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Faculty of Graduate Studies

Profile of Pedestrian Crashes in Nablus Governorate

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Dedication

All Thanks for who provided me with their support to achieve my work successfully.

I dedicate my simple work for the dearest people to me:

My beloved parents, my brothers, my sister,

my grandfather, and my grandmother

Acknowledgment

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الاقرار

أنا الموقع أدناه مقدم الرسالة التي تحمل العنوان:

Profile of Pedestrian Crashes in Nablus Governorate

دراسة سلامة المشاة في محافظة نابلس

أقر بأن ما اشتملت عليه هذه الرسالة إنما هي نتاج جهدي الخاص، باستثناء ما تمت الإشارة إليه حيث ما ورد، وإن هذه الرسالة ككل، أو أي جزء منها لم يقدم من قبل لنيل أية درجة عملية أو لقب علمياً وبحثي لدى أية مؤسسة تعليمية أو بحثية أخرى.

Declaration

The work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification.

Student's name: **اسم الطالب:**

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Abstract

The safety of the pedestrians in Nablus City is one of the main concerns for the transportation engineers and decision makers. Nablus Governorate was chosen in this study since previous studies highlighted high pedestrian crash rates there. Therefore, this will be an essential direction for stakeholders to develop an action plan for pedestrian safety in Nablus.

The aim of this research is to study, analyze, and evaluate the pedestrian crashes in Nablus Governorate for the period of 2012 – 2016. This is investigated in terms of geographical distribution of pedestrian crashes in Nablus Governorate and their characteristics, and by conducting detailed profiles of pedestrian crashes in the most critical localities in the governorate and the most hazardous zones in Nablus City. Furthermore, the study analyzed the crashes according to their severity, and temporally and spatially. The data was collected from different sources, which included time and date of crashes, locations, demographic parameters, severity, type of vehicles, zones, etc.

Results indicated that Thursday had the highest number of crashes while Friday had the lowest. The period from noon to the late afternoon was the peak for pedestrian crashes, with 3:00-4:00 been the most

dangerous hour for pedestrians. Young children of less than 10 years old were the most vulnerable group to be involved in pedestrian crashes (36%); the majority was males (68%). Private cars were involved in the majority of crashes with 64.5%. Although public transportation vehicles form only 6% of the total vehicles in Nablus Governorate, they were involved in 25% of these crashes. In general, pedestrian crash severity was low as compared to selected international statistics.

Nablus City was the major locality in the Governorate with the highest number of people and vehicles; therefore, the results were generally similar to the Governorates'. Huwwara locality was ranked second after Nablus City in terms of pedestrian crashes frequency, and had the highest rate. Beita was third in terms of frequency and Biet Wazan was the second in terms of crash rate per capita. Huwwara was somehow different from the governorate status in terms of critical days, the highest age category, and KSI (Killed or Seriuosly Injured). Beita had pedestrian crashes all over the year with somehow steady weekly and monthly frequencies, and close to the Governorate results. The most hazardous zones where the roads of Faisal, Rafedia, Omar Khattab, Quds, Sufian, and Ras Alein.

The rate of crashes (crash/100,000 people) was the highest in Nablus City. Approximately, 7% of pedestrian crashes resulted in serious injury or fatality. Although, the majority of pedestrian crashes occurred in urban areas, their severity was higher in rural areas and in off-peak traffic periods.

Appropriate countermeasures, such as traffic calming, police enforcement, and upgrading of the pedestrian facilities should be implemented at the critical areas where pedestrian crashes are most frequent or severe. The responsible authorities should develop an action plan for the pedestrian safety program at the national level and provide for the appropriate regulatory environment. Comprehensive traffic safety awareness campaigns targeting drivers and pedestrians should be conducted. The traffic police could reallocate the limited human resources to the critical areas and times. Collaboration between traffic safety stakeholders, including community groups and public transport drivers, is needed to increase traffic safety awareness.

Chapter One

Introduction

Chapter One
Introduction

1.1 General Background

People are using the transportation system as a pedestrian; therefore, has the potential of being harmed if the system is not sufficiently safe. As such, walking is an important mode of transportation, which should be studied carefully to reduce the probability of facing risks.

A pedestrian, as defined for this fact, is any person on foot, walking, running, jogging, hiking, sitting, or lying down who is involved in a motor vehicle traffic crash. A traffic crash is defined as an incident that involved one or more motor vehicles where at least one vehicle was in transport and the crash originated on a public traffic way, such as a road or highway. Crashes that occurred on a private property, including parking lots and driveways, are not considered here (NHTSA, 2014).

According to the National Complete Streets Coalition (NCSC, 2005), a complete street is “designed and operated to enable safe access for all users, including pedestrians, bicyclists, motorists, and transit riders of all ages and abilities. Complete Streets make it easy to cross the street, walk to shops, and bicycle to work.”

“Pedestrians are parts of every roadway environment, and attention should be paid to their presence in rural as well as urban areas, … pedestrians are the lifeblood of our urban areas, especially in the downtown and other retail areas” (AASHTO, 2001).

Injuries for any pedestrian may lead to death, which contradicts with the philosophy of engineering that is to protect human beings and provide them with the suitable and safe facilities. However, they should be taken into consideration when designing roads; therefore, the usage of them could be improved in an easy and safe way.

Pedestrian safety is one of the most critical concerns in transportation safety. In order to overcome or reduce crashes, studies should be prepared at the critical locations where pedestrian crashes are relatively high or severe. As stated by Litman (2007), an improved pedestrian safety and safer walkable environment help the community to improve accessibility for non-drivers, reduce the cost of transportation, enhance parking efficiency, improve aesthetics, save the land needed for road construction, reduce the level of pollution, and support public transportation.

During the last years, there was nearly a steady number of traffic crashes, and the same for the percentage of pedestrian crashes at West Bank. The Higher Traffic Council's reports showed that pedestrian crashes were 5383 between 2011 and 2014, forming 17.5% of total crashes (Higher Traffic Council, 2011-2014); see Figure (1). These statistics call for the necessity to study pedestrian safety issue.

Figure (1): Total Crashes & pedestrian crashes in the West Bank (2011-2014), source: (Higher Traffic Council Reports: 2011-2014)

1.2 Significance of the Study

Previous local researches about pedestrians' safety are somehow few in the West Bank with no adequate studies about pedestrians' safety issues. Statistics of traffic crashes in Nablus Governorate showed relatively high rate of crashes among Palestinian governorates or cities (Higher Traffic Council, 2015). On the other hand, pedestrians' safety studies or official interventions are very limited in Palestine, and they were only used as static indicators from the Police Departments so that the Higher Traffic Council could use them in its annual reports.

The critical cases of pedestrians' safety conditions in Nablus City were highlighted (Khader, 2014), therefore; there is a need to conduct pedestrians' safety studies to identify critical conditions and to examine the challenges facing pedestrians' safety.

The pedestrian crash data are recorded manually in the police reports with low accuracy in the recording crash status. The frequency of road

crashes and deaths had increased in the past few years in Nablus. Furthermore, there is no detailed pedestrian safety study yet in Palestine. Therefore, the need arises to conduct this study that deals with Nablus Governorate as a case study; similar work could be conducted in other governorates as well.

1.3 Study Objectives

The main objectives of this thesis are:

1. Determine the geographical distribution of pedestrian crashes in Nablus Governorate and their characteristics.
2. Prepare detailed profiles of pedestrian crashes in the Nablus Governorate, most critical localities in the governorate, and the most hazardous zones in Nablus City.
3. Provide general recommendations to improve the level of pedestrian safety in terms of data collection, safety programs, and appropriate countermeasures.

1.4 Study Area

Nablus Governorate is an administrative district in the State of Palestine located in the central highlands of the West Bank, 53 km north of Jerusalem Figure (2). It has a population of 390,000 inhabitants, covering 605 km^2. It consists of one city, 9 towns, 47 villages, and 3 refugee camps as shown in Figure (3) (PCBS, 2016).

Figure (2): Location of Nablus Governorate in West Bank (source: PCBS, 2016)

Figure (3): Localities of Nablus Governorate

Nablus City is considered one of the most settled cities in the West Bank. It is the major and only city in the governorate with an altitude between 600-800 meters above mean sea level. It has a population of more than 150,000 inhabitants (Palestinian Central Bureau of Statistics, 2017). It is located between two steep mountains (Eibal on the north and Jerzeem on the south), as shown in Figure (4). Thus, the extension of the city is

towards the east and the west directions, which makes the network of highways, especially the major corridors, concentrated in a longitudinal direction connecting east with west.

Economically, Nablus is the capital of the north of the West Bank having important commercial centers so that it is visited by large numbers of people for medication, business, work, trading, and higher education purposes. Therefore, consideration should be taken regarding its pedestrian traffic system and their safety issues.

1.5 Study Locations

There were 252 pedestrian crashes in Nablus Governorate in 2014, forming 20.2% of the total in the West Bank. Therefore, it was classified as the second top governorate after Hebron in terms of frequency of traffic crashes in the West Bank (Higher Traffic Council, 2015).

According to the recommendations of Khader (2014), it was necessary to do a detailed safety study for some locations in Nablus City. These were Omar Bin Al-Khattab Street, in front of Al-Watani Hospital, Sufian Street, Al-Ghawi Intersection, and Western Graveyard Intersection due to their high annual crash rates in comparison to other locations in the city, and because of the percentage of crashes involving crossing pedestrians was considered high. Therefore, such crashes threat the safety on roads.

Figure (4): Orthophoto for Nablus City

In addition, the Higher Traffic Council in 2014 listed more than twenty locations in Nablus City, which have high rates of crashes. These are:

Al Matourat Int., Al Ghawi Int., Al Quds Int., Al Masaken – Al Hesbah Int., Al Maslakh. Int, Beita – Huwwara Int., Al Sawia Int., Al Fatmiah Int., Al Kindi Int., Al Lobban Int., Western Graveyard Int., Old Campus Int., Burqa Int., Burin – Huwwara Int., Al Ziout – Al Kartoon Int., Abdul Raheem Mahmoud Int., Al Ein Camp Int., Al Salam Mosque Int., Al Quds St., Faisal St., Rafedia Hospital Int., Huwwara St., Western Terminal Int., Al Ateereh Building Int., and Al Basatin neighborhood.

Table (1): Pedestrian Crashes in West Bank and Nablus City, (source: Higher Traffic Council, 2015)

	West Bank	Nablus	Percentage
2011	1458	269	18.5%
2012	1388	252	18.2%
2013	1289	249	19.3%
2014	1248	252	20.2%
During the 4 years	**5383**	**1022**	**19.0%**

However, the crashes involving pedestrians in the other communities of Nablus Governorate were not studied before. Therefore, in this thesis, all the zones of Nablus City and all communities of Nablus Governorate will be fully studied and analyzed in terms of pedestrian safety.

1.6 Thesis Outline

The thesis contains the following chapters; introduction which presents general background, significance of the study, objectives, and the study area. Literature review is discussed in chapter two. The methodology and data collection are presented in chapter three. Analysis of Nablus Governorate is presented and discussed in chapter four, while the analysis of Nablus City is presented and dicussed in chapter fave. Severity and fatalities indicators are analyzed in chapter six. In addition, conclusions and recommendations are presented in chapter seven.

Chapter Two
Literature Review

Chapter Two
Literature Review

Different relevant papers, reports, and articles were reviewed, which considered pedestrian crashes and safety issues. In the following sections, some of the studies were summarized. The studies were classified into three levels; international, regional, and local studies. Unfortunately, local studies as researches, manuals, books, etc. are scarce as shown in the following sections.

2.1 International Studies

2.1.1 General

Garber and Hoel (2009) indicated that a "crash" is the commonly accepted word for an occurrence involving one or more transportation vehicles in a collision that results in property damages, injury, or death. Also, the term accident implies a random event that occurs for no apparent reason other than "it just happened". The word crash is not universally-accepted terminology for all transportation modes and is most common in the context of highway and traffic incidents.

Davis (2001) also indicated that the word accident indicates in a simple factual way what is observed, while crash seems to suggest, in addition, a general explanation of why it occurred without any evidence to support such an explanation.

The World Health Organization (WHO, 2004) also indicated that the term of "accident", in particular can give the impression of inevitability and

unpredictability or it is an event that cannot be managed. Road traffic crashes are amenable to rational analysis and remedial action. Based on this, "crash" is used instead of "accident" to represent traffic collision.

The planning component of the Highway Safety Improvement Program (HSIP) consists of three processes.

Figure (5) describes the process showing that the information obtained under the planning component serves as input to the two other components, and that results obtained from the evaluation component may also serve as input to the planning component (FHWA, 2013).

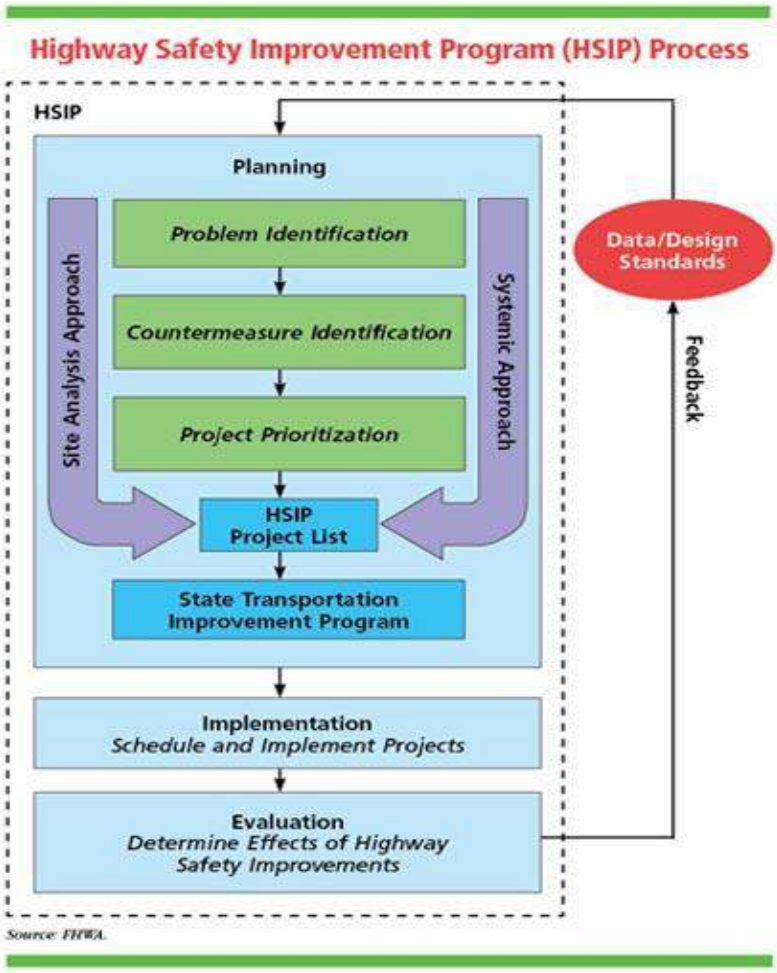


Figure (5): Highway Safety Improvement Program at the Process Level. (Source: FHWA, 2013)

2.1.2 Pedestrian Safety Studies

In 2013, there were 4,735 pedestrians killed and an estimated 66,000 injuries in traffic crashes in the United States; constituting 4,653 traffic crashes each had one or more pedestrian fatalities. On the average, a pedestrian was killed every 2 hours and injured every 8 minutes in traffic crashes (Fatality Analysis Reporting System, 2013). Going through the year of 2015 the NHTSA statistics showed that there were 5,376 pedestrians killed and an estimated 70,000 injured in traffic crashes. A total of 5,295 traffic crashes had one or more pedestrian fatalities. On average, a pedestrian was killed every 1.6 hours and injured every 7.5 minutes in traffic crashes. NHTSA studied these crashes and constructed a profile contained the environmental characteristics, time of day and day of week, age, gender, type of vehicles, and fatalities by cities and states (NHTSA report, 2015). The number increased in 2016 to reach 5987 pedestrian killed.

Zegeer et al. (2001) prepared the largest and most comprehensive study of marked crosswalks in the USA at that time. The authors analyzed data from 1,000 marked crosswalk sites and 1,000 matching unmarked sites in 30 USA cities. Information was collected at each of the 2,000 sites, including pedestrian crash history (average of five years per site), daily pedestrian volume, traffic volume, number of lanes, speed limit, area type, type of median, type and condition of crosswalk marking, location type (midblock vs. intersection), and other site characteristics. All study sites were at intersections or midblock locations with no traffic signals or stop

signs on the approaches. The study found that on two-lane roads, the presence of a marked crosswalk alone at an uncontrolled location was associated with no statistical difference in pedestrian crash rate, compared to an unmarked crosswalk.

A study was conducted to determine the effect of crosswalk markings on driver and pedestrian behavior at un-signalized intersections (Knoblauch et al. 2001). A before-and-after evaluation of crosswalk markings was conducted at 11 locations in 4 USA cities. Behavior observed included pedestrian crossing location, vehicle speeds, driver yielding, and pedestrian crossing behavior. The authors found that drivers approach a pedestrian in a crosswalk somewhat slowly, and that crosswalk usage increases after markings were installed. No evidence was found indicating that pedestrians were less vigilant in a marked crosswalk. No changes were found in driver yielding or pedestrian assertiveness because of adding the marked crosswalk. Marking pedestrian crosswalks at relatively low-speed, and low-volume, un-signalized intersections was not found to have any measurable negative effect on pedestrian or motorist behavior at the selected sites, which were all 2- or 3-lane roads with speed limits of 35 or 40 mph (55 or 65 km/hr).

Hauck (1979) reported a before and after study done in Peoria, Illinois, USA in which 17 crosswalks at traffic signals were repainted. Operational evaluation at the sites showed a general decrease in both pedestrian and motorist violations when comparing "before-and-after" results. It was found that the percentage of pedestrians who stepped out in

front of traffic during the after period decreased at 12 out of the 17 locations; crossing against the DON'T WALK phase (signalized intersections) decreased at 13 of the 17 locations, though jaywalking was unchanged.

Gadiel (2007) analyzed the safety effects of crosswalks with in-pavement warning lights by evaluating the yielding rates and crosswalk usage of existing and proposed in-pavement lights systems. Data on pedestrian and driver behavior in the field, and the interaction between them was collected using video camera technology in the Amherst, Massachusetts area. Data regarding drivers scan patterns during the approach to a crosswalk with in-pavement warning light system was collected using a driving simulator and an eye tracker. The field evaluation resulted in increased yielding rates and crosswalk usage after installation of in-pavement warning lights, while driving simulator evaluation resulted in drivers not becoming accustomed to scanning for lights instead of a pedestrian.

Tracy (2012) examined the relationship between pedestrian perceptions of their right of way in marked versus unmarked crosswalks and the level of caution they exercise when crossing. Survey data collected showed many pedestrians believe they have the right of way only in marked crosswalks. When observing pedestrian behavior in three different crosswalk treatments, however, pedestrians surprisingly showed higher levels of cautiousness in marked crosswalks than unmarked crosswalks.

These findings suggested that marked crosswalks did not give pedestrians a false sense of security or correlate with reckless behavior.

Mohanty (2013) aimed at finding a walkable environment for pedestrians with minimum pedestrian-vehicle interaction. In order to determine PLOS (pedestrian level of service), a set of qualitative data was collected by devising a questionnaire, which was used to get the real time response of people in road environment. People of across all genders and age groups participated in the survey. Most of the questions were rating based with some yes/no types and some were questions based on logical choices. After segmenting the data, it was analyzed by using inverse variance method. The pedestrian level of safety was determined and it was found out that the study area was an ideal location for pedestrians to travel, as they perceived the area safe and all the amenities in the road are available, which would attract the people to walk.

Igazvölgyi (2015) found some methods in pedestrian's behavior analysis at traffic lights and in longer green time suggestion. The study analyzed stairways (effective width), zebra crossings, and tramline platforms. The number of crashes showed the fact that the ratio of the pedestrian's crash was significant; the pedestrians were vulnerable road users. The pedestrians did not have to know the Highway Code (in Hungarian KRESZ). They were involved in 40% of the crashes. In 2010, 192 pedestrians died in Hungary. This value was 124 in 2011, 156 in 2012, and 147 in 2013.

Çicek (2009) proposed a new design methodology; “Behavioral Black Spot Analysis,” which was namely based upon pedestrians’ route choice and risk perception statements. Additionally, it was observed that students chose the shortest route on their way. “Behavioral Black Spot Analysis” revealed that traffic flows, pedestrian visibility, vehicle visibility, waiting time, and road width were most important parameters of pedestrians’ perception of traffic safety. Results of unobtrusive observations indicated that interventions had significant effect on vehicle speed, number of conflicts, yielding behavior of drivers, total number of cars forming a queue, number of pedestrians stopping on the curb, head movements, crossing angles, crossing tempos, and crossing distances of pedestrians.

Andreou (2009) showed that safety is a major barrier to children’s physical activity behaviors as pedestrian-vehicle crashes threaten their lives and independent mobility. It investigated whether the road environment balances the needs of child pedestrians, especially around schools. It examined the built environment and urban form variables through critical evaluation of the current literature, analysis of planning and traffic policy and practice, and qualitative interviews and case studies. The research findings showed that transport, urban form, and engineering solutions played important roles in developing an urban environment, which was safer and; therefore, healthier for pedestrians. Planning and engineering a safer environment requires schools to promote connectivity and accessibility to pedestrian and public transport networks in order to reduce

conflicts between pedestrians and vehicles and promote opportunities for safe walking environments. The study suggested recommendations for future policy makers in planning for pedestrian safety.

