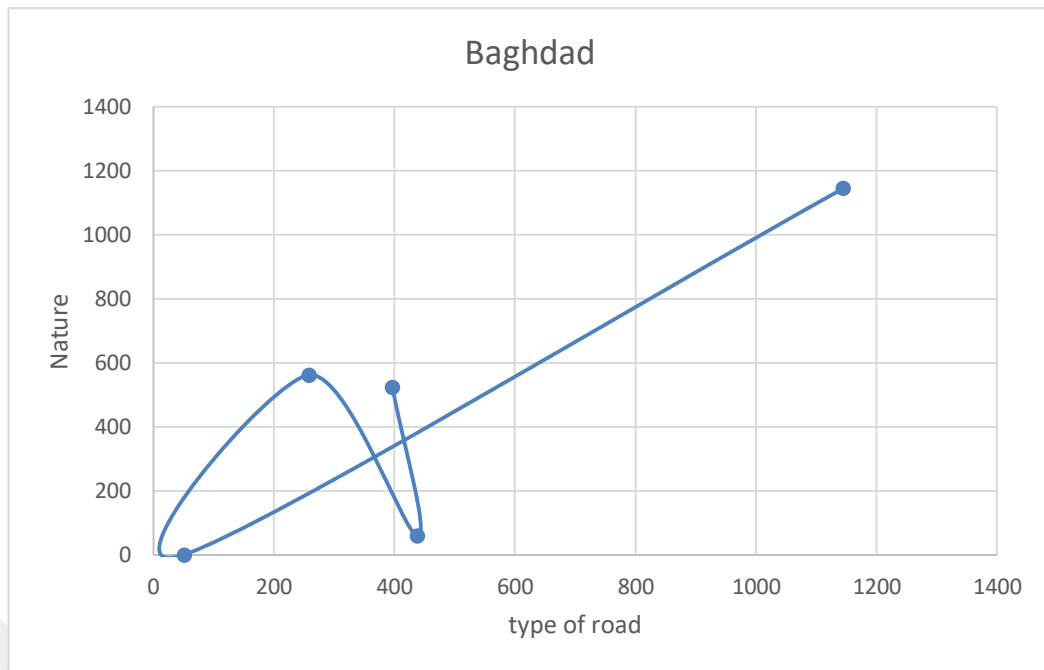


Figure 4.5: The Relationship between Nature of Accident and Type of Roads in Baghdad Province

Finally, the results of Bivariate correlations between the Nature of accidents and type of road variables in Baghdad province showed that there is a medium Positive relationship between these variables as illustrated in Table (4.10).

Table 4.10: The Results of Bivariate Correlations between Variables in Baghdad Province

		NatureBAGHDAD	TypeBAGHDAD
Nature-BAGHDAD	Pearson Correlation	1	0.331
	Sig. (2-tailed)		0.669
	N	4	4
Type-BAGHDAD	Pearson Correlation	0.331	1
	Sig. (2-tailed)	0.669	
	N	4	4

4.3.2 Relationship between the nature of accident and road characteristics

Statistical analysis was conducted on the data that gathered from governorate institutions which related to each type of accidents and the road characteristics for finding whether there is a relationship between them.

Figure (4.6) illustrates the percentage effect of road characteristics like (Bridge, tunnel, Arc sharp, Bow, elevated way, one way, in line, and flate) on the occurrence

of crash accidents in Iraqi roads, where the flat road has a highest effect on occurrence crash accidents with rate of 59.3% and followed by In-Line road with rate is 30.39 % and followed by the remained characteristics.

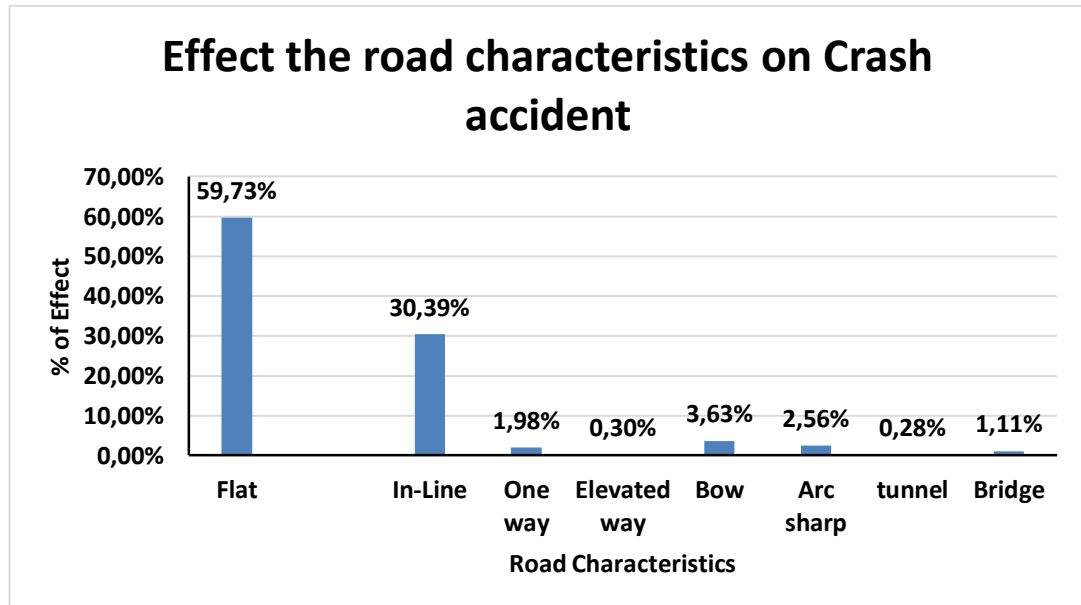


Figure 4.6: The Relationship between Crash Accident & Road Characteristics

Figure (4.7) illustrates the percentage effect of road characteristics like (Bridge, tunnel, Arc sharp, Bow, elevated way, one way, in line, and flat) on the occurrence of Runover accidents in Iraqi roads, where the flat road has a highest effect on occurrence crash accidents with rate is 58.16% and followed by In-Line road with rate is 32.03 % and followed by the remained characteristics.