Obeng-Atuah (2016) showed that pedestrian fatalities constitute 42% of road traffic fatalities in Ghana, and 68% of the total pedestrian fatalities were related to pedestrian crossing facilities and behavior. The study examined the state of pedestrian crossing facilities (crosswalks) and behavior on urban roads in Ghana, and its consequences on pedestrian safety, using New Juaben Municipality as a case study area. A 5-year road traffic collision data, information on the condition and utilization of cross walks, and pedestrians' perceptions of cross- walks located at different land uses were collected and analyzed. Findings showed that 98% of pedestrian collisions occurred in locations further away from crosswalks. In addition, accessibility of the crosswalks was a challenge to many urban residents, particularly the disabled, children, and pregnant women. Pedestrian behavior was found to be central to the numbers and extent of pedestrian collisions. Major factors associated with pedestrian behavior include time of walking, fatigue, place of walking, inappropriate crossing points, and the influence of alcohol and drugs. The study concluded that pedestrian safety appurtenances should be installed to encourage pedestrian and driver compliance, as well as public education campaigns to encourage behavioral change amongst pedestrians and drivers.

The "Vision Zero" is a program in the USA and other countries such as Sweden, Netherlands, Canada, and UK, sought to eliminate all deaths

from traffic crashes regardless of whether on foot, bicycle, or inside a motor vehicle. The Borough Pedestrian Safety Action Plans are one of 63 Vision Zero initiatives advancing that goal for all street users. Despite aggressive pedestrian-oriented street re-engineering between 2007 and 2013, citywide pedestrian fatalities had not declined. In fact, they increased in 2012 and 2013 while fatalities to other street users fell. Comparing the periods of 2005-2007 to 2011-2013, pedestrian fatalities actually rose by 2% while fatalities to all other users fell by 24%. At the same time, the pedestrian share of overall fatalities rose from 51% to 58%. Nationwide, pedestrians made up just 14% of all traffic fatalities. In Manhattan, pedestrians are 73% of all fatalities (Borough PSAP report, 2013)

In an effort to drive these fatalities down, the Department of Traffic and New York Police Department developed a set of five plans, each of which analyzes the unique conditions of one New York City borough and recommended actions to address the borough's specific challenges to pedestrian safety. These plans pinpointed the conditions and characteristics of pedestrian fatalities and severe injuries; they also identified corridors, intersections, and areas that disproportionately account for pedestrian fatalities and severe injuries, prioritizing them for safety interventions. Each Borough Plan was shaped by the community input from nine Vision Zero Pedestrian Safety Workshops held across the five boroughs and thousands of comments collected through the interactive Vision Zero Input map. Finally, these plans recommended a series of actions that intend to

alter the physical and behavioral conditions on city streets that lead to pedestrian fatality and injury.

2.2 Regional Studies

Hammoudi et al. (2013) evaluated the relevant factors related to traffic safety and crashes among pedestrians in Abu Dhabi. A self-developed questionnaire was piloted in the UK and UAE. There were two versions of questionnaires distributed, one in Arabic language and the second in English language. In addition to the profile of the respondents' including age, gender, monthly income, education, and nationality, the questionnaire data had been analyzed using SPSS to evaluate responses on questions related to traffic safety and crashes. The results highlighted a number of issues that require attention in order to reduce traffic crashes. The results of the study developed a better understanding of issues related to traffic safety and crashes related to pedestrians. The study proposed that collaboration among all traffic safety stakeholders, including community groups and organizations should continue to be encouraged during traffic safety awareness campaigns.

Al-Masaeid (2009) investigated the characteristics of traffic crashes in Jordan and evaluated the safety impact of policy measures undertaken in 2008, including intensification of police enforcement and implementation of traffic law with stiff penalty levels. To accomplish these objectives, crashes' data of 1998 through 2007 were obtained from the Jordan Traffic Institute and other related sources. Results of analysis revealed that Jordan

had experienced huge human and economic losses as well as social and emotional negative impacts. Children, young and elderly had been exposed to an elevated pedestrian crash risk. Young drivers of ages less than 25 years and elderly of ages over 60 years were over-involved in crashes. Carelessness and aggressive driving behavior were the major causes of traffic crashes. The results of analysis also indicated that motorization level could be used to explain variations in traffic crashes and fatalities. Furthermore, intensifying of traffic enforcement and implementing traffic law with stiff penalty levels were found to have a strong positive safety impact on crashes and fatalities. Finally, it was recommended to restructure and empower the Higher Council for Traffic Safety to be able to draw a comprehensive strategy with clear vision and rational safety policies to tackle the traffic crashes' problem.

Al-Omari and Obaidat (2013) analyzed pedestrian crashes in Irbid city, as an example for urban areas in Jordan, based on a total of 1090 pedestrian crashes that had occurred in the city during the three years period (1999 - 2001). The analysis was based on pedestrian characteristics, driver characteristics, crash time, crash location, weather, road surface condition, illumination condition, vehicle characteristics, speed limit, crash severity, pedestrian faults, and driver faults. The Geographic Information System (GIS) tool was used to locate all pedestrian crashes over the study area. The results of the study showed that the majority of pedestrian crashes occurred at non-intersection locations, during clear and sunny weather, on dry surface, during daylight, and at low speed limits. Furthermore, more

pedestrian crashes had occurred during the afternoons, on Thursdays, and during July. The majority of involved drivers in pedestrian crashes were males, with private license type, driving private vehicles, and committed the fault of "not giving priority to pedestrians". The majority of pedestrian victims were males, children less than 15 years old, and hit by vehicles while crossing the road.

Shbeeb and Mejahed (2003) studied the pedestrian safety issues in Jordan. Accident data at the national level were reviewed and analyzed. Three questionnaires were designed, for children, their parents, and their schools. Observations of children behavior while walking and crossing roads were analyzed to assess their actual behavior. Finally, observations on routes leading to school were made to assess how walker friendly their environments are. Ten schools were selected in the Greater Amman area. Seven out of the ten selected schools were public schools. A total of 198 students participated in this survey. Descriptive statistics were used to analyze the data. Chi-square and Cramer's tests were carried out when examining the relationships between categorical variables. T-test was performed to investigate mean differences of interval variables. Results showed that children in Jordan are at a high risk of being injured in traffic, pedestrian accidents composed only 10-11% of all reported accident but resulted in 47% of fatalities, more than 50% of pedestrian accidents occurred on streets with a speed limit of 40 km/h speed, children knowledge of traffic rules reflected their desire to be a driver, and finally 40% of children walking time were on the road and not on the sidewalks.

Alexander and Supawanich (2012) studied the pedestrian safety process in the United Arab Emirates focusing on Al Ain City. There were common ingredients of a dangerous pedestrian environment like high vehicle speeds, lack of safe crossings, and ineffective pedestrian safety treatments. The research identified the priority locations in the aspects of activity, safety, and sidewalk characteristics, gave weighted factors for more than 50 locations to match the case matter with the location. Finally, it developed targeted improvements in crossing, traffic calming, junctions, and roundabouts.

2.3 Local Studies

Kobari (2000) developed a GIS-oriented database using TransCAD software as a tool in improving quantitative accidents data analysis for two years (1997-1997) for Nablus City. The study included number of phases: establishment of detailed database with information on accidents, traffic characteristics and physical road data, integration of these databases into GIS, and definition and development of GIS-based applications to road safety and management. The study analyzed pedestrian accidents by year, month, day of week, and time of day. The findings were that the monthly pedestrian variation ranged from as low as 6% in December up to 11% in July. This may be attributed to the large exposure of pedestrian during summer due to the good weather and school holiday season. By day, Friday recorded the least number of all. On the contrary, Saturday recorded the highest number of accidents. The hourly distribution showed that between 4:00 and 5:00 PM hour had the highest percentage of pedestrian accidents.

Abu Zant (2001) designed a new comprehensive police crash report, and a new computer program based on Microsoft Access Software. Crash data in the study were based on records of years 1997 and 1998 for Nablus City. According to the study, Al-Hesba Intersection was the most hazardous location so a detailed study was conducted for this intersection. The study did not specifically address pedestrian crashes in the city.

Abu Sa'a (2007) developed models for describing the behavior of pedestrians on pedestrian crosswalks. In turn, combined models (Birth-Death process) were used to test and compare different infrastructure designs, both from the perspective of efficiency and safety. The objective related to the management of the pedestrians crosswalks to enhance utilization of traffic signals, which was considered one of the main issues facing transportation system especially inside the congested cities. A mathematical model was derived and developed for the CBD areas based on actual field measurements of key parameters at crosswalks in the urban area of Nablus, Palestine. The model was tested and calibrated on other locations in the city and the CBD area of the city of Ramallah and showed that it could be applied with significant efficiency, which eventually would be reflected in the design of pedestrian signal.

Al Masri (2011) studied the reasons behind not using pedestrian facilities in Al Azhar intersection, Al Thala Thini Street, and Al Saraya intersection in Gaza City, as well as the movement for pedestrians and how much the satisfaction for using facilities. A total of 180 questionnaires were

analyzed then showed the necessity of painting the crosswalks and maintaining sidewalks and signals.

Khader (2014) studied the reality of traffic safety conditions at selected locations in Nablus City. Traffic crash data and information was collected based on crash reports from the Police Directorate in Nablus City for the study period (2009-2011). Analysis was done for several patterns of traffic conditions that might have an effect on traffic safety at these sensitive locations, such as crash rate, weather, lighting, road surface, road geometry, types and causes of crashes, etc. Several results emanated from this study. For example, the highest intersection crash rate was at Al-Ghawi Intersection followed by the Western Graveyard Intersection and Al-Salam Mosque Intersection. As for streets, the highest rates were on Sufian Street followed by Omar Ibn Al-Khattab Street and Faisal Street. Furthermore, pedestrian crashes formed approximately 20 percent of all crashes. Results also showed that certain conditions and patterns may contribute to the level of road safety. Pedestrians, wet pavement conditions, and night-time crashes were high at certain locations while elderly and females were involved in a limited number of crashes. The practical application of this research is that it formed a road map for traffic crashes and road safety conditions studies and for improving traffic safety conditions in Nablus City. The study recommended, among others, conducting detailed studies for pedestrian crashes at the critical locations in the city.

Abu Aisha et al. (2015) studied the several problems related to pedestrians' movement and traffic and how they affect each other in

specific locations in Nablus City. The study area extended from “Al-Haj Nimer Mosque” to “Western Public Transport Complex” in the CBD of Nablus, which is considered as a vital zone since it is a part of Faisal Street – one of the most important streets of the city. Therefore, it aimed basically to minimize these problems by reducing the delay, improving the pedestrians’ safety conditions, and increasing the efficiency of traffic control devices. One of the issues that were explored was deciding whether it is warranted or not to construct an underpass or an overpass for pedestrians in front of “Al-Watani Hospital” so it also serves the surrounding area. The results for the project – mainly constructing the underpass- contributed to achieving the aimed objectives to improve the mobility and accessibility of pedestrians and vehicles as well as geometric elements for the whole area for a long time.

2.4 Summary

The previous studies provide some insight towards achieving the objectives of this study. Each one has its own methodology, results, data, location, etc. Knowing these information leads to get the benefits from these studies directly, or later to make some comparisons with the results from this thesis.

The studies showed that there is clear interest in pedestrian safety issues all over the world, searching for causes and trying to minimize, as much as possible, the pedestrian crashes and fatalities. The word “crash” is used in this study instead of “accident” according to Garber and Hoel

(2009), Davis (2001), and WHO (2004) explanations. Zegeer (2001), Knoblauch (2001), Tracy (2012), and Igazvölgyi (2015) helped in defining the locations of the study, wherever they were in mid-blocks or intersections, and concentrating on how a crash could be explained by the behavior of pedestrian in interacting with the road.Andreou (2009) highlighted on the importance of location and age of victims, which will be studied in in this study. The NHTSA (2015) and Vision Zero (2013) reported some quantitative data such as number of crashes, rates, and other environmental characteristics, which could be beneficial to make comparisons with the area of this study. In addition, they provided a sound methodology of showing the results in what is called “Profiles” presenting who, where, when, and other questions related to pedestrian crashes. The study of Al-Masaeid (2009) was conducted in a somewhat similar environment to Palestine; therefore, a comparison with it would be helpful. The GIS tool of Al-Omari (2013) would be a reliable way to present and analyze the results. Locally, there were limited studied related to the objectives of this study, but those studies formed a good background. These will allow for comparing the results of this thesis with those studies such as the studies of Kobari (2000) and Khader (2014) since both are in the same area of study with somewhat similar scope.

Chapter Three

Methodology

Chapter Three
Methodology

Studies that have dealt with the safety of pedestrians are extremely limited in Palestine. The lack of proper pedestrian environment and services would lead to ignoring this important matter. Therefore, studies should be done such as this one to analyze the pedestrian safety and to develop a pedestrian safety action plan.

The objective of this thesis is related to the safety of the pedestrians in Nablus City, which is one of the main concerns of the transportation engineers and decision makers. Nablus Governorate was chosen in this study since previous studies highlighted a high pedestrian crash rates in Nablus City and Governorate. Therefore, this will be an essential direction for stakeholders to develop an action plan for pedestrian safety in Nablus.

The thesis will study the pedestrian safety in details including developing profiles for Nablus Governorate, most critical localities, and most dangerous zones in Nablus City. The study will moreover provide recommendations and steps to improve pedestrian safety conditions.

The components of the methodology to achieve the objectives are the following:

I. Literature Review

Desk studies and internet research to review existing publications, studies, and literature related to pedestrian safety for different locations around the world.

II. Data Collection

In this thesis, data of pedestrian crashes for a 5-year period from 2012 to 2016 in collaboration with the Department of Traffic Accidents in the Police Directorate of Nablus Governorate were collected. This database is used in analyzing the pedestrian safety study conditions in the study area.

The crash data are filled manually in the Police Directorate of Nablus Governorate, the information was hand-written by the police officers, which was a challenge. Therefore, careful attention had to be paid to obtain accurate information, as much as possible.

It should be noted that some data gaps in the documented information about crashes do exist; for example, sometimes the crash report may not mention important conditions such as time of crash, pedestrian age, place, or others. However, sufficient database was collected to conduct appropriate analysis and reach proper conclusions.

Data originated from the crash report was filed in a special logbook at the police department, which includes details of the traffic crashes. This information includes:

1- Time and Date of Crash: date, day, and hour.

2- Location of Crash: Location of traffic crash indicates the place where the crash occurred, indicating sometimes the name of the locality, street or neighborhood, and sometimes the reports provide the name of the surrounding area; general location. This was a challenge as the exact

location of crash is not well defined, and opens the door to different possibilities.

3- Demographic Parameters: The crash reports provide age and gender for the victims and drivers in each crash.

4- Severity: Traffic crashes can cause a number of different injuries, depending on the circumstances of crash and the severity of the impact on pedestrians. Injuries of pedestrian crashes were divided in the police report into four types including minor, moderate, serious, and fatal injuries, as judged from policemen or hospital first aid evaluation

5- Type of Vehicles: Every crash is characterized by the type of vehicle involved in the pedestrian crash, which includes private, shared taxi, commercial, agricultural, governmental, and (motor) bikes. Those types will be analyzed for each profile.

After the collection of data for the five-year study period, necessary analysis was done to evaluate and to study the profile of pedestrian safety at the different locations, as will be discuss later.

There were some other information to be collected from different sources, such as GIS shape files, maps, demographic statistics about areas, and population for the period of analysis (2012-2016).

1- GIS shape files: These were obtained to export maps showing the spatial distribution of crashes and the high-rate localities or zones. Some shape files were used from the Municipality of Nablus.

2- Zoning: Nablus City was divided into zones. This would facilitate the analysis and provide a spatial dimension to the results.

The PCBS in 2007 divided Nablus City into 29 zones. However, there were some zones that have the same nature, activities, demographic characteristics, and long collector or arterial roads crossing through them; therefore, they were combined for the purpose of analysis. On the other hand, there was also a very large zone with different area characteristics; therefore, it was separated into two zones for the purpose of analysis. As such, the 29 zone were compiled into 27 ones, as shown in Figure (7).

3- Population: Population statistics for all of localities in Nablus Governorate will be taken from PCBS website for the period of analysis (2012-2016). It should be noted that the latest census was in 2017.

III. Analyze the pedestrian crashes for the Nablus Governorate, showing the most critical locations spatially, and their characteristics.

IV. Develop Pedestrian Crash Profiles for Nablus City including zones spatially, temporally, and the demographic distributions of crashes.

V. Set proposed recommendations based on the data analysis and reviewing safety conditions, in coordinating with stakeholders, resources, and potentials.

Figure (6) shows the flowchart of methodology.

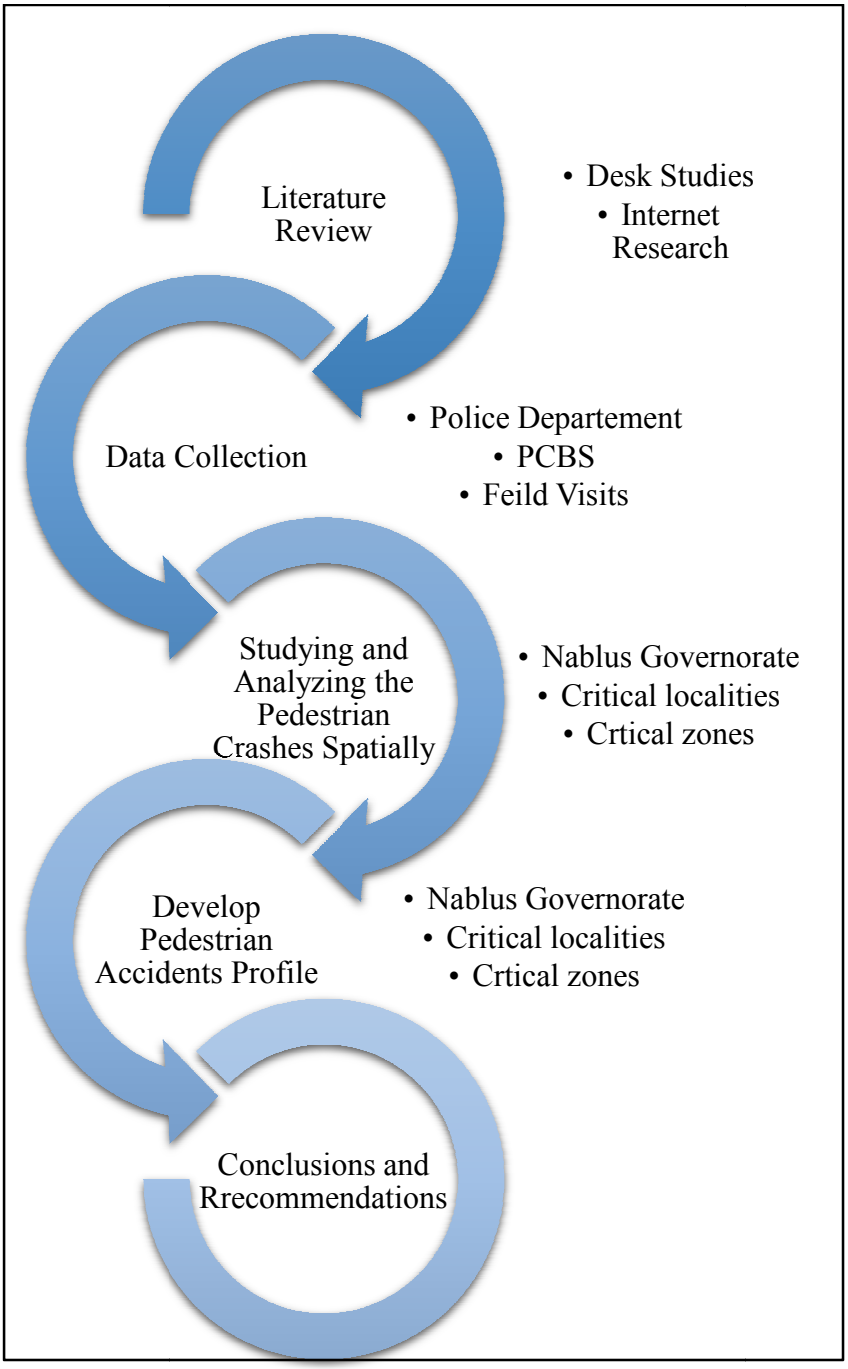


Figure (6): Methodology Flow Chart

Figure (7): Final Zones used in the Thesis with Orthophoto

Chapter Four

Analysis of Nablus Governorate

Chapter Four
Analysis of Nablus Governorate

The following subsections provide detailed profiles about pedestrian crashes for Nablus Governorate, and in the critical localities of Huwwara and Beita, which have the highest crash frequencies (after Nablus City). On the other hand, crashes in Nablus City will be presented in a separated chapter.

It is necessary to shed light on some of the socio-economic characteristics of the Palestinian communities as these might be correlated to the crash patterns. The official working days are Sunday to Thursday, and Friday and Saturday are the weekend days. The working hours are 8:00 AM to 4:00 PM; some government employees may leave a bit earlier. Thursdays afternoons experience heavy movements of people (pedestrians and vehicles) as the weekdays end and people start moving back to their hometowns for the weekend, and considerable shopping and entertainment activities are observed in town centers and commercial areas. The regular school hours are 8:00 AM to 2:00 PM, with some young-aged schools (kindergarten and elementary schools; up to 6^{th} grade) start exiting at noontime and shortly after. The winter season starts in November and the summer season starts in June. Schools typically start in late August/early September and ends in late May/early June.

4.1 Profile of Nablus Governorate

This section addresses an analysis for pedestrian crashes all over Nablus Governorate spatially and temporally, in addition to

identifying the characteristics of pedestrians whom were involved in these crashes.

A total of 1312 pedestrian crashes occurred in the Nablus Governorate during the years of 2012-2105. Figure (8) shows the total number of pedestrian crashes in each year in the Governorate, which shows the highest crash frequency in the year 2015. This is not for a remarkable reason, it goes like a random evidence.

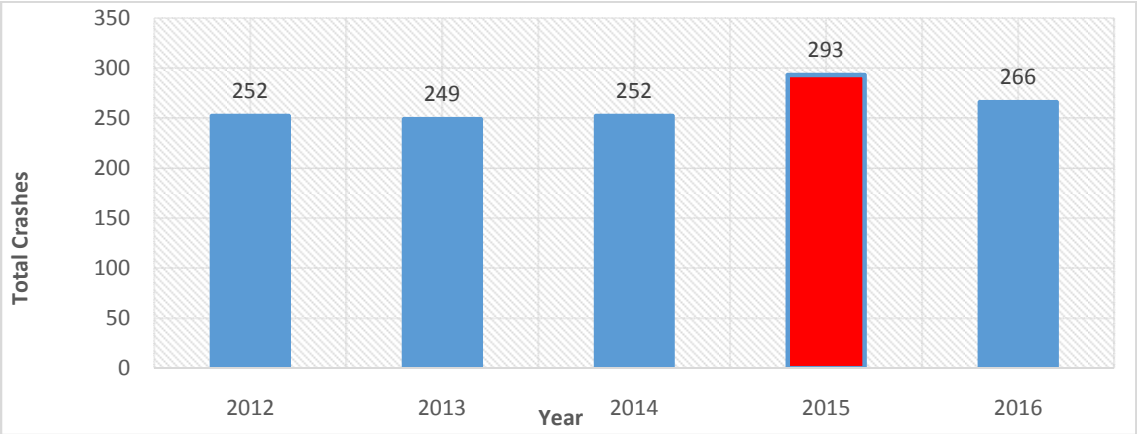


Figure (8): Total Pedestrian Crashes in Nablus Governorate by Year

These numbers indicates that in average there are 262 pedestrian crashes annually, which means that there are five pedestrian crashes weekly in the Governorate.

On the other hand, Thursday was the day of the week with the highest pedestrian crashes as shown in Figure (9), while Friday was the lowest with only 10.7% from the total pedestrian crashes in the governorate for the study period. This is reasonable; Thursday is the end of the weekdays, which means more activities as people are preparing for the weekend, so the traffic volume is generally high particularly in the

afternoon, as compared to the other days of the week as the localities experience active movements of people and vehicles mainly for shopping and entertainment. While those are not observed on Fridays, as a weekly holiday, which have the lowest traffic volume.

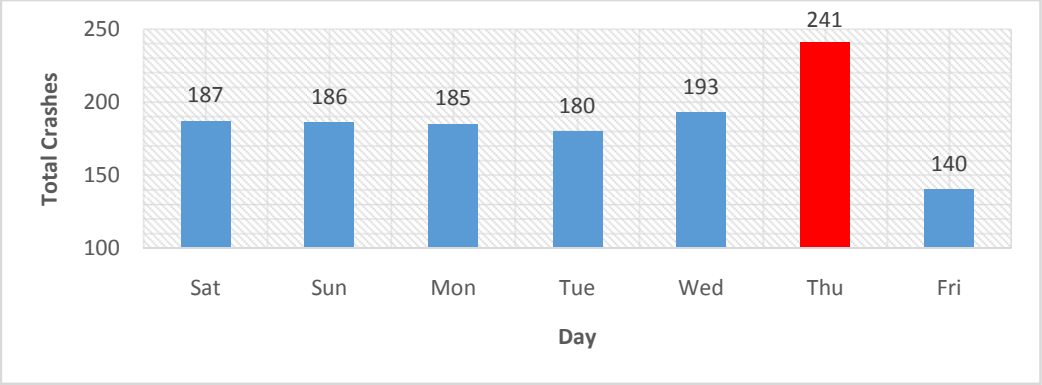


Figure (9): Distribution of Pedestrian Crashes in Nablus Governorate by Day

Furthermore, the daily pedestrian crashes for each year showed that Saturday had the highest number of crashes in year 2012 and 2015, while it was the safest in year 2014. It should also be noted that Saturdays, as the weekend days, typically experience also high traffic volumes with high pedestrian activities, mainly for shopping.

As for the hour of occurrence, Figure (10) shows that the crashes fluctuated from one hour to another, with a concentration around mid-days and shortly after (from 12:00 to 19:00), which formed 57.5% of the total pedestrian crashes for the study period. The most critical hour was from 13:00 to 14:00, which contained 142 crashes with a percent 11.2% from the total. These are the hours when movement of people in vehicles or by walking starts to increase after the mid-days, elementary school children exit their school (at around 1:00 PM), and people started the mid-day shopping activities. Therefore, pedestrian crashes were registered high

during these hours. This period experiences increased pedestrian activities. Elementary school-children start exiting their schools shortly after 12:00 noon, workers start leaving their workplace at 2:00, and shoppers start major daily shopping in the mid to late afternoon period.

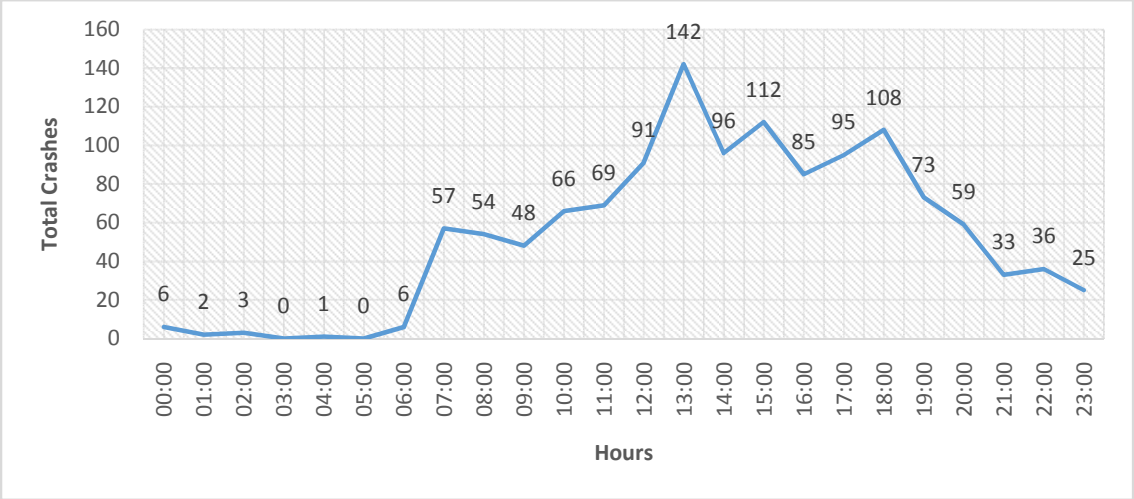


Figure (10): Distribution of Pedestrian Crashes in Nablus Governorate by Hour

In terms of the monthly distribution of pedestrian crashes, Figure (11) illustrates this. The spring season months had the highest frequency. May was the critical month with 131 crashes with a percent of 10.0%, then came April, August, and March with 129, 127, and 127 crashes, respectively. Approximately 29.5% of the crashes happened in the spring season, which is the most season people prefer to walk. On the other hand, the least was in winter season (December, January, and February) with 18.8% of the total crashes. This is reasonable as people's travel and pedestrian activities in winter season decline due to inclement weather conditions, while these activities pick up sharply with the beginning of the spring season and throughout the summer when the schools are in the summer holiday.

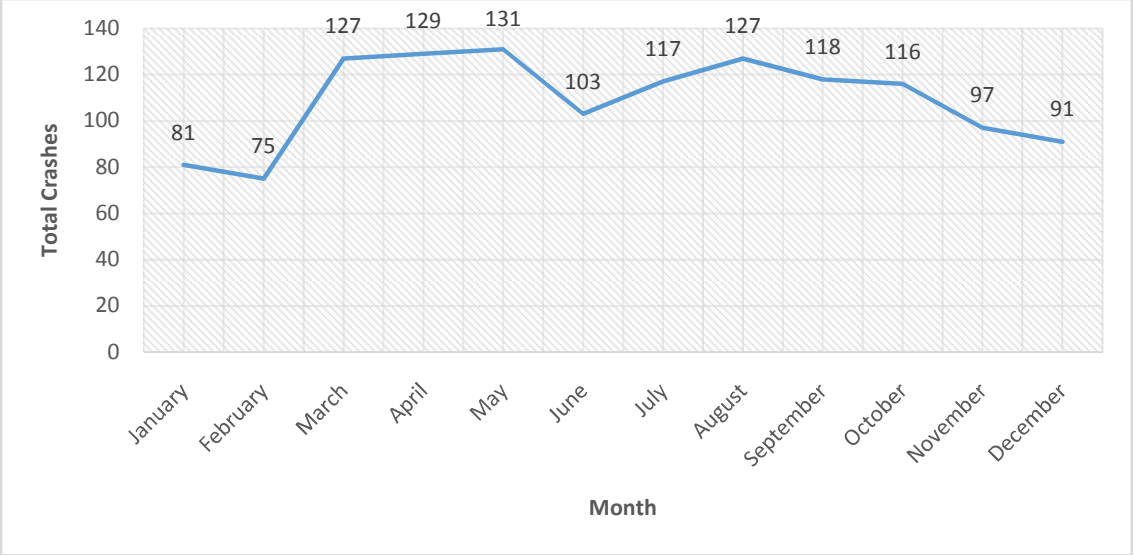


Figure (11): Distribution of Pedestrian Crashes in Nablus Governorate by Month

Ramadan was analyzed temporally by monthly distribution. It was clear that the crashes nearly similar to other months. The average pedestrian crashes in Ramadan is 21.8 while in other months is 21.9. So it could be not that significance to divide Ramadan month and study it separately**.**

Crash severity is an important indicator to be considered, which is shown in Figure (12). The injuries in Nablus Governorate were mostly minor or moderate (93% of total crashes). The KSI (Killed or Seriously Injured) crashes formed 7% in the period of analysis with 93 injuries, during the study period. By analyzing this indicator according to the population, the annual KSI per 100,000 capita equaled to 4.89.

When compared with one of the developed countries; this comparison is because of the limitations of similar studies within the nearby areas regionally, for example Great Britain (GB), the KSI for pedestrian crashes in GB was 8.53 in 2016 (Department of Transport Statistics, 2017), which is almost twice the value for Nablus Governorate.

Although GB is different in its charachtarsitcs from Palestine, but it couled be compared, so this values indicate a relatively low severity level of pedestrian crashes as compared to GB; on the other hand, the registed vehicles in Nablus Governorate equals 82 per 1000 capita, where it reaches 571 per 1000 capita in Great Britian.

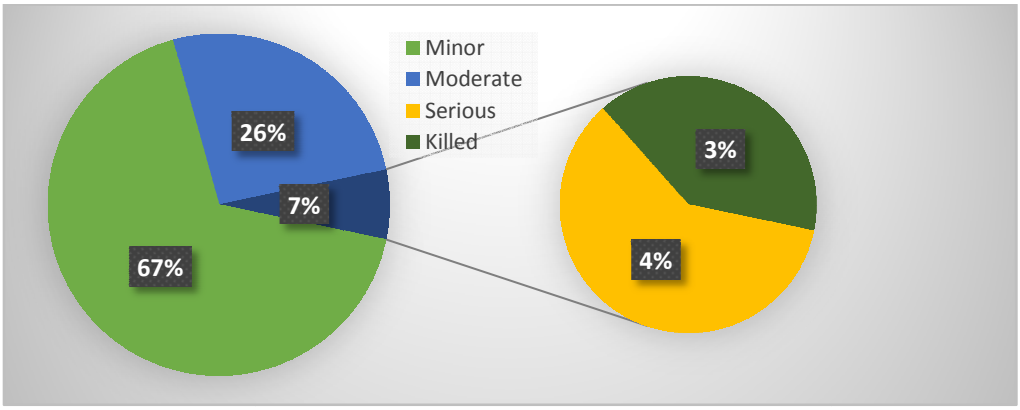


Figure (12): Pedestrian Crashes Severity in Nablus Governorate

Figure (13) shows the distribution of pedestrian crashes by age. The age category whom is younger than 10 years old was the highest group involved in pedestrian crashes, forming 26.3% of total crashes. On the other hand, more than half of the crashes were those less than 20 years old (55.6%). It is clear that older group (mature), are the least involved in a pedestrian crash. In comparison between the percentages of number of people in each category to the percentage of pedestrian crashes that occur to the same category, it is found that:

For those younger than 17 years old, their percentage was 58.8%, and they were involved in 54.2% of pedestrian crashes. On the other hand, those older than 60 formed 8.6% from the total population and were involved in 7.9% of the total pedestrian crashes. This leads to the fact that

the number of pedestrian crashes and pedestrians' age is inversely proportional.

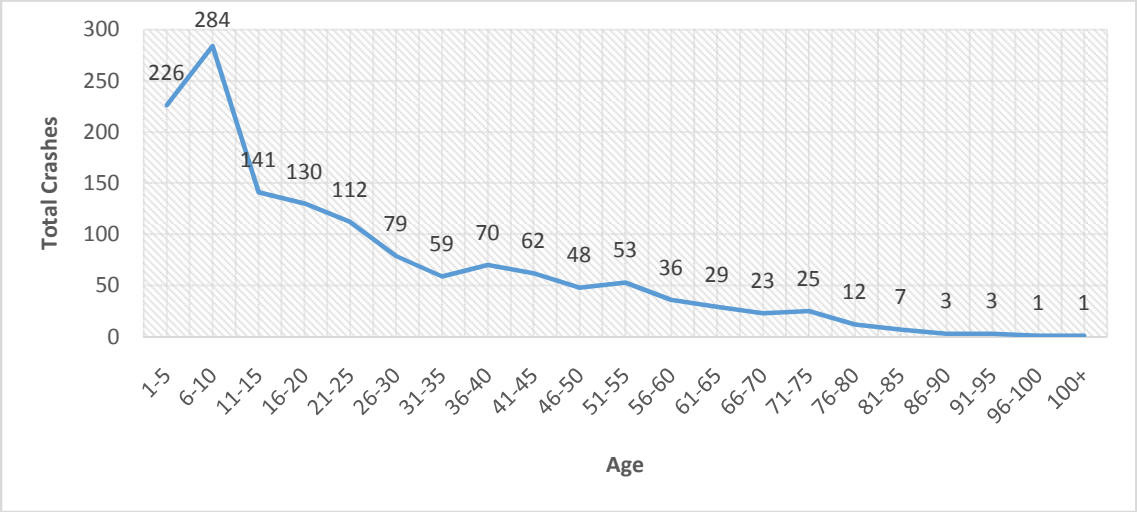


Figure (13): Distribution of Pedestrian Crashes in Nablus Governorate by Age

By analyzing the gender of victims and drivers, it is found that 68% of the victims were males and 32% are females. On the other hand, the drivers who were involved in the crashes in Nablus Governorate were mostly males with a percent of 95% as shown in Figure (14).

Figure (14

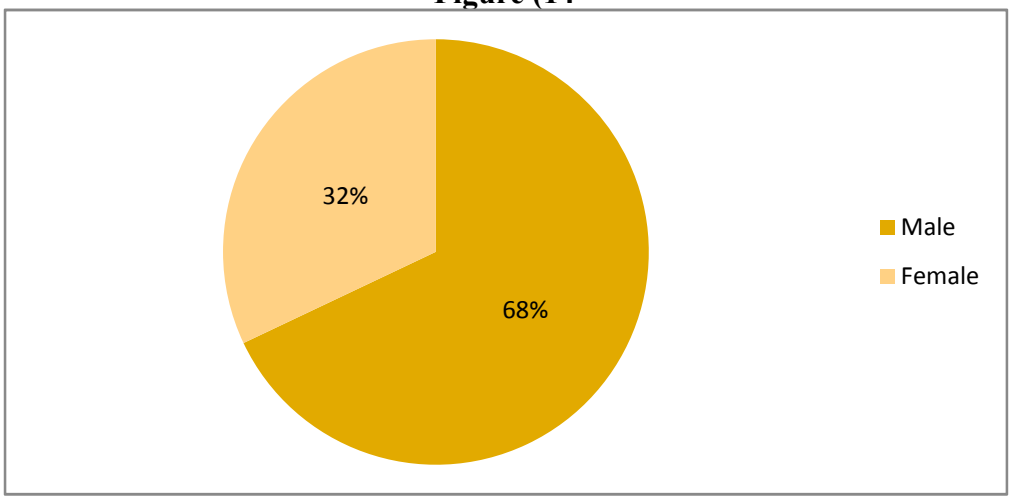


Figure (14): Analysis of Pedestrian Crashes in Nablus Governorate by Gender of Victims

Figure (15) shows the percentage of different types of vehicles involved in the crashes. The private cars formed 64.5% of total crashes, shared-taxis formed 24.5%, commercial vehicles formed 9.3%, and the other vehicles such as agricultural, governmental, or bikes formed 1.7% only. However, the total registered vehicles at the end of 2016 were 30,870 vehicles in Nablus Governorate, the private vehicles formed more than 82.7%, and shared-taxis form nearly 5.76% (PCBS report, 2017). Although public transportation vehicles (taxis and buses) constituted approximately 6% of the total vehicle composition in the governorate, they contributed in about one quarter of these crashes. On the other hand, their vehicle-kilometer of travel is normally much higher than the other vehicles. Nevertheless, their involvement in crashes is still relatively high.

According to the police reports, 80.6% of the causes of these crashes was "not taking the safety standards for road", which is a vague description, followed by reversing movement (13.9%), and deviating from the traffic lane (5.5%).

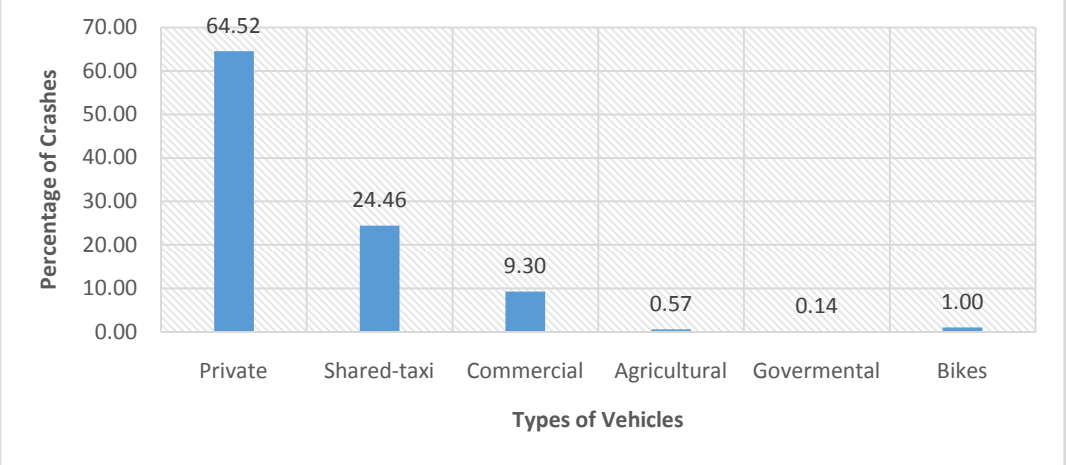


Figure (15): Analysis of Pedestrian Crashes in Nablus Governorate by Type of Vehicles

4.2 Spatial Analysis of Pedestrian Crashes in Nablus Governorate

As Nablus Governorate contains 57 localities (see Figure (16)), with a population of more than 380,000 capita (PCBS, 2017), the pedestrian crash profile was done for each locality. It is clear that Nablus City was the most critical unit, and had 78.7% of total pedestrian crashes in the governorate. The other 56 localities formed 21.3% of total crashes (280 crashes during the period of (2012-2016). Huwwara had an average of 7 crashes per year, then came Beita with an average of 5.8, after that there was a cluster of Badan, Talluza, and Annassarya with an average of 4.2 crashes per year. In addition, the localities of Qabalan, Awarta, Beit Foureek, Aseera Ashamalya, Roujeeb, and Jammain also had an average of more than two crashes per year.