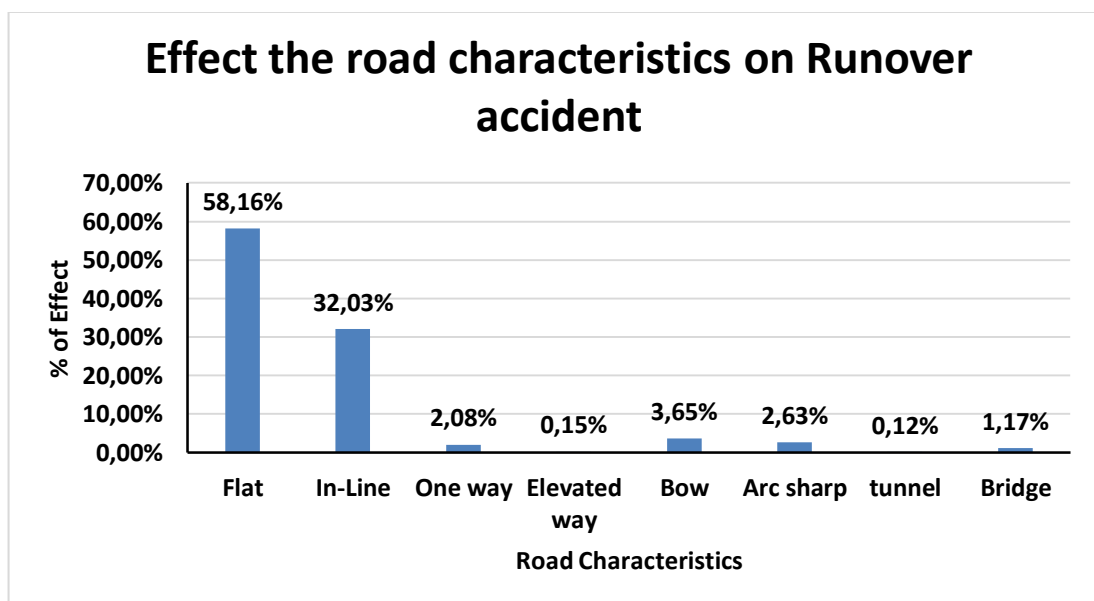


Figure 4.7: The Relationship Between Runover Accident & Road Characteristics

Figure (4.8) illustrates the percentage effect of road characteristics like (Bridge, tunnel, Arc sharp, Bow, elevated way, one way, in line, and flate) on the accourence of Turnover accidents in Iraqi roads, where the the flate road has a highest effect on occurrence crash accidents with rate is 56.37 % and followed by In-Line road with rate is 30.86 % and followed by the remained characteristics.

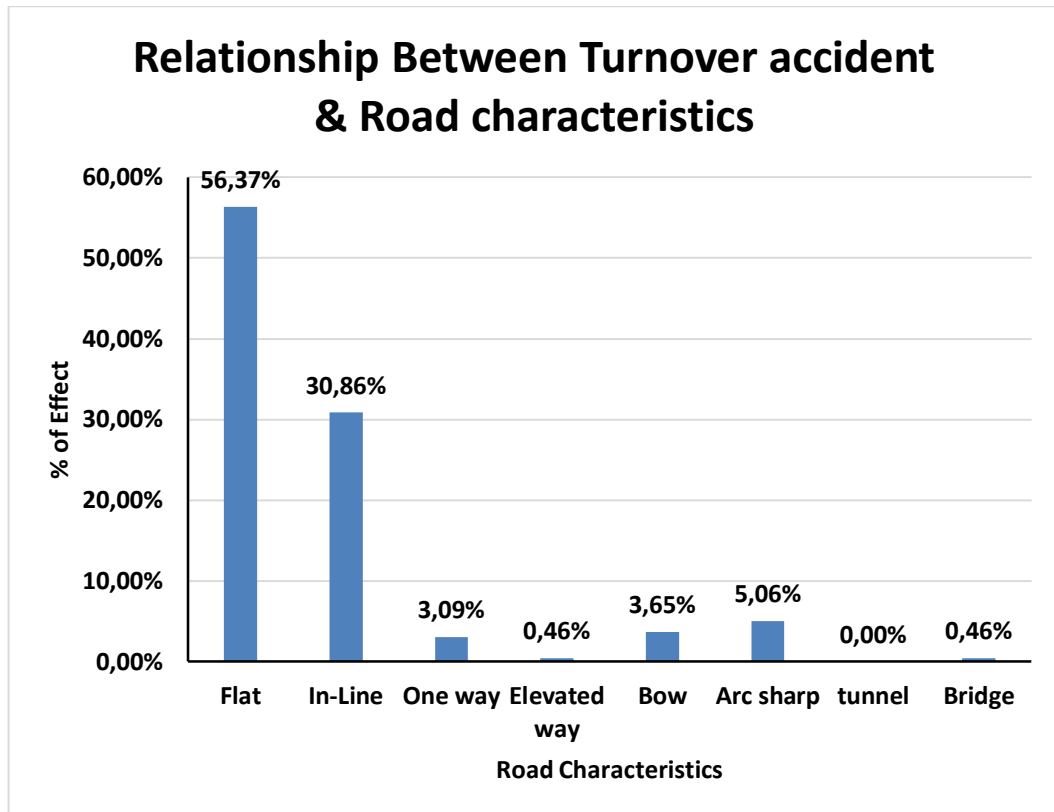


Figure 4.8: The Relationship between Turnover Accident & Road Characteristics

Figure (4.8) illustrates the percentage effect of road characteristics like (Bridge, tunnel, Arc sharp, Bow, elevated way, one way, in line, and flate) on the accourence of other accidents in Iraqi roads, where the the flate road has a highest effect on occurrence crash accidents with rate is 75.88 % and followed by In-Line road with rate is 23.52 % and followed by the remained characteristics.

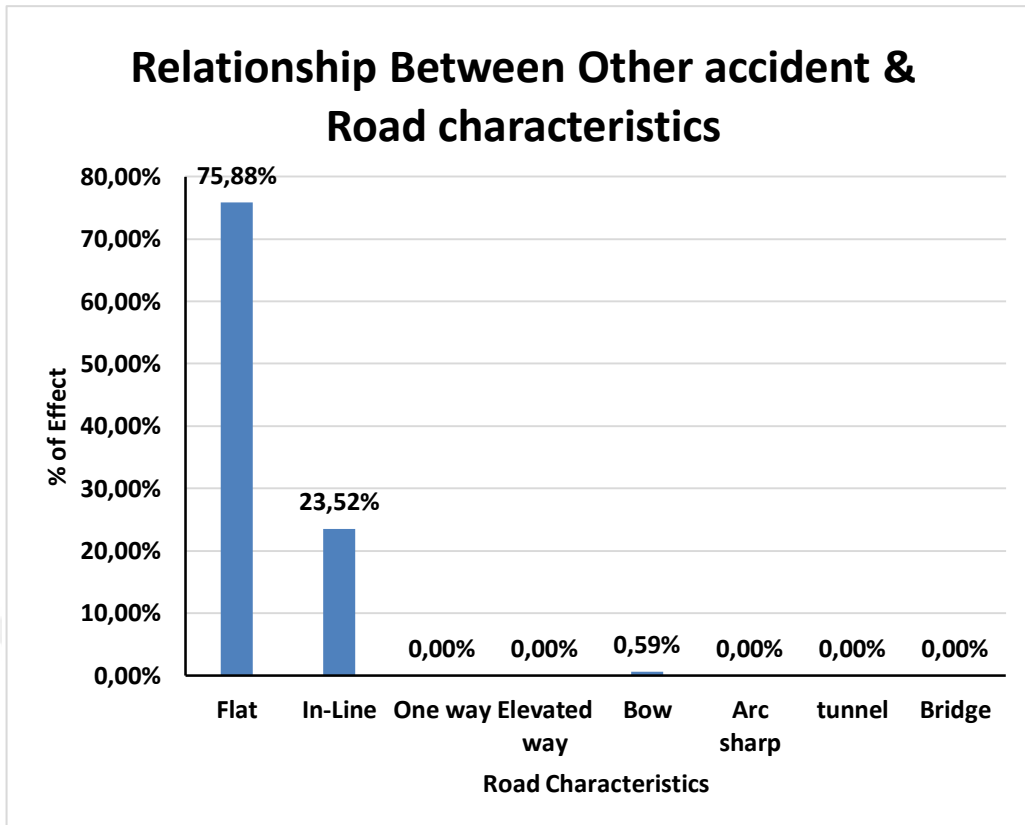


Figure 4.9: The Relationship between other Accidents & Road Characteristics

4.3.3 Relationship between the accidents and gender

After analysis the data related to Gender with traffic accidents in Iraqi roads that gathered from the related governorate directorates.

Figure (4.10) describes the number of deaths due to traffic accidents with the gender, where the male has a highest rate is 81 %.