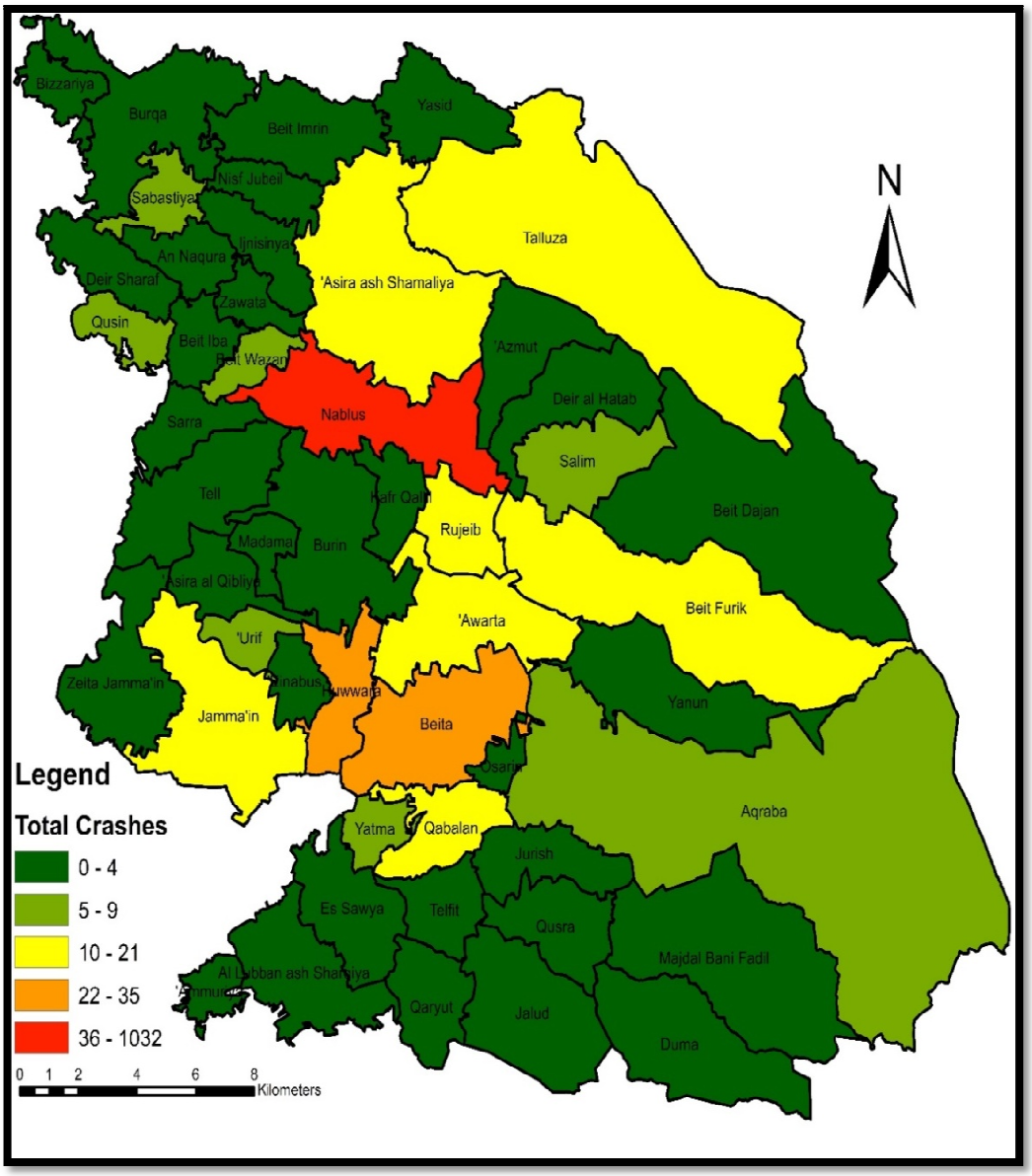


Figure (16): Distribution of Pedestrian Crashes in Nablus Governorate by Locality

To be more specific, the pedestrian crashes all over the governorate were analyzed by rate of crashes per population of each locality. The analysis of crashes per area will not be applicable, because the locality's land area is larger than the built up area. In addition, some connecting roads are outside the built up area; therefore, it would not be useful to analyze neither by the built up area nor by the land area.

As shown in Figure (17), it is obvious that Nablus City, Biet Wazan, and Huwwara were the most critical localities in pedestrian crashes per

100,000 capita in the Governorate during the period of analysis. Furthermore, the crashes concentrated in the localities that are adjacent to Road 60; therefore, it needs more attention to take into consideration. In Nablus City, the annual rate of pedestrian crashes per 100,000 capita was approximately 135. In other localities, rates were the followings: Huwwara (104), Beit Wazan (94), and Qusin (68).

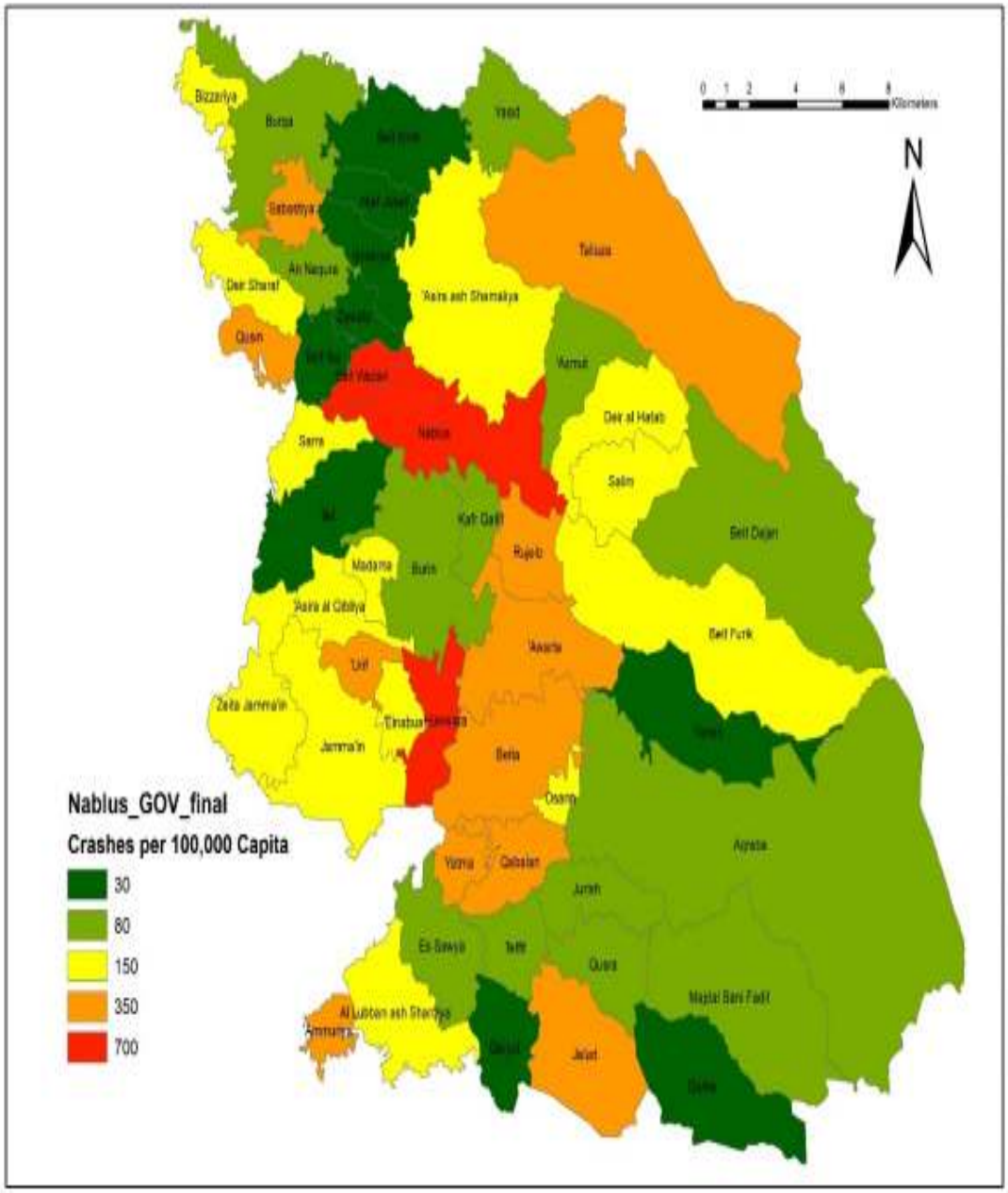


Figure (17): Pedestrian Crashes per 100,000 Capita in Nablus Governorate

4.3 Profile of Huwwara

Huwwara is located in the south of Nablus City, with 6659 population (PCBS, 2017) and nearly 8 km^2 as an area. Road 60 passes it longitudinally, which causes a very heavy movement of vehicles with different commercial activities there; therefore, this leads to high potentials for crashes. Figure (18) shows Huwwara location in Nablus Governorate.

Huwwara is considered as a passing area for heavy movement of vehicles or freights. Therefore, the majority of traffic is going from the north of the West Bank to the middle or south of the West Bank, and vice versa would pass through Huwwara using Road No. 60 which is a regional road crossing a very dense commercial area. This leads to high congestion on Sundays and Thursdays (beginning and end of work weekdays), and during the peak hours in the morning and evening; those are the times of going to and coming back from the work activities between the north and middle regions of the West Bank.

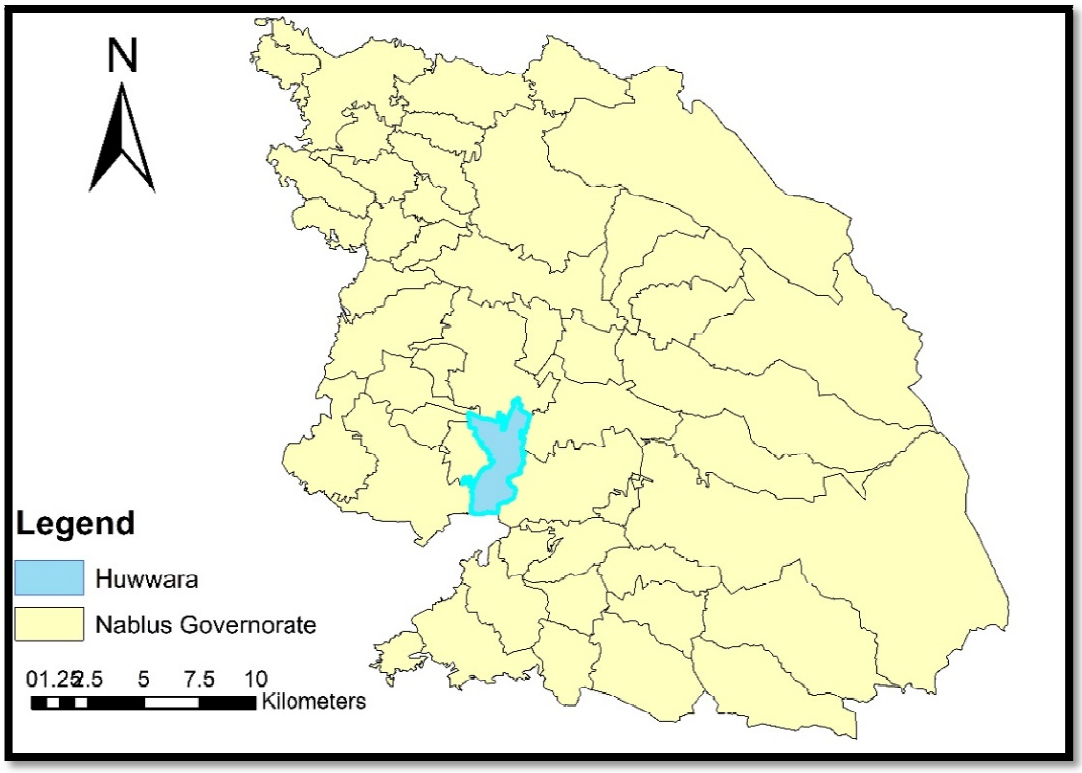


Figure (18): Huwwara Community Location Relative to Nablus Governorate

Figure (19) shows the distribution of the total number of pedestrian crashes over the study years. Although the overall pedestrian crashes increase in 2015 in the Governorate, Huwwara's are the less in the same year. Moreover, in 2013 the Governorate had the less number of pedestrian crashes, and Huwwara had the most.

Pedestrian crashes in Huwwara mostly occurred in the mid-week and on Fridays with an average of approximately seven crashes per year, as shown in Figure (20). Therefore, the highest pedestrian crashes occurred during off-peak days where congestion is relatively low; therefore, vehicles' speed is relatively high.

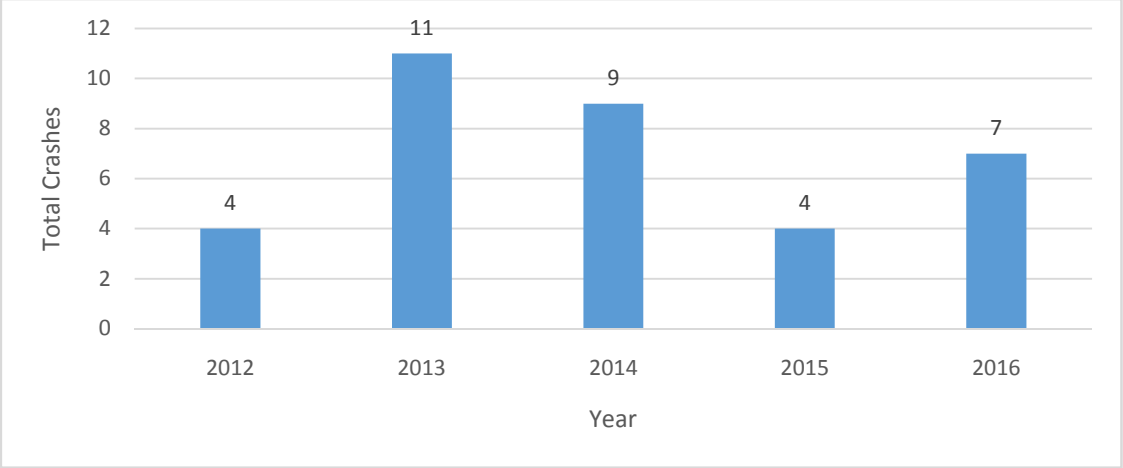


Figure (19): Distribution of Pedestrian Crashes in Huwwara by Year

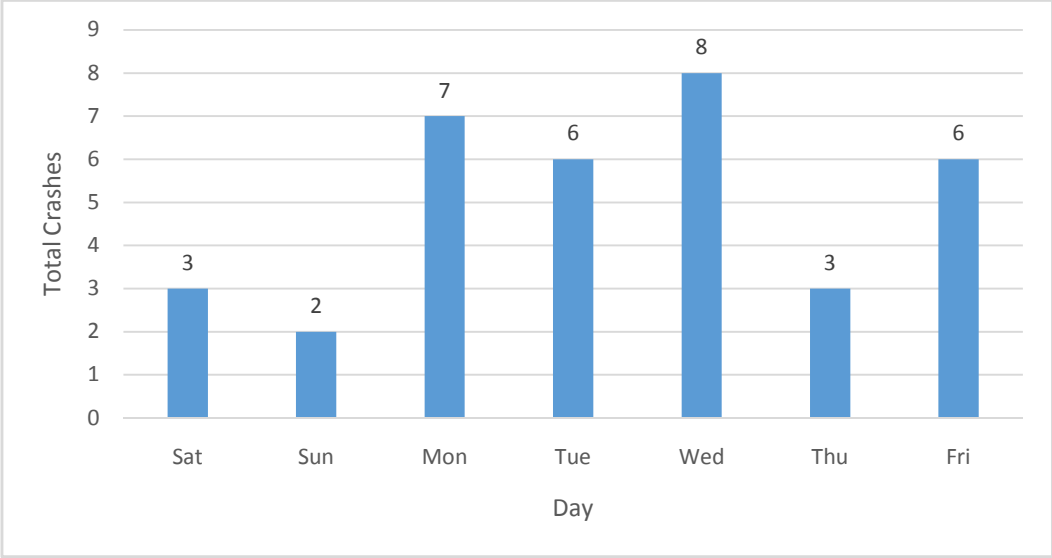


Figure (20): Distribution Pedestrian of Crashes in Huwwara by Day

Pedestrian crashes, similar to the Governorate's profile, fluctuated from hour to another, with a concentration period from 12:00 to 14:00 forming 29.4% of the total crashes, in addition to a morning peak between 9:00 and 10:00, as shown in Figure (21). These are the observed hours where traffic is relatively low; therefore, they tend to drive at a higher speed.

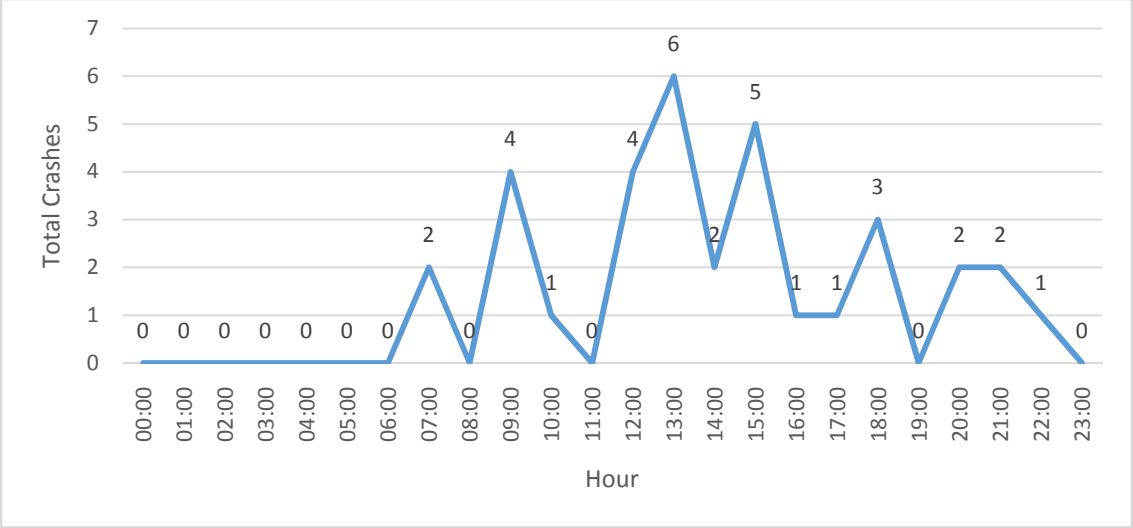


Figure (21): Distribution of Pedestrian Crashes in Huwwara by Hour

Figure (22) illustrates the monthly distribution during the study period in Huwwara. The most critical month was May with 6 crashes, followed by April and July with 5 crashes, while the lowest months were February, March, June, and August with one pedestrian crash only during the last five years. These results are similar to the Governorate profile, with same reasons and conditions.

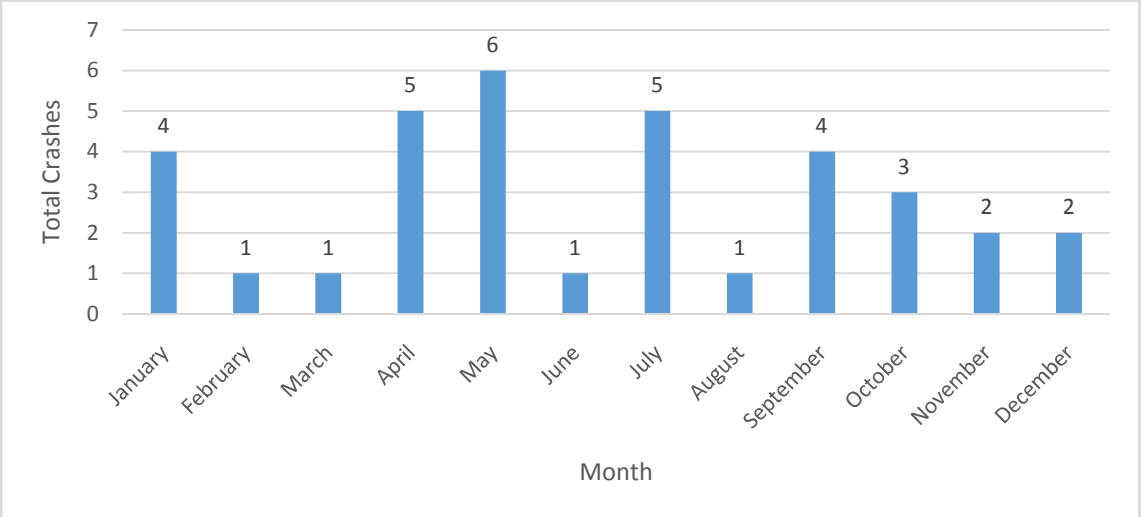


Figure (22): Distribution of Pedestrian Crashes in Huwwara by Month

The severity of injuries in Huwwara is presented in Figure (23). The KSI indicator formed 20% of total injury crashes during the analysis

period. The KSI per 100,000 capita was 21.5, which is much higher than the governorate's average. Again, this could be explained by the high occurrence of pedestrian crashes during the off-peak periods where traffic is traveling at a relatively high speed; therefore, the severity of injury is high. Furthermore, the majority of traffic is passing through Huwwara and not registered in it; as such, the exposure level is high.

In terms of age distribution of victims, Figure (24) shows this distribution in Huwwara. The age category younger than 10 years old formed 27.3% of total pedestrian crashes. In addition, the category of 21-40 years old formed 42.5%.

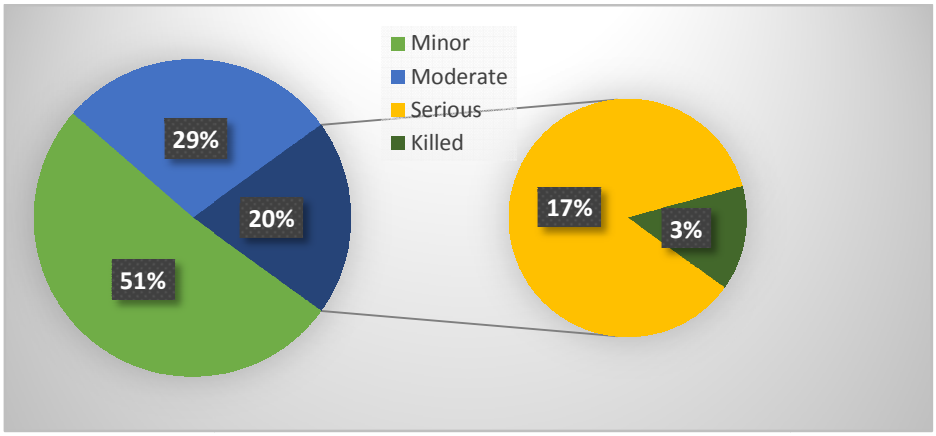


Figure (23): Pedestrian Crashes Severity in Huwwara

There was limited number of elderly (older than 65 year) victims of pedestrian crashes. This is reasonable because people there are primarily for shopping, due to its commercial characteristics and the large volume of crossing people through it.