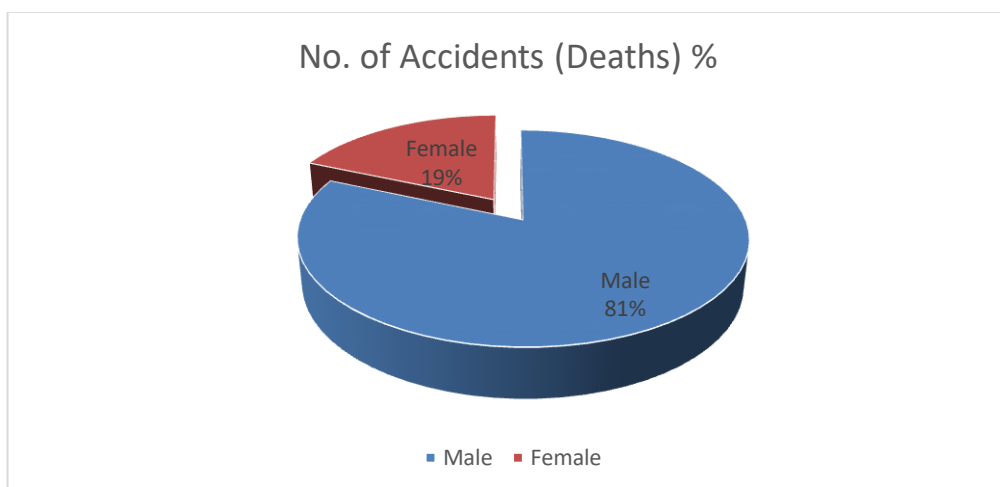


Figure 4.10: The Relationship Between Number of Deaths & Gender

While Figure (4.11) shows the relationship between the main causes of traffic accidents (that identified in previous chapter) and the gender, where the highest rate of accidents was due to the high speed with rate is 80 % caused by male, and followed by the causative factor " lack of attention" with rate is 82 % caused by male, the followed by the remained causative factors.

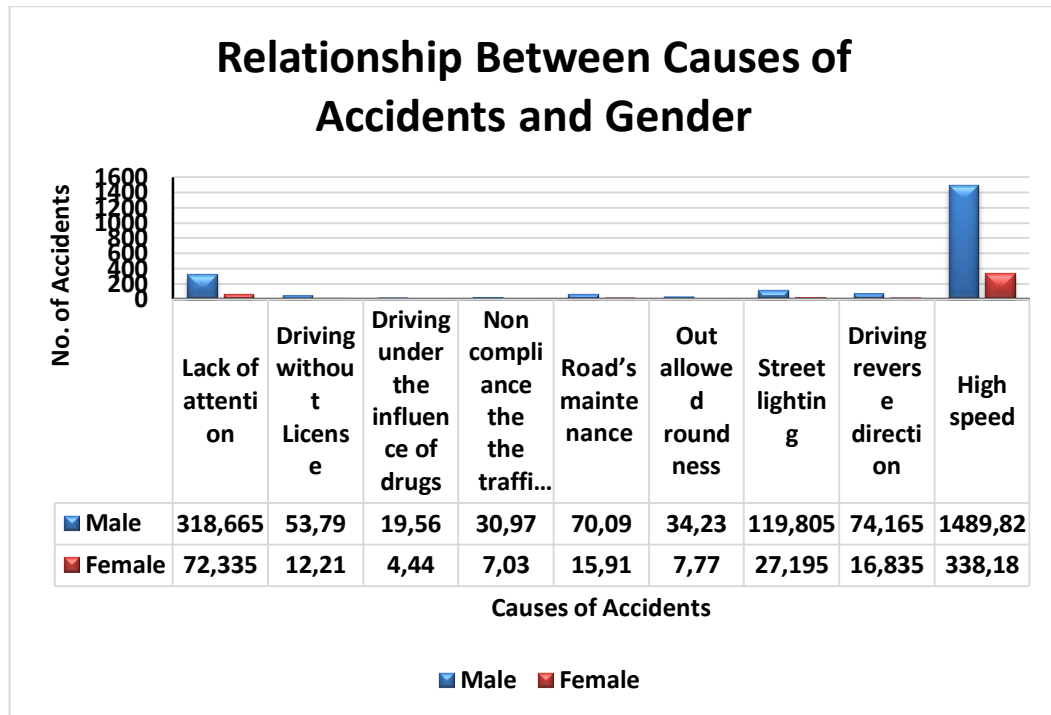


Figure 4.11: The Relationship between Causes of Accidents & Gender

4.3.4 Relationship between the nature of accidents and degree of injury

The research was gathered the related data to degree of injury that caused by each type of traffic accidents.

After the statistical analysis process, Figure (4.12) showed that the most injuries that resulted from crash accidents are injuries only with the rate equal 65.5 %, while the lowest rate is death with injury.

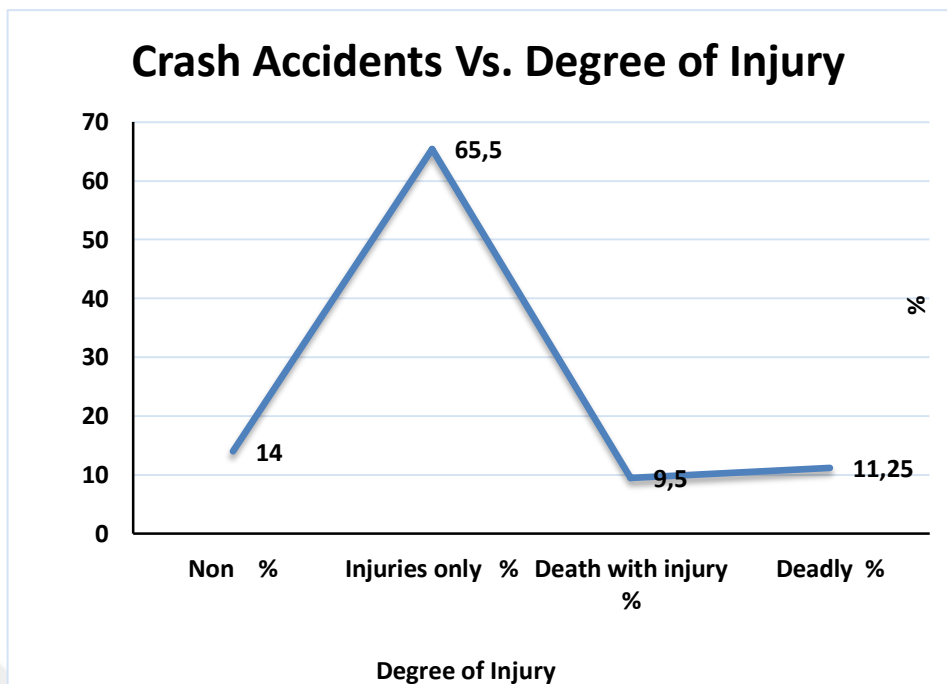


Figure 4.12: The Relationship between Crash Accidents and Degree of Injury that Occurred

Figure (4.13) shows the relationship between the runover accidents and degree of injury. It's referred to the most injuries that resulted from runover accidents are injuries only with the rate equal 56 %, and followed by the remained degrees of injury.

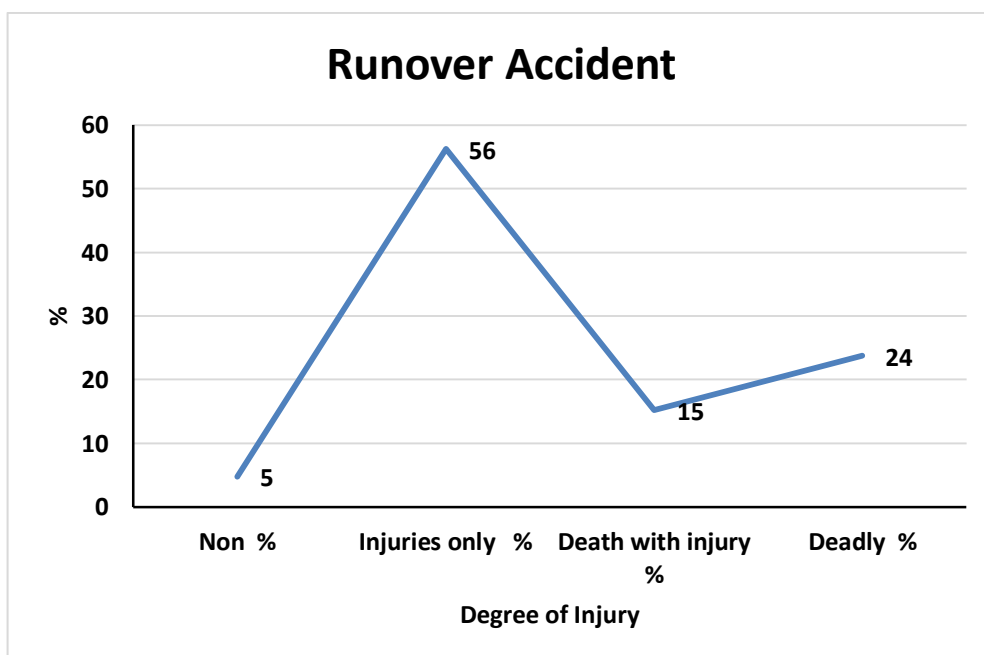


Figure 4.13: The Relationship between Runover Accidents and Degree of Injury

Figure (4.14) shows the relationship between the turnover accidents and degree of Injury. Also, it's referred to the most injuries that resulted from turnover accidents are injuries only with the rate equal 67 %, and followed by the remained degrees of injury.