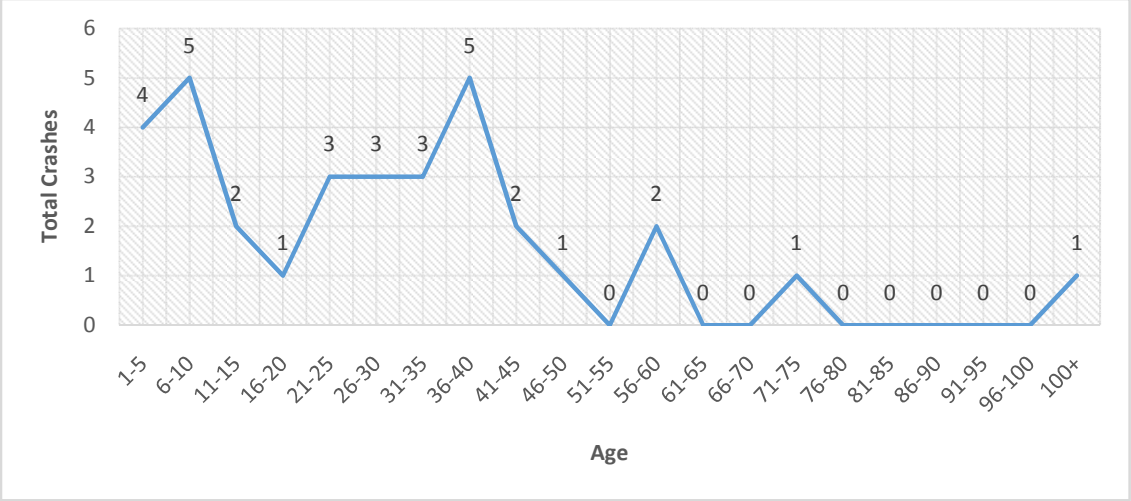


Figure (24): Distribution of Pedestrian Crashes in Huwwara by Age

By analyzing the gender of victims or drivers, it is found that 77% of the victims were males, and 23% were females, as shown in Figure (25). On the other hand, the drivers who were involved in the crashes in Huwwara were mostly males with a percent of 97%.

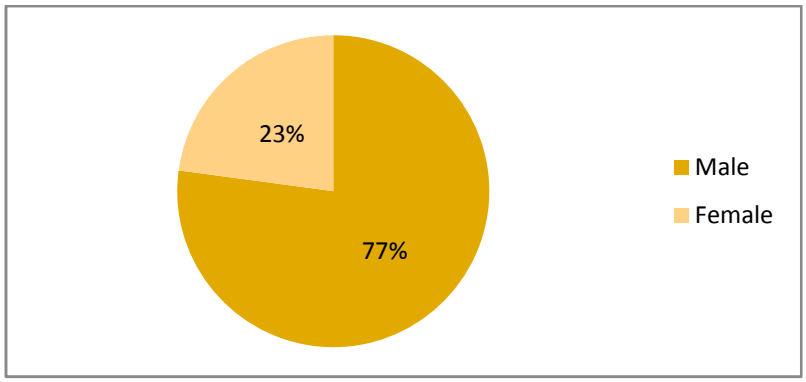


Figure (25): Analysis of Pedestrian Crashes in Huwwara by Gender of Victims

Figure (26) shows the percentage of different types of vehicles involved in the crashes. The private cars formed 86% of total crashes, shared-taxis formed 7%, and commercial vehicles formed 7%. The percentages are nearly similar to the percentage of ownership for each type as shown before. This percentage is somehow unexpected; because there is a high public transport traffic volume of shared taxis that is originated from

or destined to the northern cities of West Bank passing through Huwwara. On the other hand, their high level of driving experience could be a reason of their capacity not to be involved in pedestrian crashes. According to the police reports, 78.6% of the causes of these crashes was "not taking the safety standards for road", which is a vague description, followed by reversing movement (22.4%).

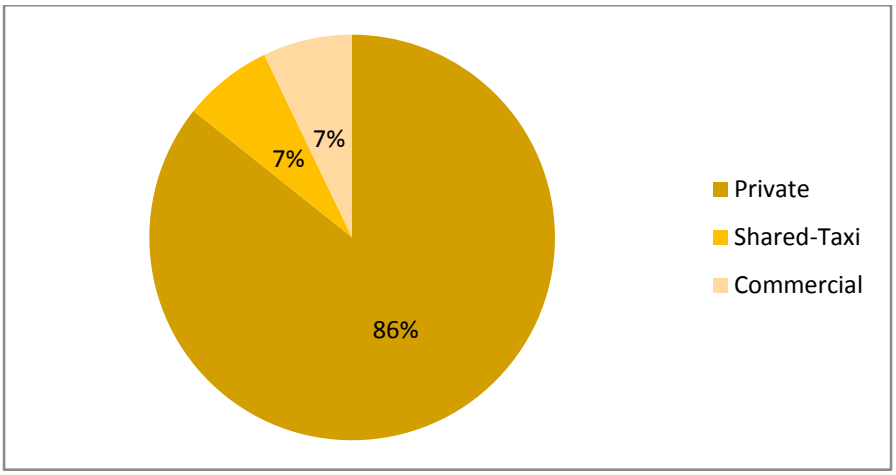


Figure (26): Analysis of Pedestrian Crashes in Huwwara by Type of Vehicles

4.4 Profile of Beita

Beita is located 10 km south of Nablus City with 11,682 population (PCBS, 2017). Figure (27) shows the location of Beita community in Nablus Governorate.

The trade sector absorbs 30% of the town's workforce. This percentage makes Beita an active center in trade and economic activities, especially having the produce market and more than 200 other markets (ARIJ, 2014). Furthermore, its location adjacent to Huwwara and Road No. 60 makes the locality active in terms of traffic.

Figure (28) shows the distribution of the total number of pedestrian crashes over the study years (2012-2016). It is obvious that there was a relatively steady occurrence of pedestrian crashes in the locality.

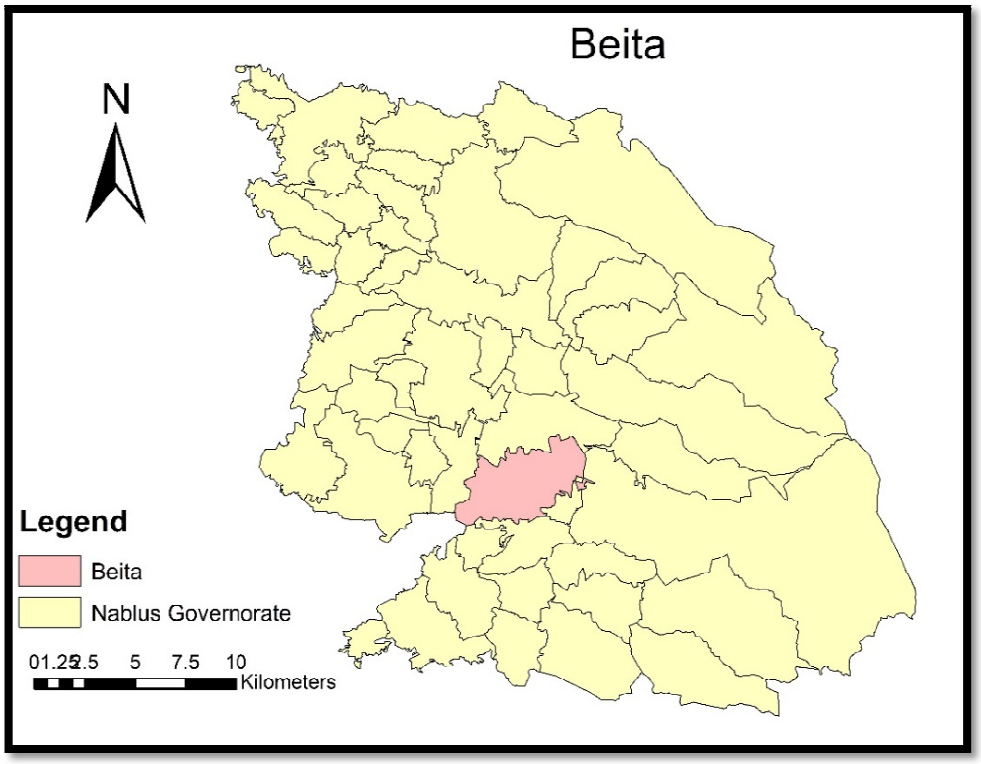


Figure (27): Beita Community Location in Nablus Governorate

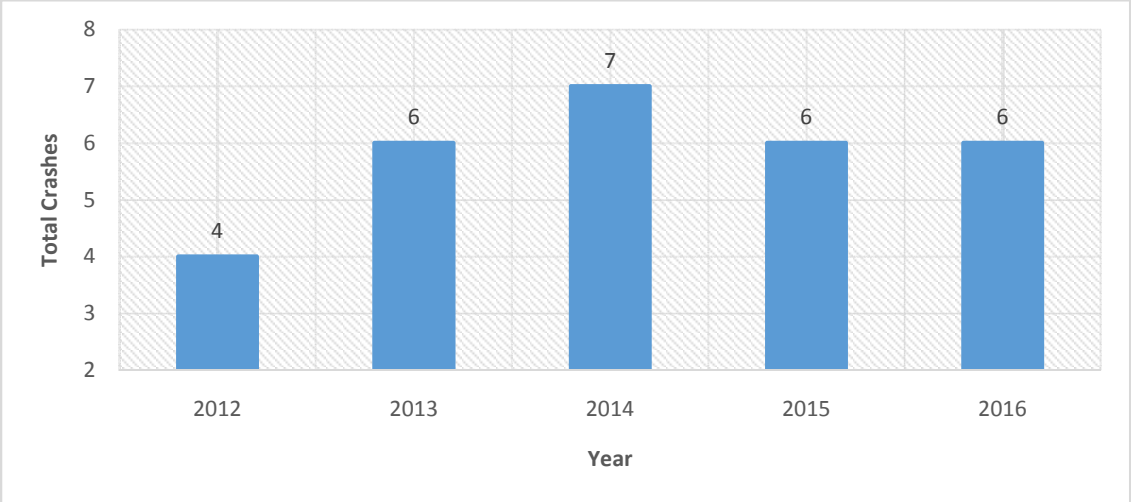


Figure (28): Distribution of Pedestrian Crashes in Beita by Year

Similar to that, the crashes were distributed throughout the week, and there was no obvious difference among them, except Wednesday with the lowest number of pedestrian crashes, as shown in Figure (29).

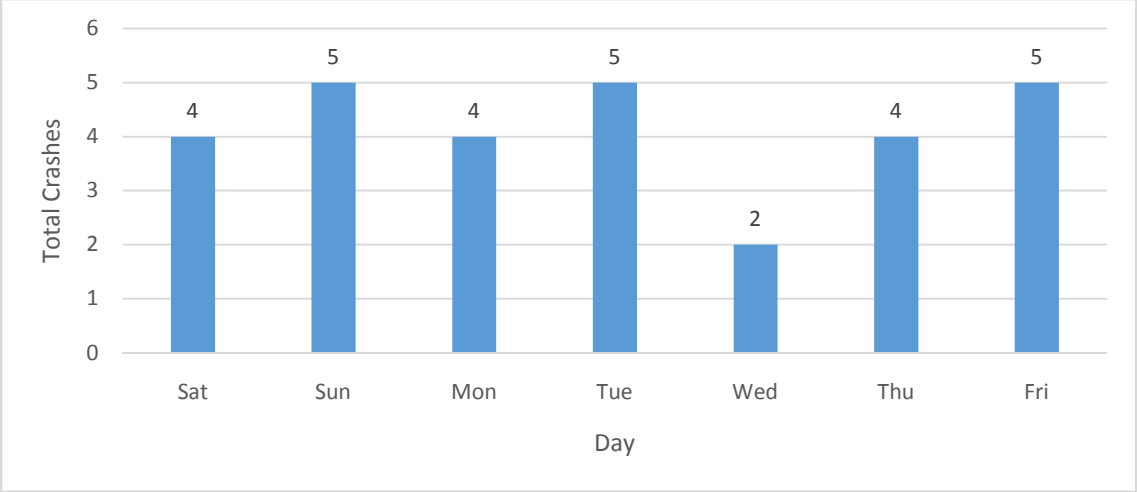


Figure (29): Distribution of Pedestrian Crashes in Beita by Day

As for the hour of occurrence, it is clear that the crashes fluctuated from hour to another, with a concentration period from 15:00 to 20:00 forming 46.4% of the total crashes, and a peak hour was from 19 to 20:00. The stakeholders there (professionals, policemen, and people) mentioned that this is due to that children were used to go out for playing in roads after finishing schools' time, as the percentage of them reached 60% and particularly in spring and summer seasons. Figure (30) shows the hourly distribution of pedestrian crashes.

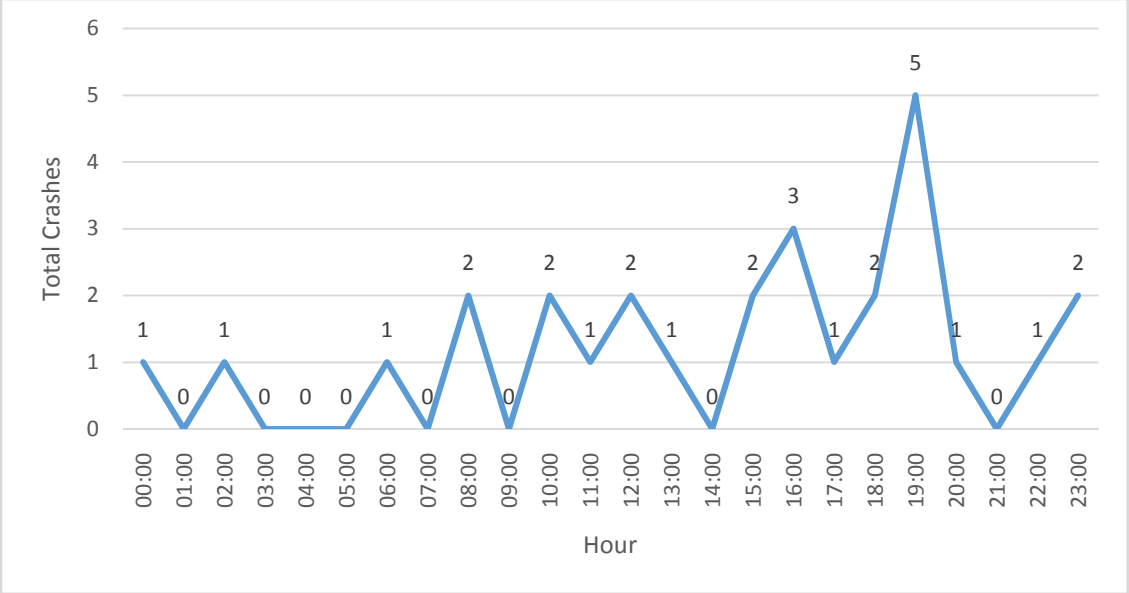


Figure (30): Distribution of Pedestrian Crashes in Beita by Hour

Figure (31) illustrates the monthly distribution all over the last five years. The most critical month was July with 8 crashes, then October with 5 ones. On the other hand there were no crashes during February and August during the study period. Children playing in the roads during the schools summer break explained the high rate in July relative to other months.

Crash severity for Beita is shown in Figure (32). The crash injuries were mostly minor or moderate (90% of total crashes). The KSI crashes formed 10%, with 3 injuries during the study period. By analyzing this indicator according to population, the KSI per 100,000 capita was 5.71, which is nearly around the Nablus Governorate's value.

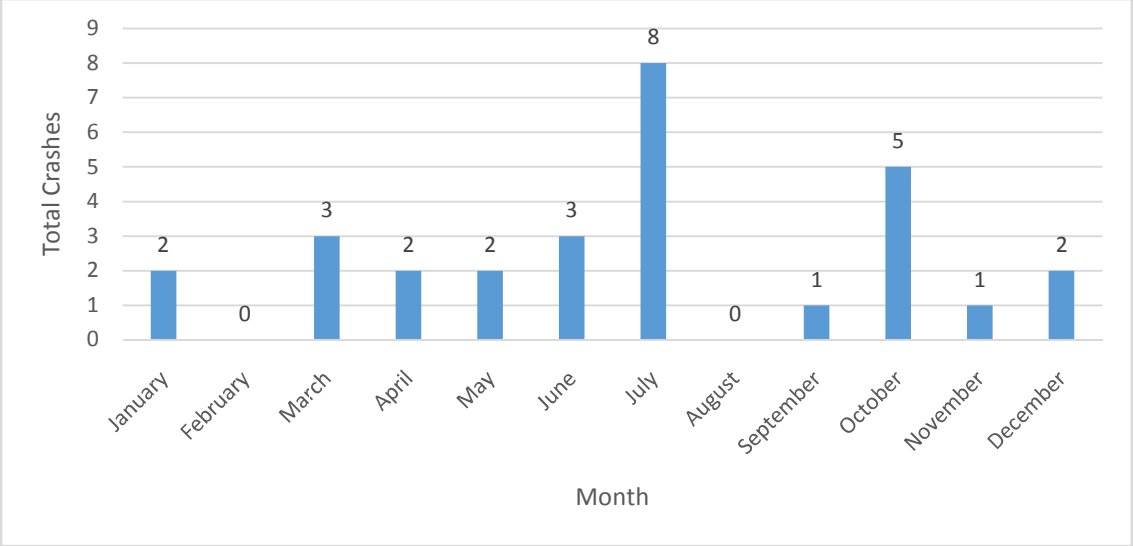


Figure (31): Distribution of Pedestrian Crashes in Beita by Month

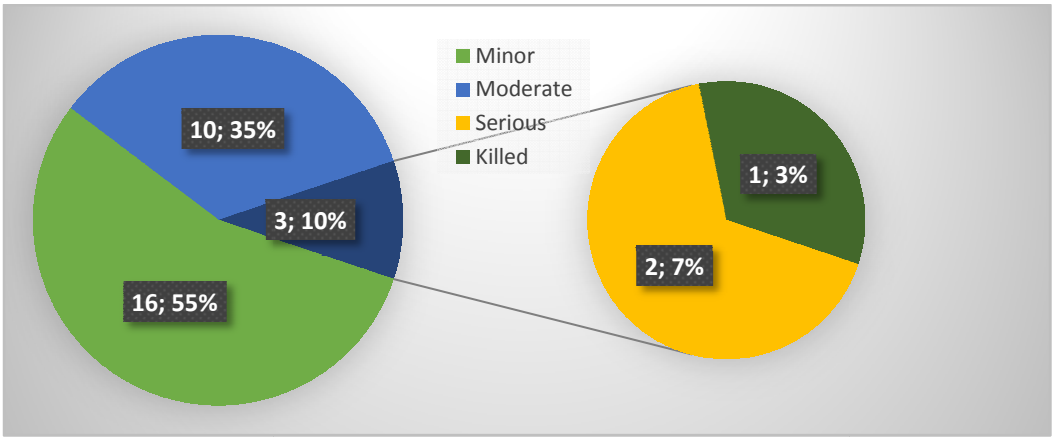


Figure (32): Crash Severity in Beita

In terms of age of pedestrians involved in crashes, Figure (33) shows the distribution of crashes by age. The age category younger than 10 years old were the highest group involved in pedestrian crashes, forming 53.6% of total pedestrian crashes happened in the town.

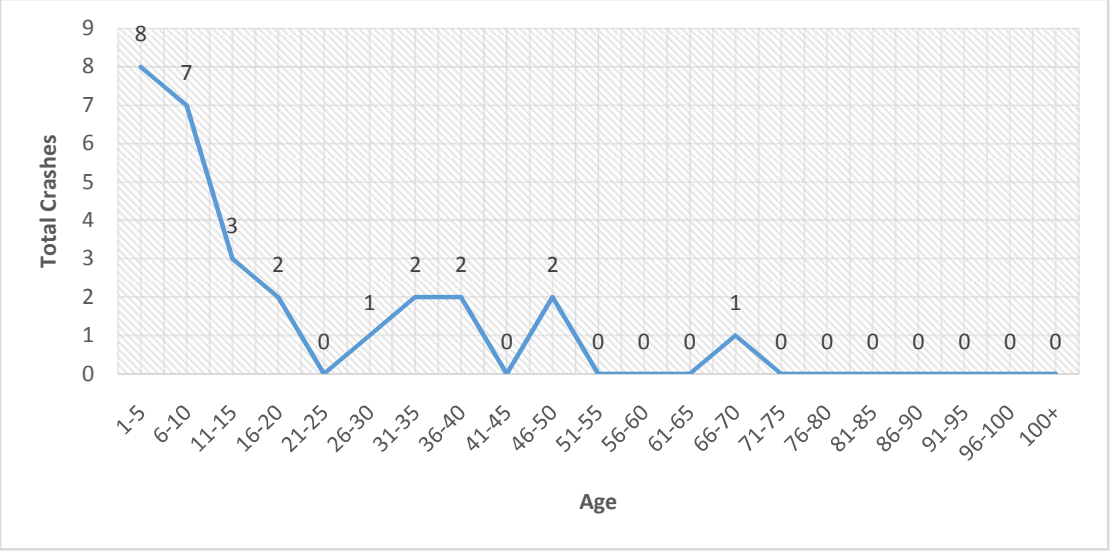


Figure (33): Distribution of Pedestrian Crashes in Beita by Age

By analyzing the gender of victims or drivers, it is found that 86% of the victims were males and 14% were females. On the other hand, and similar to other towns, the situation of females' driving in the town was rare and nearly not existing, which leads to a 100% percent of males who were involved in the crashes see Figure (34). According to the police reports, 76.5% of the causes of these crashes was "not taking the safety standards for road", followed by reversing movement (11.8%), and deviating from the traffic lane (5.9%).

Figure (35) shows the percentage of different types of vehicles involved in the crashes. The private cars formed 88.2% of total crashes and commercial ones formed 11.8%; this is due to trade activities and existing produce market. It is also noticed that there were no shared-taxis involved in pedestrian crashes; that is because the number of shared-taxis in the town is only 11 (Higher Traffic Council, 2016). Police records shows that these crashes occurs in some specific locations in Beita, such as Green Market, and Oil press.