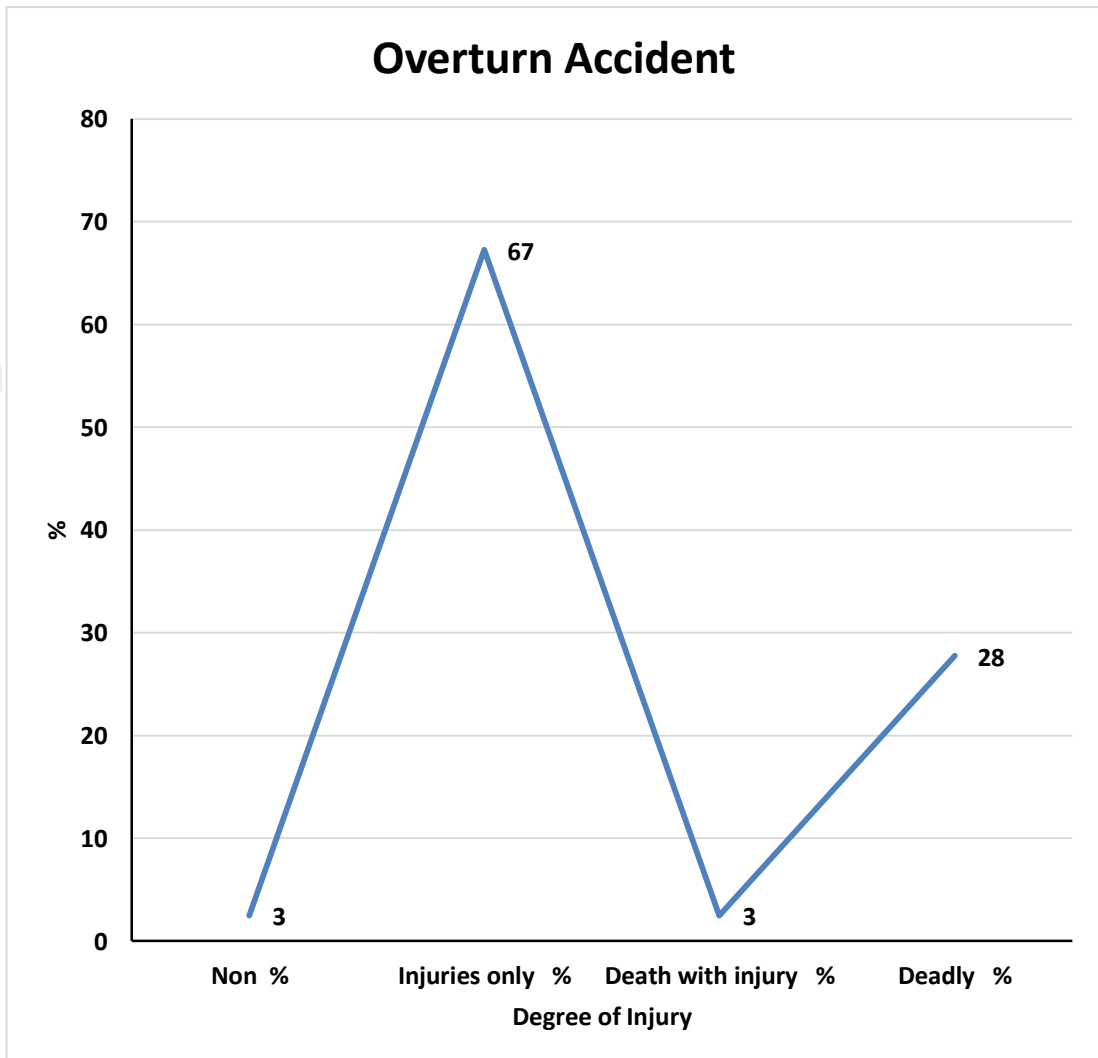


Figure 4.14: The Relationship between Turnover Accidents and Degree of Injury

While Figure (4.15) shows the relationship between the other accidents and degree of Injury. The information in Figure (4.15) is referred to the rate equal 73 % of other accidents not cause any injuries and followed by the remained degrees of injury.

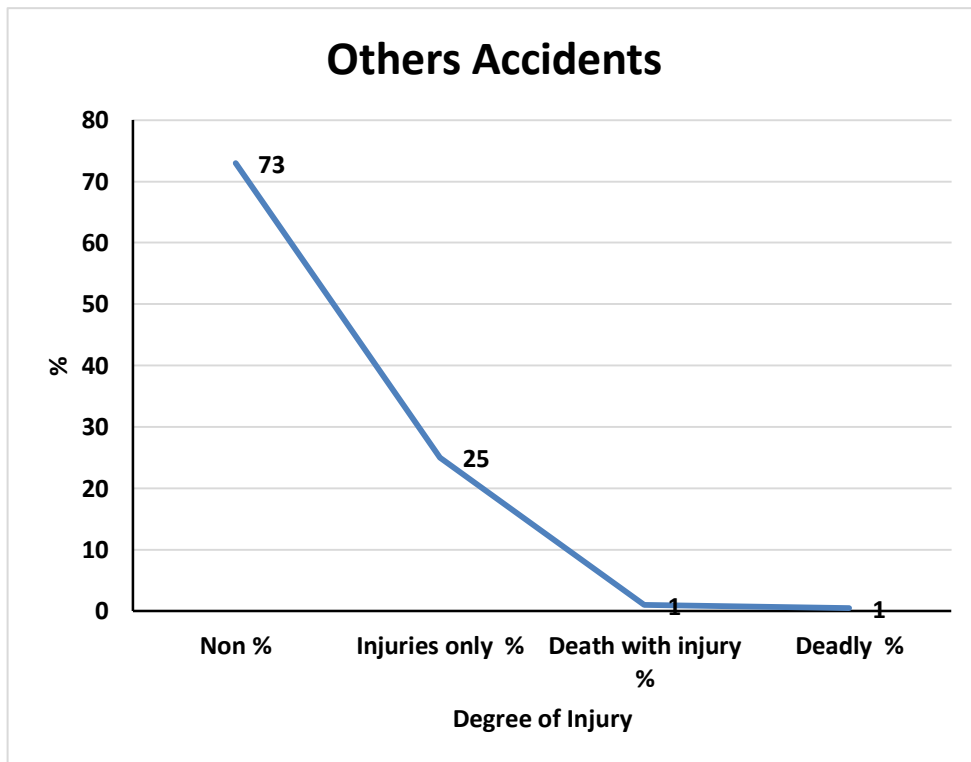


Figure 4.15: The Relationship between Other Accidents and Degree of Injury

4.3.5 Other information related to the accident sources & number of accidents in each month

In order to highlight on the traffic accidents and pay attention by the competent government directorates, the researcher were identified the following main sources of traffic accidents in Iraqi roads (as mentioned in previous chapter):

- Moving car
- stopping car
- train
- electricity pole
- motorcycle
- animal
- street fence
- house fence
- others

The related data to the sources of traffic accidents was analyzed carefully. The results of the statistical analysis process showed that the main source of traffic accidents in Iraqi roads was " moving car " " and followed by the " motorcycle " and followed by

the "stopping car". while the lowest impact on traffic accidents in Iraq was the source "train", as shown in Figure (4.16)