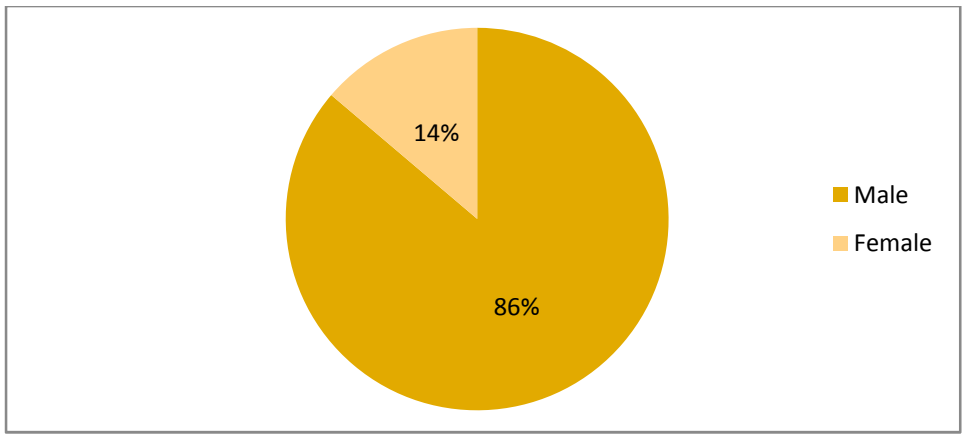


Figure (34): Analysis of Pedestrian Crashes in Beita by Gender of Victims

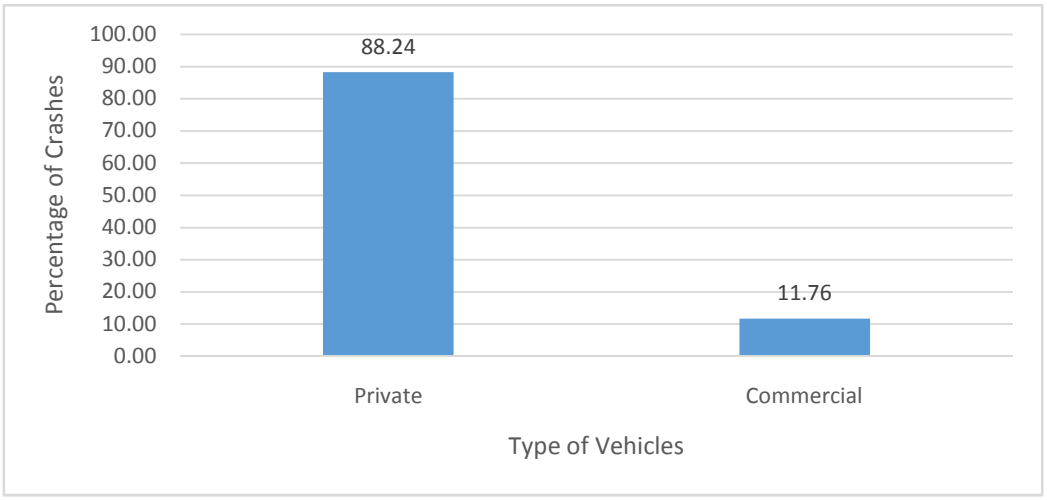


Figure (35): Analysis of Pedestrian Crashes in Beita by Type of Vehicles

Chapter Five

Analysis of Pedestrian Crashes in Nablus City

Chapter Five
Analysis of Pedestrian Crashes in Nablus City

Nablus City is as the second largest city in the West Bank, with 28.6 sq. km (MoLG, 2016). It lies in a narrow valley between the two mountains of Ebal and Gerizim. Nablus City is considered a vital commercial and service center in the West Bank. It has a high concentration of commercial centers and traditional industries, the largest university in the West Bank, and it hosts other historical, educational, cultural, financial, and medical institutions.

Nablus City road network forms the shape of longitudinal network from east to west. For instance, Al Quds St. and its extension (Faisal St.) are considered as arterial roads and gates for Nablus City for the eastern and southern localities and governorates. Moreover, Rafedia St. is another arterial street linking the CBD area with Rafedia area, to reach the New Campus of An-Najah National University, which also extends to the western localities and governorates. In addition to these, there are some collector roads such as Amman St., Al Makhfia St., Tunis St., Haifa St., Jaffa St., etc., which are considered as main and vital roads in the City. Figure (36) shows the roads network in Nablus City.

Its nature, which contains different neighborhoods, demographics, daily activities, etc., necessitates dividing the city into different zones. This will facilitate the analysis and achieving better accuracy in dealing with more than 186,433 capita (PCBS, 2017).

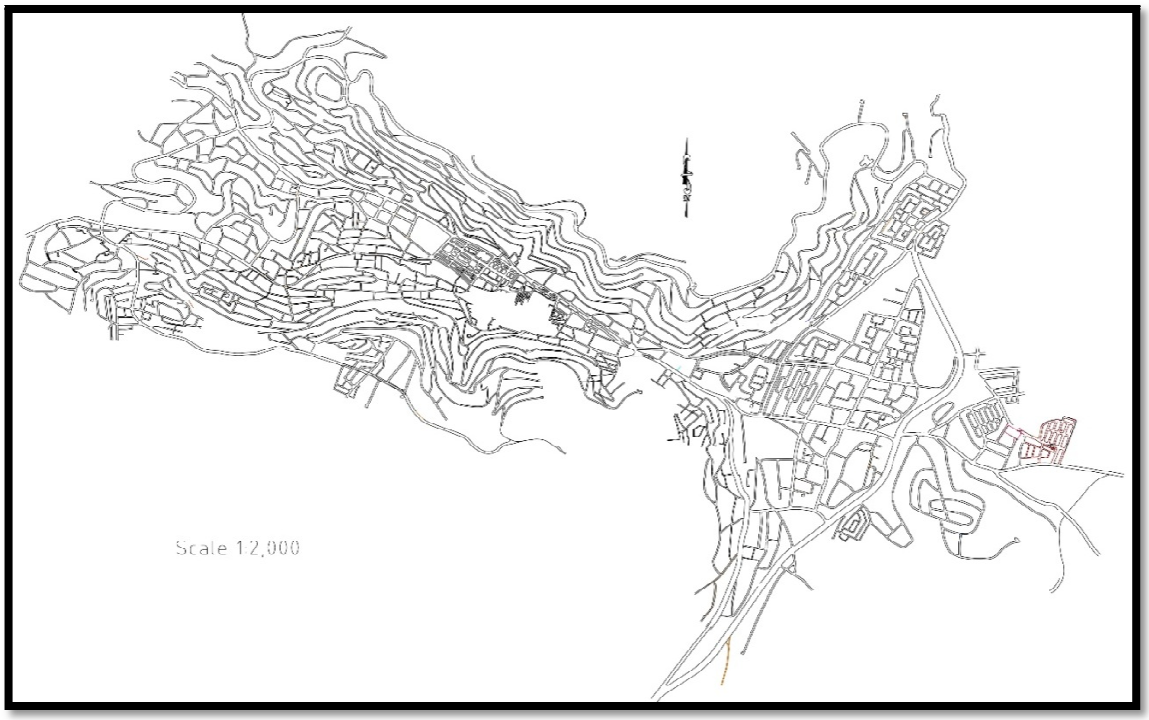


Figure (36): Nablus City Roads Network

5.1 Profile of Nablus City

As mentioned in Chapter 3, the city was divided into 27 zones depending on the nature of activities, people's movement, and road network; therefore, the city will be analyzed more accurately.

Nablus City had 1030 pedestrian crashes during the period of analysis (2012-2016). However, in analyzing cities' pedestrian crashes, it is clarified by three questions; Where? When? Who?

Spatially, Figure (37) shows the distribution of these crashes in the 27 zones during the study period. It is clear that Zone 1 was the most critical and hazardous zone, which had 18.5% of the total pedestrian crashes in the city, followed by zones 2 and 5 with percentages of 10.4% and 8.6%, respectively. These categories are classified depending on GIS

analysis in dividing data into a relative scale. Critical zones will be analyzed later in a full profile for each.To test thess zones within they are statistically different or they should be merged, ANOVA test is used. Table (2) shows the results:

Table (2): Pedestrian Crashes in Selected Main Locations in Nablus City

ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	7697.659	26	296.0638	31.72112	3.17E-39	1.598423
Within Groups	1008	108	9.333333			
Total	8705.659	134				

As shown, F is larger than F critical which means that one of the groups is statistically different. Moreover, P value is smaller than alpha (0.05) which means that the groups are statistically different.

Table (3) shows the number of pedestrian crashes along the main (arterial and collector) roads and critical areas in Nablus City zones during 2012-2016 years.

Table (3): Pedestrian Crashes in Selected Main Locations in Nablus City

Road Name	Number of Pedestrian Crashes	% of Pedestrian Crashes	Zones' Numbers
Faisal St.	122	11.82%	1 & 21
Rafedia St.	85	8.24%	4 & 5
Al Shuhada' Square	52	5.04%	1
Omar Bin Khattab St.	43	4.17%	3
Al Quds St.	40	3.88%	19
Sufian St.	32	3.10%	2
Ras Al Ein St.	27	2.62%	22

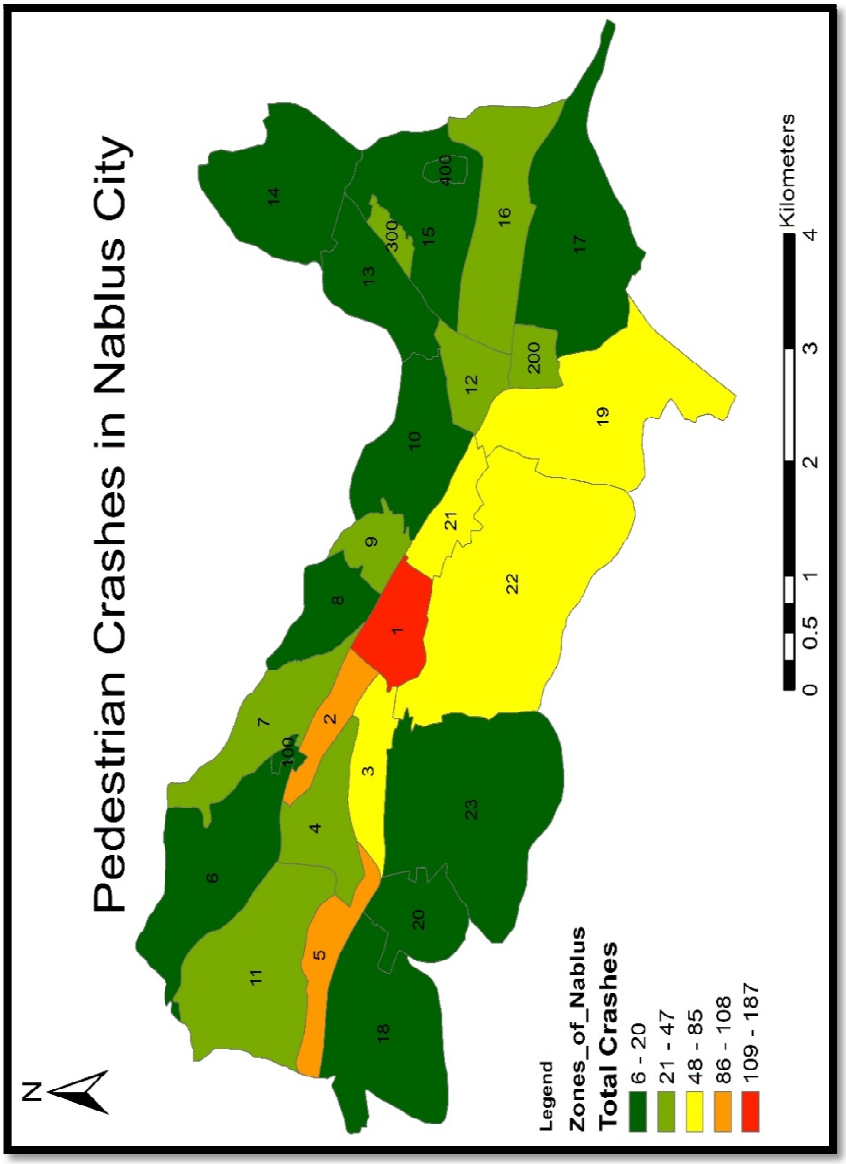


Figure (37): Distribution of Pedestrian Crashes in Nablus City by Zone

In comparison with the all crashes investigated from (Khader, 2014), Faisal Street comes first in pedestrian crashes while it is second in all crashes, Rafedia Street comes second in pedestrian crashes, while it is first in all crashes.

The rate of crashes in the city's zones could be analyzed per area, population, or traffic volume. It is concluded that the rate per area would be more applicable in the case of Nablus City due to the nature of people's

and traffic movement. It would be an indirection expression of the rate per distance travelled. For the purpose of this analysis, some zones were combined, as quarters, as shown in Figure (38).

By analyzing pedestrian crashes per km^2, it is found that the CBD area was the most critical one in the city, followed by Rafedia zone and Jaffa Street zone. The CBD had 235.6 pedestrian crashes per km^2 in the five years, as an extreme high rate, and could be explained by the high traffic volume there, other quarters are shown in Figure (38).

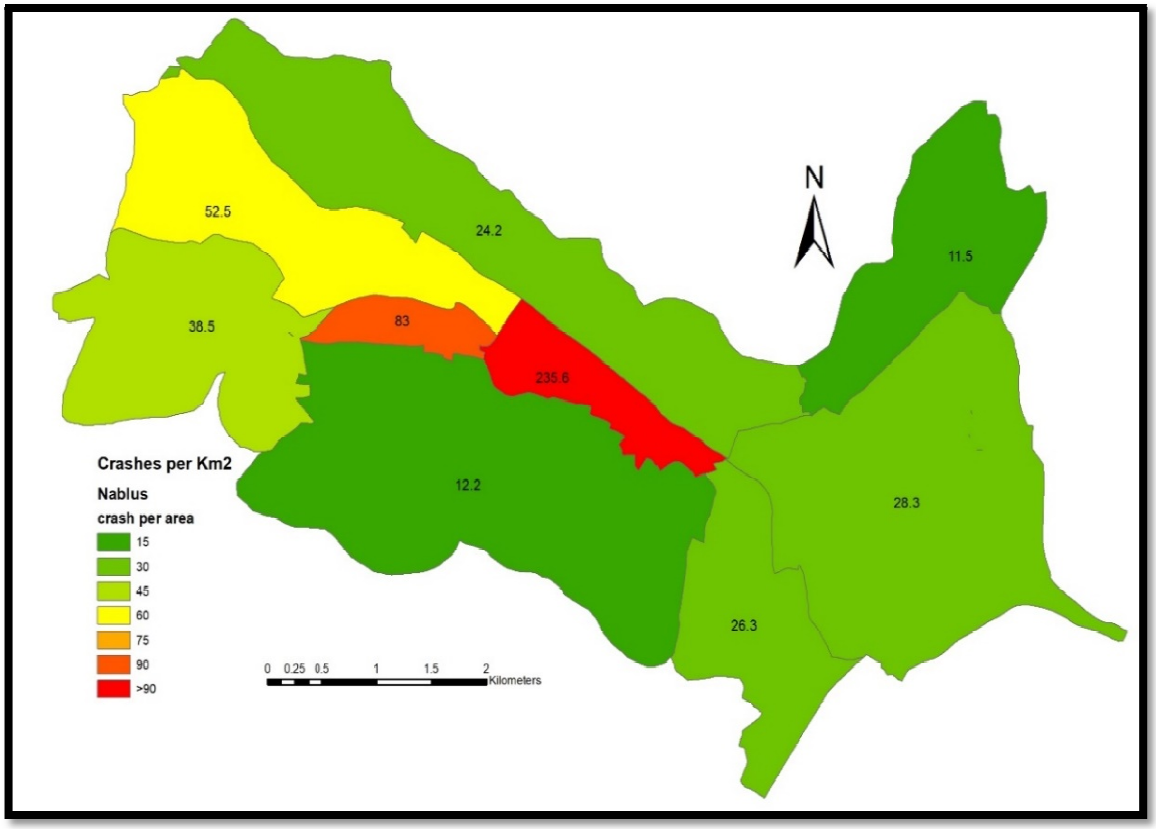


Figure (38): Analysis of Pedestrian Crashes per km^2

As mentioned before, Nablus City had an average of 135 pedestrian crashes per 100,000 capita per year. In terms of their spatial distribution, the CBD area had 3.52 crashes per 1000 capita per year, Jaffa (2.88), An-

Najah National University new campus area (2.16), and Rafedia (1.46), as shown in Figure (39). These areas are well-known in the city of being very active in traffic and pedestrian movements, and a considerable portion of traffic passes through these areas.

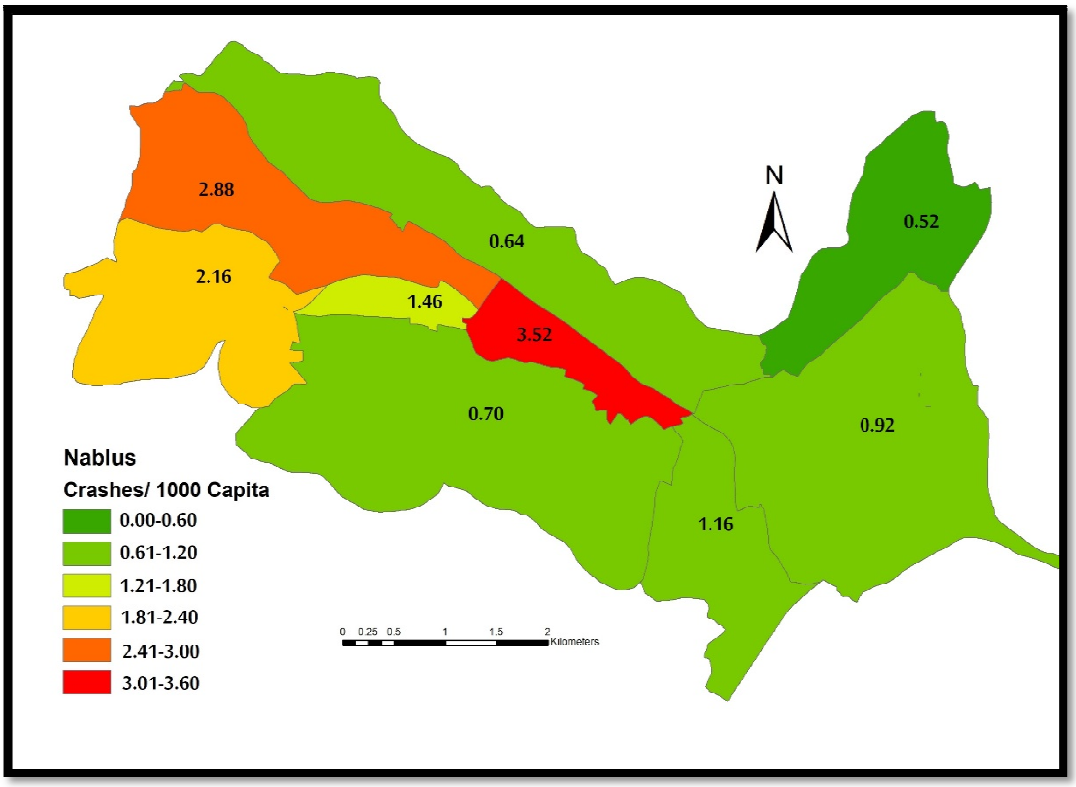


Figure (39): Analysis of Pedestrian Crashes per 1000 capita

The year 2015 had the highest pedestrian crashes. There was an increase by about 15% than the yearly average crashes; however, the total pedestrian crashes decreased in the following year (2016). The yearly distribution of pedestrian crashes during the period of analysis is shown in Figure (40). After reviewing what was happened in the city which could effect on pedestrian crashes increase, there were no significant issue regarding pedestrian movement, so this increase were with no apparent reason.

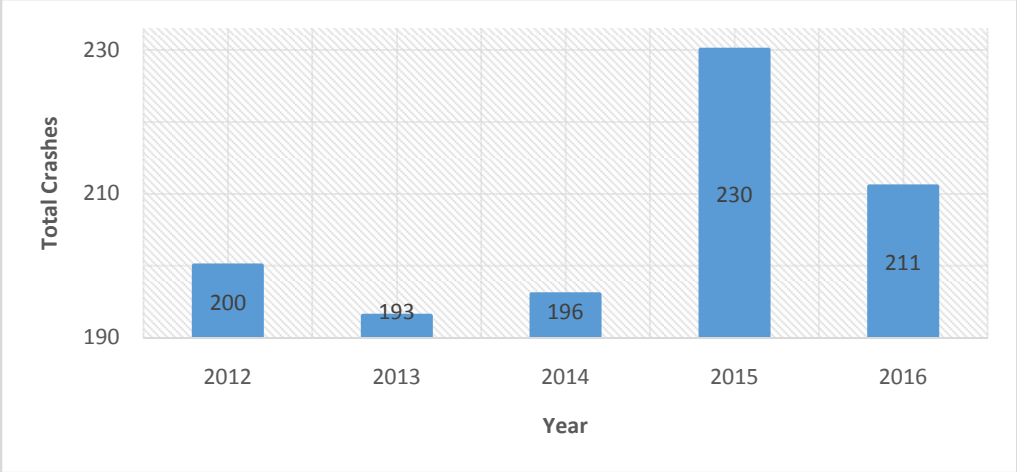


Figure (40): Total Pedestrian Crashes in Nablus City by Year

In terms of monthly distribution of pedestrian crashes, Figure (41) illustrates this. May was the critical month with 106 crashes with a percent of 10.3%, and then came March, August, and April with 99, 99, and 98 crashes, respectively. These results are similar to the profile of Nablus Governorate. Approximately 29.4% of the crashes occurred in the spring season. On the other hand, winter had the lowest percentage with 19.3% only. These results are so logical due to the obvious pedestrian movements all over the city in spring or summer seasons, unlike winter or autumn.

Furthermore, and similar to the governorate profile, Thursday was the day of week with the highest pedestrian crashes in the city with 18.4%, as it is the end of week. On the other hand, Friday was the lowest with 10.5% only from the total pedestrian crashes in the city, as shown in Figure (42).

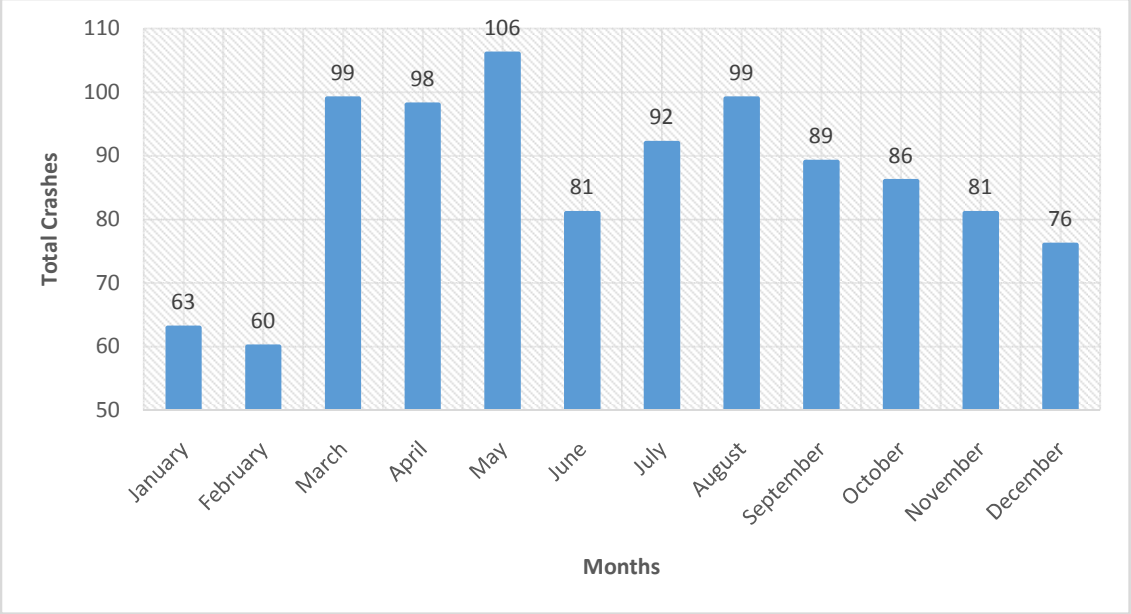


Figure (41): Distribution of Pedestrian Crashes in Nablus City by Month

As for the hour of occurrence, it is clear that the crashes fluctuated from one hour to another, with a concentration around mid-day and in the afternoon to the evening hours (12:00 to 19:00), which formed 56.5% of the total pedestrian crashes. The most critical hour was from 13:00 to 14:00, which contained 111 crashes with a percent of 11.1% from the total, as shown in Figure (43).

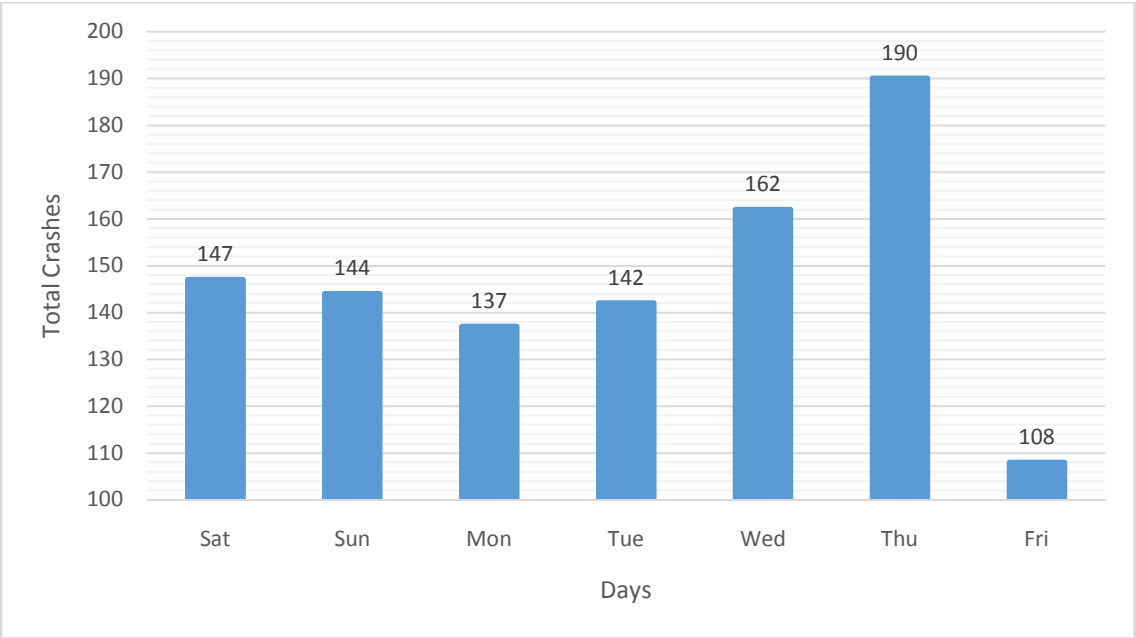


Figure (42): Distribution of Pedestrian Crashes in Nablus City by Day

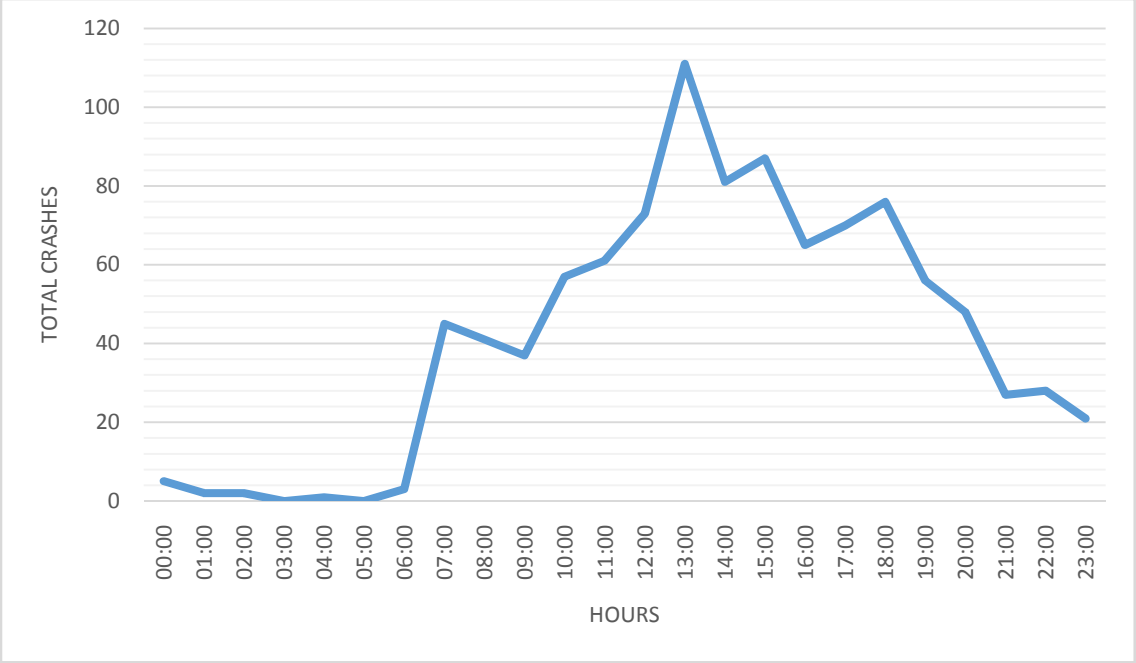


Figure (43): Distribution of Pedestrian Crashes in Nablus City by Hour

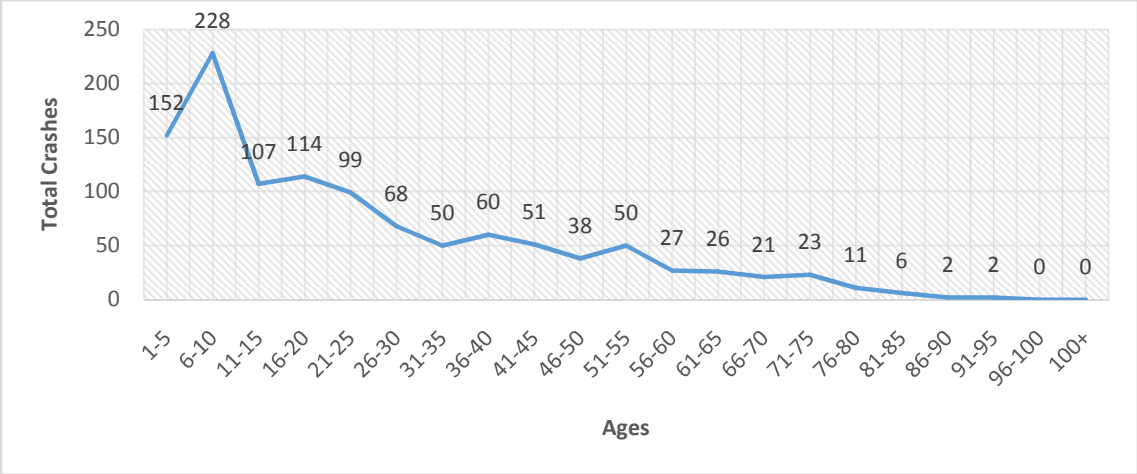


Figure (44): Distribution of Pedestrian Crashes in Nablus City by Victim's Age

By analyzing the gender of victims or drivers, it was found that 67% of the victims were males and 33% were females. On the other hand, the drivers who were involved in the crashes in Nablus City were mostly males with a percent of 95% as shown in Figure (45).

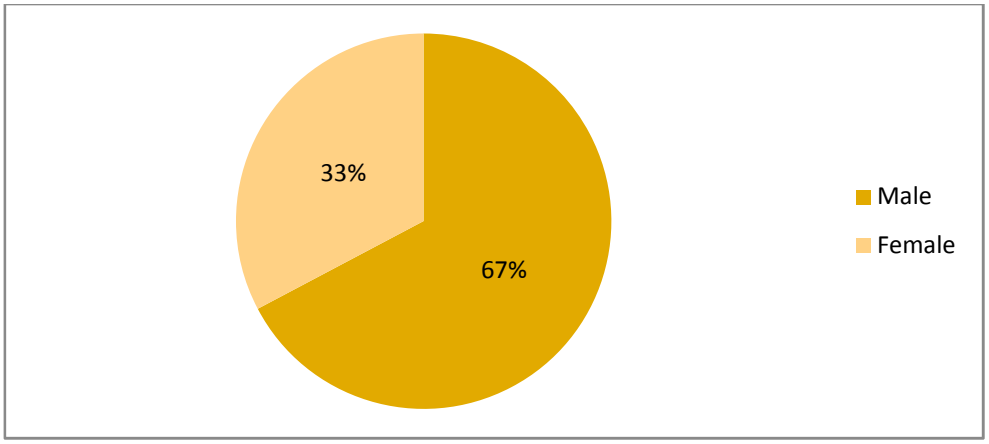


Figure (45): Analysis of Pedestrian Crashes in Nablus City by Gender of Victims

Figure (46) shows the percentage of different types of vehicles involved in the crashes. The private cars formed 62.9% of total crashes, shared-taxis formed 26.9%, commercial vehicles formed 8.8%, and the other vehicles such as agricultural, governmental or bikes formed 1.4%.

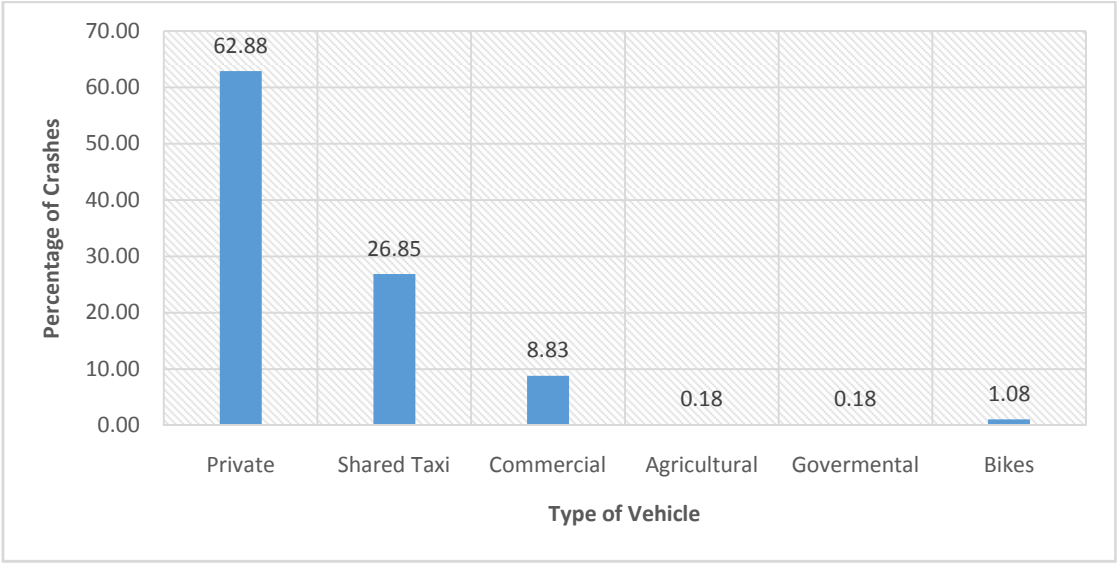


Figure (46): Analysis of Pedestrian Crashes in Nablus City by Type of Vehicles

Moreover, crash severity is an important indicator to be considered, which is shown in Figure (47). The injuries in Nablus City were mostly minor or moderate; they formed 95% of total crashes. The KSI crashes formed 5% during the study period with 51 injuries.

By analyzing this indicator according to population, the KSI per 100,000 capita was 5.60. It is clear that Nablus City is very close to the Governorate KSI rate' this is because it forms the major percent of people and area, in addition it has the most urban interactions between vehicles and pedestrians among all the governorate. Chapter 5 discusses this number in details.

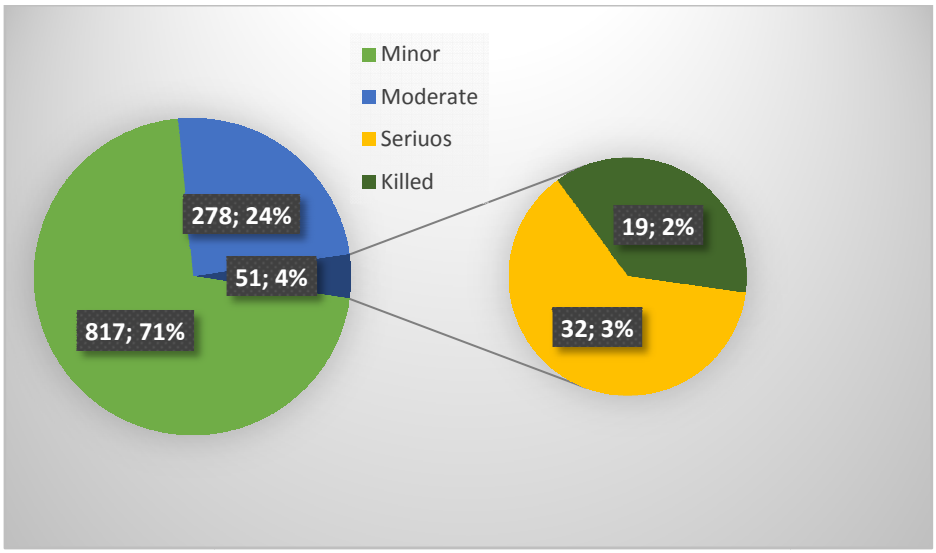


Figure (47): Crash Severity in Nablus City

Comparing the genders with ages, it's found that after 20 years, the percentage of females increases more than the percentage of males for the same category, which means that number of females whom are injured by crashes according to the total number of them are more than males. On the other hand, males are more in the category of (less than 20 years)

On the other hand, comparing the genders with severity, it's found that percentage of females is more than the percentage of males for the minor injuries, which means that number of females whom are slightly injured by crashes according to the total number of them are more than

males. On the other hand, males are more in other categories of moderate, serious or killed injuries.

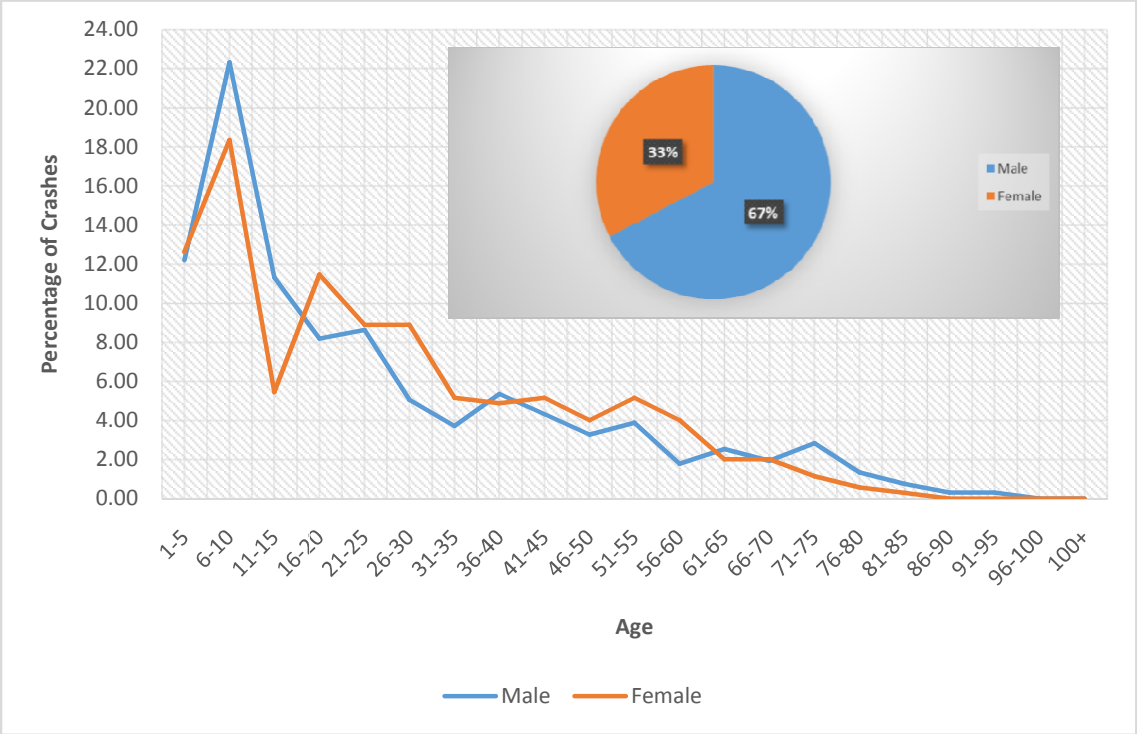


Figure (48): Percentage of crashes for different genders vs. Age in Nablus City

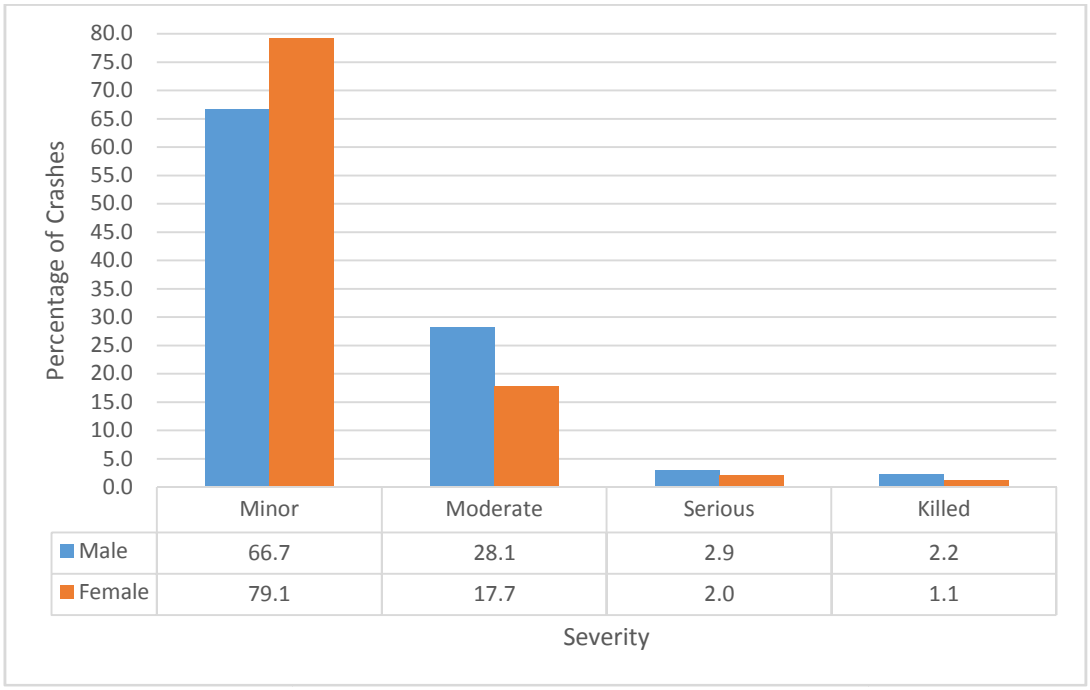


Figure (49): Percentage of crashes for different genders vs. Severity in Nablus City

5.2 Analysis of Zone 1

After analyzing the spatial distribution of pedestrian crashes in Nablus City, zone 1 (City Center – Commercial Center) was the highest in crash occurrence. As expected, this zone was the most expected to have the highest number of crashes as this is a vital location that attracts people and vehicles, and a point of destination for most of Nablus citizens and visitors. The Commercial Center area with Al Shuhada' Square is a very congested area with a high rate of walking people. In addition, there is the block of Faisal St., which contains Al Watani Hospital, Police Department, and Nablus Municipality, which was considered among the 20 most dangerous locations in Nablus City (Higher Traffic Council, 2015). Moreover, there is the Old Nablus City, which also attracts a high number of walking people, with a high population density. Figure (50) shows the distribution of pedestrian crashes in zone 1 by day.