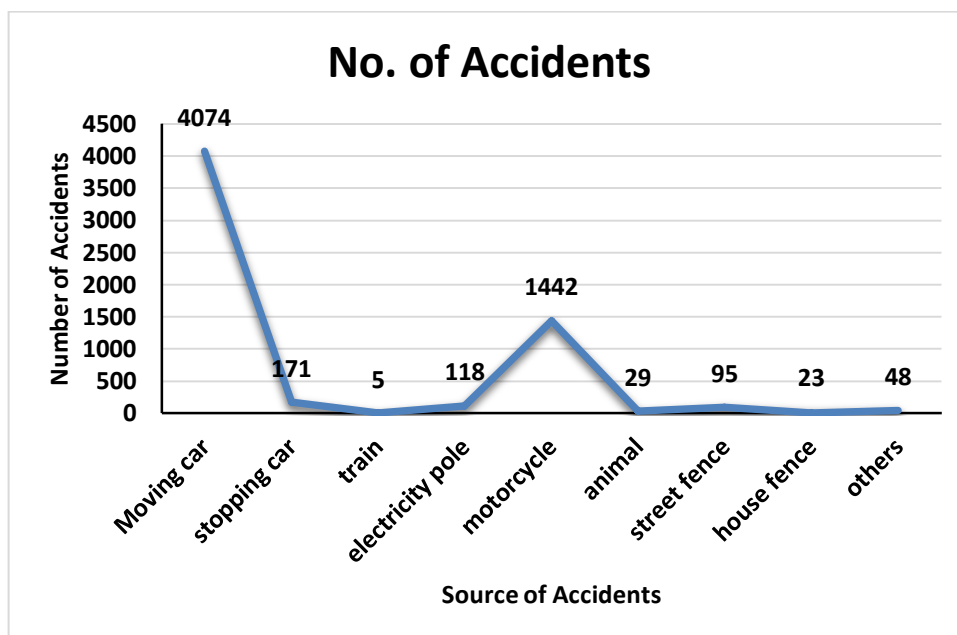


Figure 4.16: The Relationship Between Source Accidents and Number of Accidents
 Also, the researcher was founded the number of accidents during the 2022 year. Table (4.11) and Figure (4.17) describes the numbers of accidents that occurred in each month of this year.

Table 4.11: The Number of Traffic Accidents Distributed in Each Month in Year 2022

Months	No. of Accidents
January	477
February	463
March	414
April	525
May	520
June	507
July	469
August	476
September	543
October	506
November	546
December	559

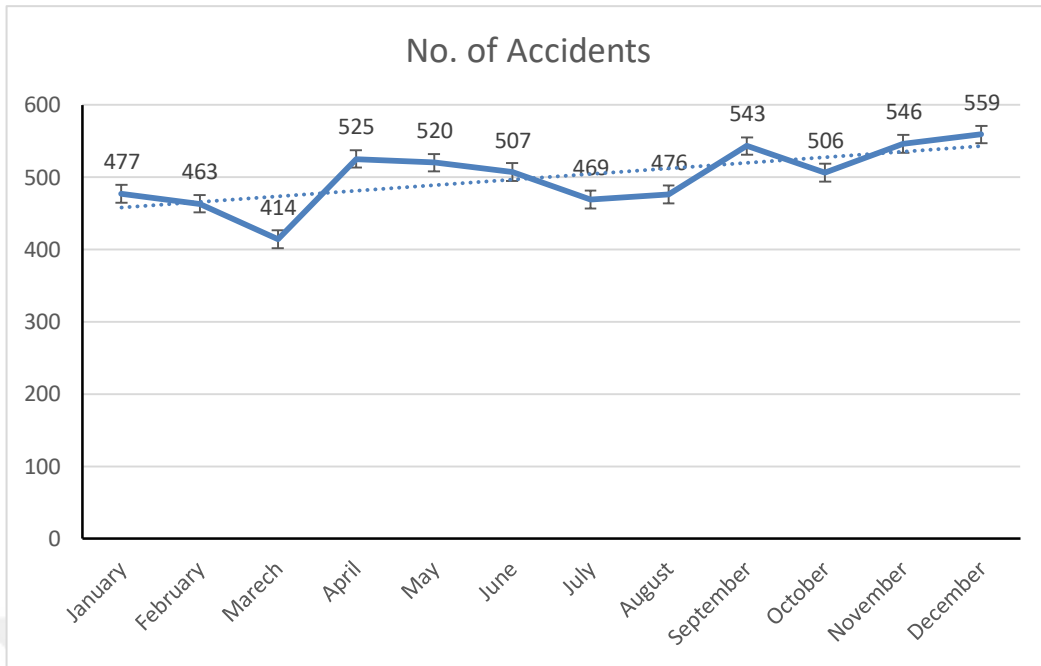


Figure 4.17: The Relationship between Number of Accidents and Months in Year 2022

Finally, the research was recoded the average time of occurrence the traffic accidents in Iraqi road during the year 2022, where the results of this survey showed that highest rate of occurrence traffic accidents is at morning time with percentage equal 61 %, while the lowest rate of occurrence traffic accidents is at sunrise time with percentage equal 8 %, As illustrated in Figure (4.18).

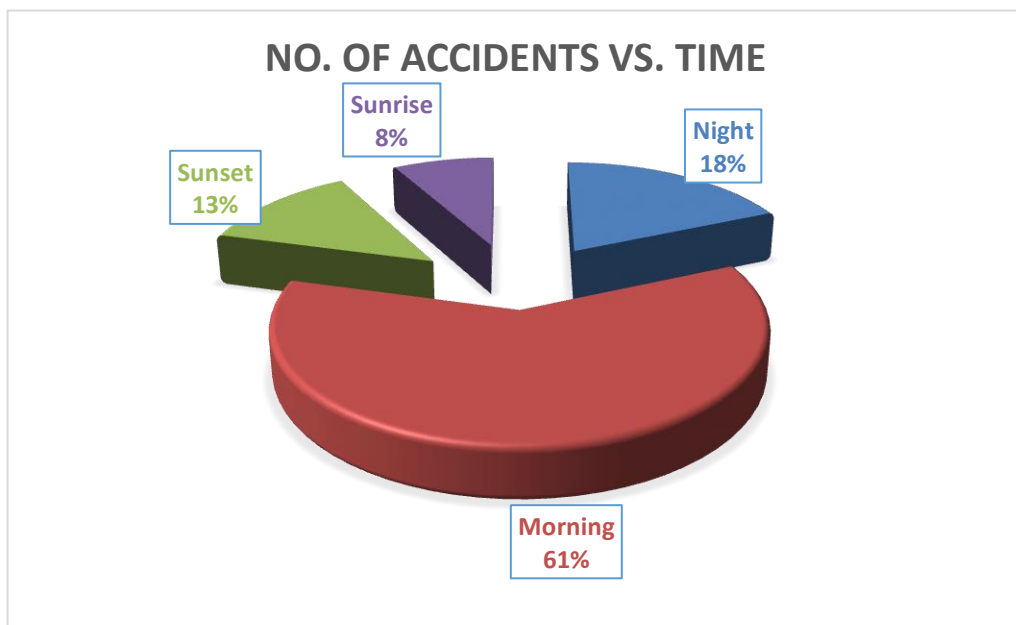


Figure 4.18: The Relationship between the Number of Accidents and Time in the Day

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Purpose

The purpose of this chapter to presents the main conclusions based on literature review, field study, and a questionnaire survey and experts' interviews. In addition to the recommendations that shall be introduced.

5.2 Conclusions

Depending on the results of analyzing the field survey and a questionnaire survey and experts' interviews, the most important conclusions reached are:

1. There is no real effective system to manage the process of roads maintenance.
2. There is a lack in knowledge by the competed directorates about the ad-hoc systems for maintenance the roads and safety of drivers and people.
3. Around 20 % of drivers in Iraq not have the driver's license, that refers to there is a weak in applying the law and traffic instructions.
4. The main factor to cause the traffic accidents in Iraqi roads is Driving reverse direction.
5. The main source of generating traffic accidents in roads of Iraq is "A car moving very fast"
6. During the last Five year the research concluded that Al Basrah province was recorded the highest rate of traffic accidents during this duration and followed by Baghdad province and followed by Al-Najaf province
7. There is a medium Inverse relationship between the Nature of accidents and type of road variables in Basrah province and Al-Najaf province, while there is a medium Positive relationship among the variables in Baghdad province.
8. The flat road has a highest effect on occurrence Crash accidents, Runover accident, Turnover accident, and other accidents, then followed by In-Line Road characteristic.

9. The highest rate of accidents was due to the high speed caused by male, and followed by the causative factor " lack of attention" with caused by male.
10. the relationship between the others accidents and degree of Injury showed that the most of traffic accident in Iraq road may be cause injuries only.
11. The highest rate of occurrence traffic accidents is at morning time, while the lowest rate of occurrence traffic accidents is at sunrise time.

5.3 Recommendations

According to the results achieved from the research, the researcher recommends the following as recommendations to this study:

1. Develop a modern methodology that aims to give a more attention to paving roads, reducing the number of cars in the streets, providing the necessary lighting and traffic signs, organizing driving courses.
2. Educating the community, making laws for all, and improving awareness of drivers and people.
3. Government encouragement of investors to invest in the field of management of road and its maintenance.
4. Activating some of the laws and to enact new laws and regulations by the government to control on the traffic process in the roads of Iraq.
5. Activating the supervisory and penal role.
6. Restructuring the roads and constructing new streets under new and regular standard specifications.
7. Follow-up of people driving underage and over speeding.
8. Road development and maintenance and enforcement of harsh traffic law.
9. The most important are street planning, and a phosphorous sign on both sides of the road, the presence of cameras in the streets and radar devices, determining the speed of driving in the streets, imposing high fines in order not to repeat mistakes.
10. Increase the government support for conducting the studies on road and bridge maintenance and the ad hoc safety service

11. The data analysis in this study can be used to develop a model that effectively mitigates one or more of the identified resources or causes.
12. In cases where information is difficult to obtain or outdated, it is possible to leverage previous studies as a foundation to develop a model.



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RESUME

Dhuha Khalid Hassooni HASSOONI

EDUCATION

- Bachelor in Civil Engineering from University of Technology 2016 -2020
- Master Degree in Civil Engineering from Istanbul Gedik University 2021-2023

WORK EXPERIENCE

-Albeit Al-Iraqi CO.

Civil Engineer, Office and Site Engineer 2020 - 2021

-Alremal Iraqi CO.

Site Engineer 2022-2023

-Earthlink CO.

Project Coordinator on FTTH Project Site and Office 2023-
Present