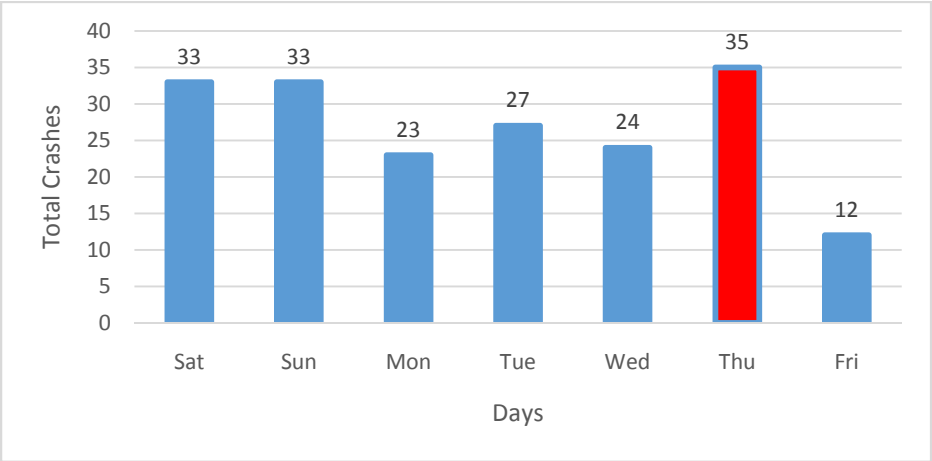


Figure (50): Distribution of Pedestrian Crashes in Zone 1 by Day

The crashes mostly happened on Thursday, which is considered as end of week workdays, followed by Sunday and Saturday as the beginning

of the weekdays with active pedestrians and vehicles activities. Those days experience the most active movements of people and vehicles in the city. On the other hand, on Friday there were only 6.4% from the total pedestrian crashes in this zone.

As for the hour of occurrence, Figure (51) shows that the crash concentration was in mid-days from 12:00 to 14:00, which formed 23.8% of the total pedestrian crashes in the zone, and this is due to the increasing numbers of people in these times there. In addition, there was also a peak morning hour from 8:00 to 9:00. Like the daily active movement, these two peak hours have the same conditions of movement.

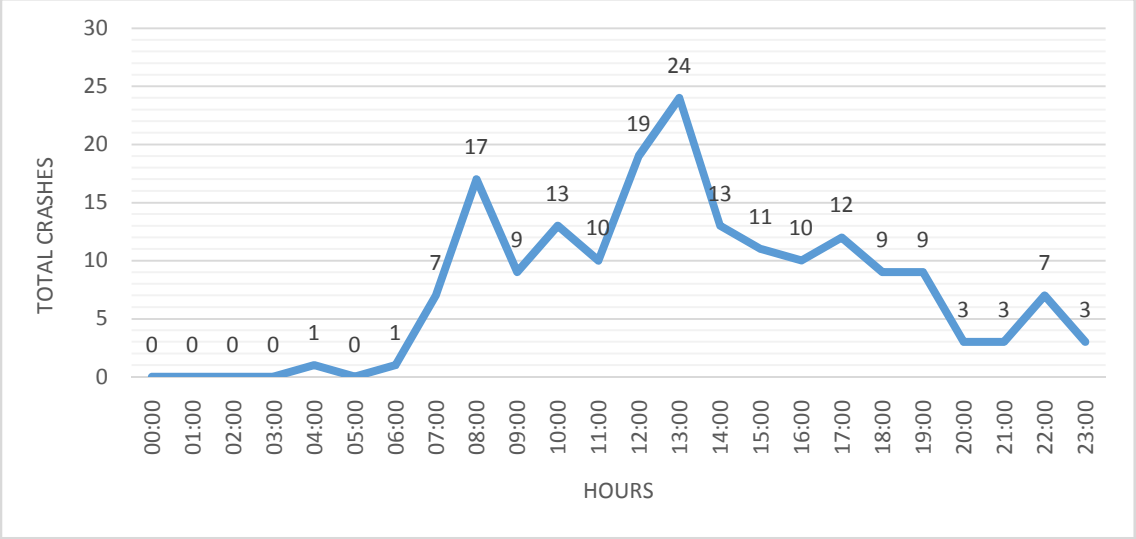


Figure (51): Distribution of Pedestrian Crashes in Zone 1 by Hour

In terms of monthly distribution, Figure (52) illustrates this. There were 2 peaks, one in the first half of the year in May (13.4%) as it usually has a very active movement of both people and vehicles, and the other in November (11.8%) that is considered as the first month of winter season, which forms a hazardous road environment for drivers and vehicles.

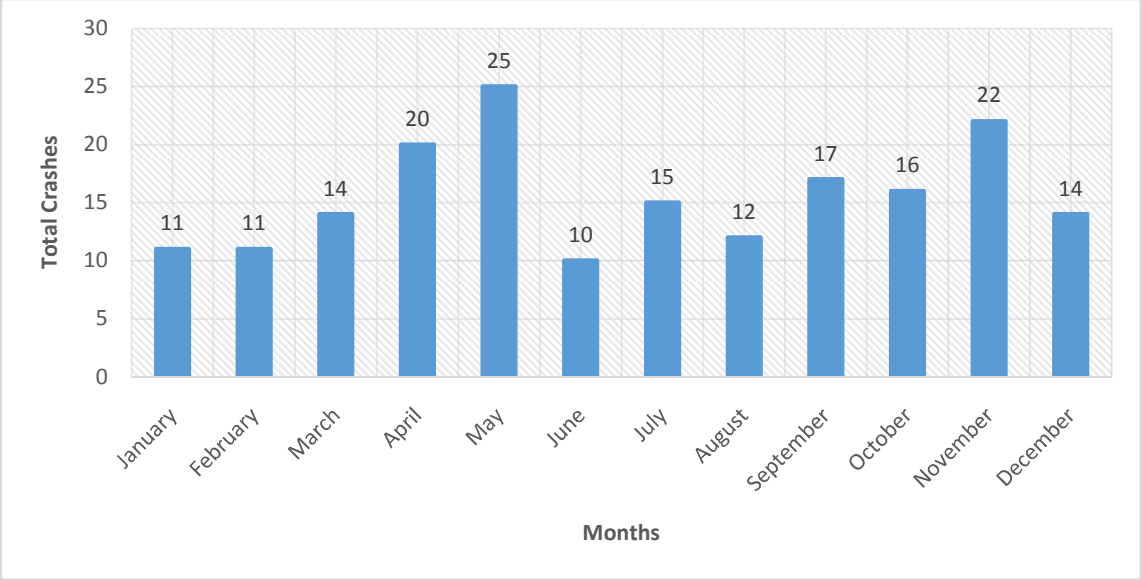


Figure (52): Distribution of Pedestrian Crashes in Zone 1 by Month

Crash severity is shown in Figure (53). The injuries in Zone 1 were mostly minor or moderate; they formed 97% of the total crashes. The KSI indicator formed only 3% in the period of analysis, and this could be explained by the low speed of vehicles in this zone due to the continuous congestion there.

By analyzing the victims, Figure (54) shows the distribution of crashes by age. The most critical age group involved in pedestrian crashes was from 21 to 30 years, forming 26.6% of total pedestrian crashes in the zone. This is realistic and reasonable because people there are primarily for shopping, with limited presence of children or school students in the zone. In addition, it was found that 61% of the victims were males, and 39% were females as shown in Figure (55). As mentioned before, zone 1 is mostly a commercial use, so that both genders interact within this area, which leads to higher percent of femals compared with the different zones of the city.

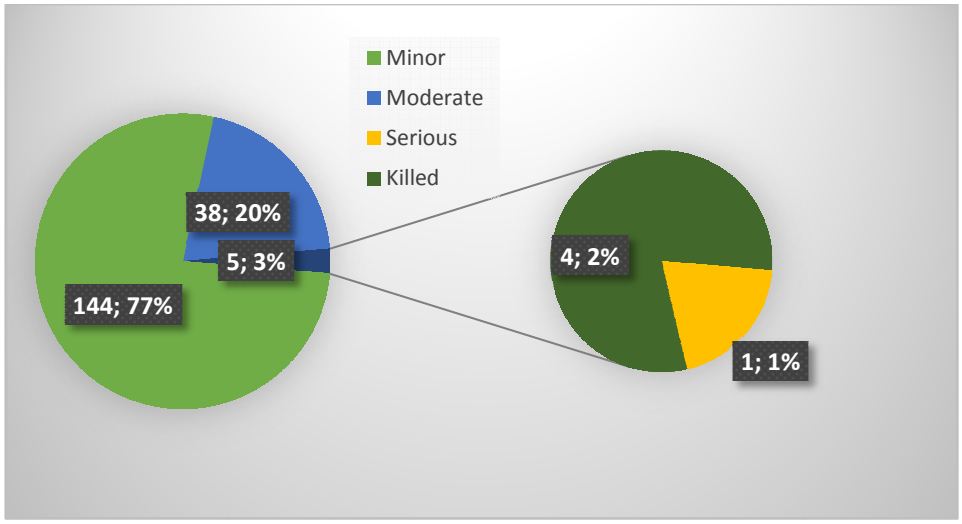


Figure (53): Crash Severity in Zone 1

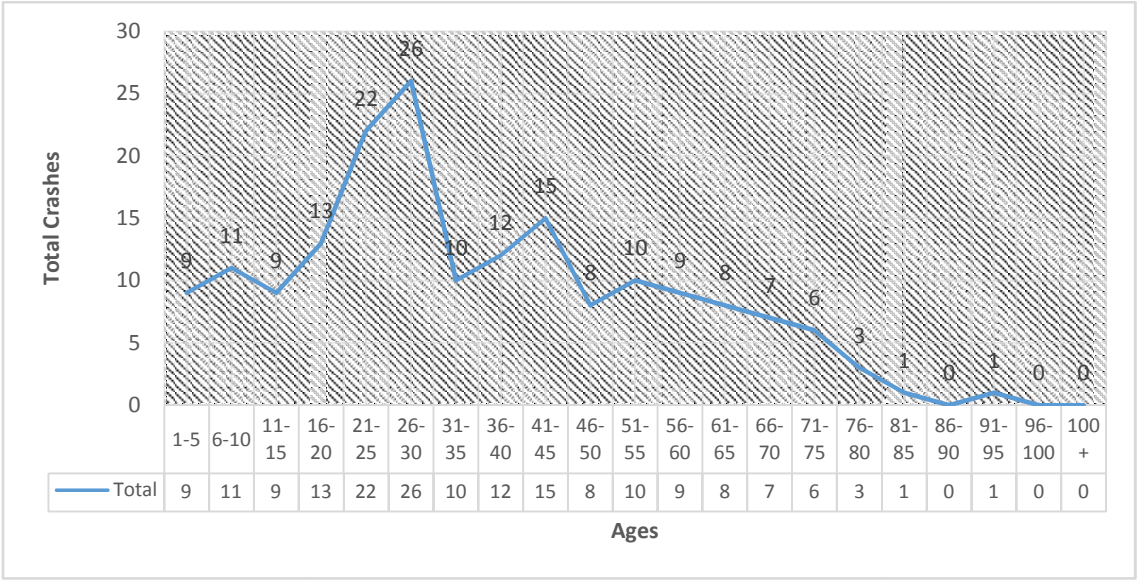


Figure (54): Distribution of Pedestrian Crashes in Zone 1 by Age

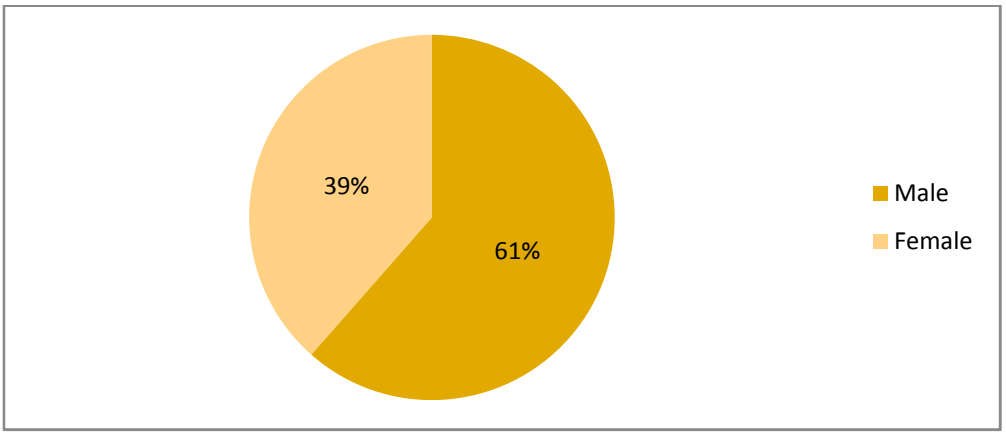


Figure (55): Analysis of Pedestrian Crashes in Zone 1 by Gender of Victims

Figure (56) shows the percentage of different types of vehicles involved in the crashes. The private cars formed 57.1% of total crashes, shared-taxis formed 31.3%, commercial vehicles formed 8.0%, and the other vehicles such as agricultural, governmental or bikes formed 3.6%.

The percentage of shared-taxis is considered high relative to the city or governorate rates. This is because of the high number of shared-taxis there, which are using the Main Square, Faisal St., and the Central Terminal Building in the CBD area. The same is true for commercial vehicles. This has led to a high percentage of crashes for those types of vehicles compared to other zones in the city. On the other hand, 82.9% of the causes of these crashes was "not taking the safety standards for road" in this zone, followed by reversing movement (11.1%).

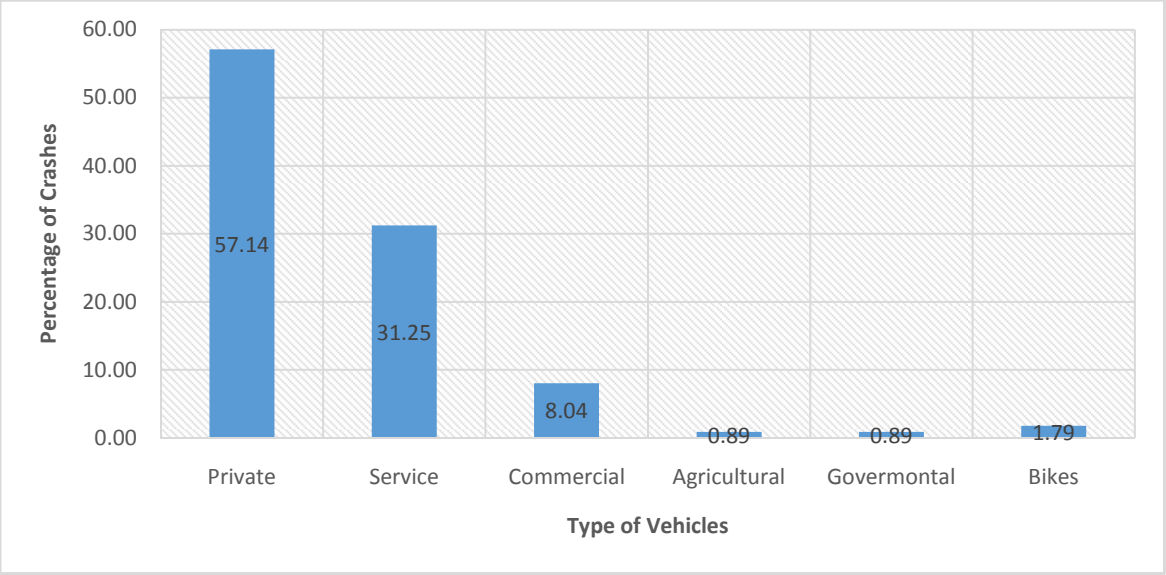


Figure (56): Analysis of Pedestrian Crashes in Zone 1 by Type of Vehicles

As for the spatial distribution of the pedestrian crashes in zone 1, Figure (57) shows this distribution. It is clear that Faisal St. and the Main Square had the highest number of crashes; therefore, there is a need to

consider this and take steps to decrease those crashes. Regarding Faisal St., it has heavy movement of traffic and freights, there is no marking for crossing or pedestrian facilities. It is also a wide street in addition to the low-time for gaps between vehicles, which would lead to pedestrian crashes while crossing. Moreover, it was observed that there was a weak respect for the traffic control devices by vehicles or pedestrians, which requires more enforcement by the Police.

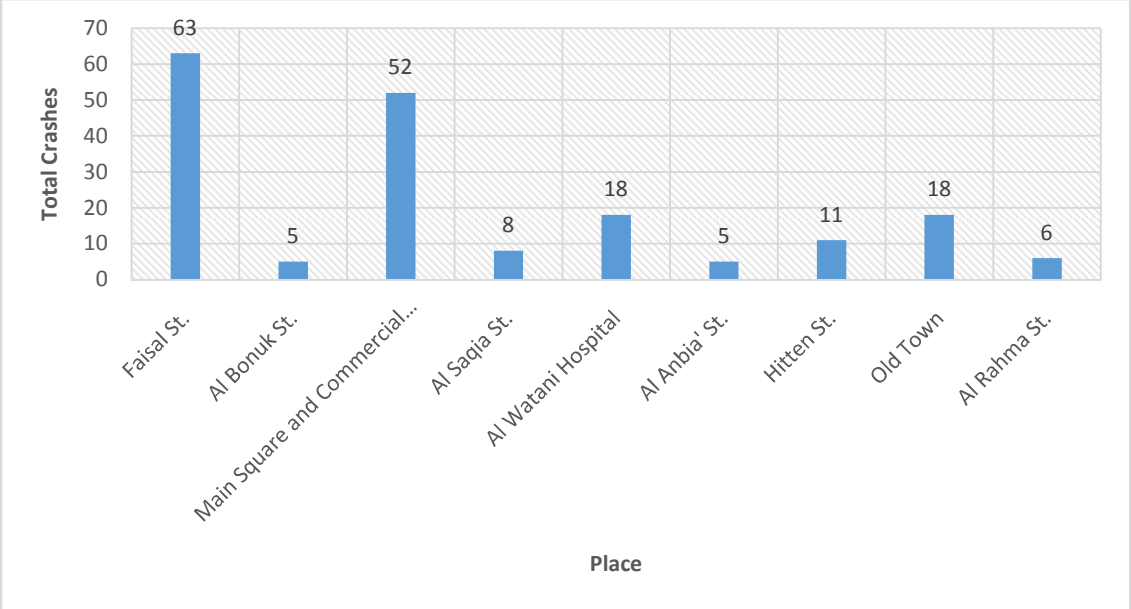


Figure (57): Distribution of Pedestrian Crashes in Zone 1 by Location

5.3 Analysis of Zone 2

Zone 2 had the second highest occurrence of pedestrian crashes in the city. This zone is also attractive for people's movements, and it is a point of destination for Nablus citizens and visitors as it is an extension of the Commercial Center area in Sufian St. It also includes the Al Adel St., Palestine St., Garanada St., and Gardens (Al Mutanazhat) St., which are congested areas with a high rate of walking people.

Subsequently, the followings are selected types of analysis for the zone. Figure (58) shows the distribution of pedestrian crashes in the zone by day. The crashes mostly occurred on Thursday then Saturday, which are similar to zone 1, and this is explained by the vicinity of the two zones with the same types of functions and activities. On the other hand, Monday and Friday were the lowest with approximately 10% from the total crashes in this zone.

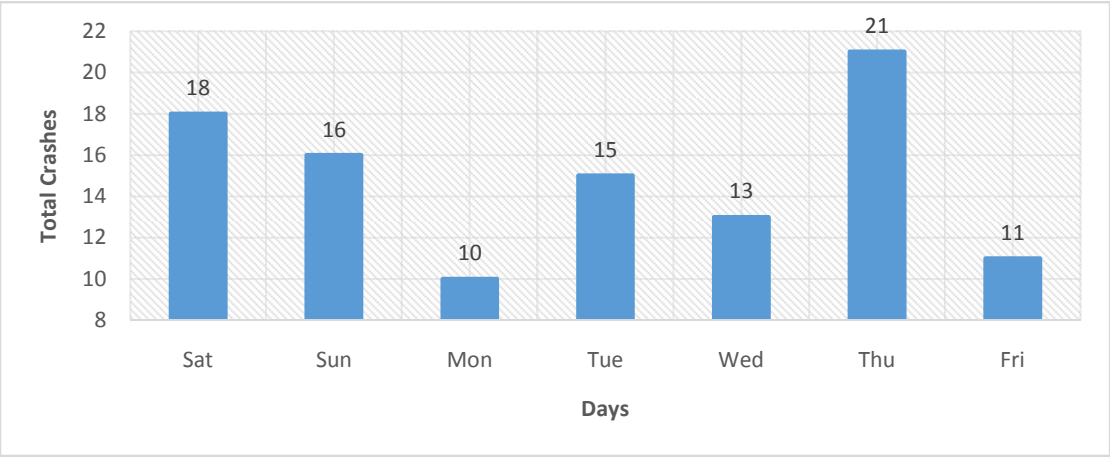


Figure (58): Distribution of Pedestrian Crashes in Zone 2 by Day

In terms of hourly distribution, there was a concentration in mid-days from 10:00 to 14:00, which formed 34.6% of the crashes in this zone as shown in Figure (59). On the other hand, the average number of pedestrian crashes during the hours of 9:00 to 16:00 was almost constant, and that is because of the constant movement of both vehicles and people during that period.

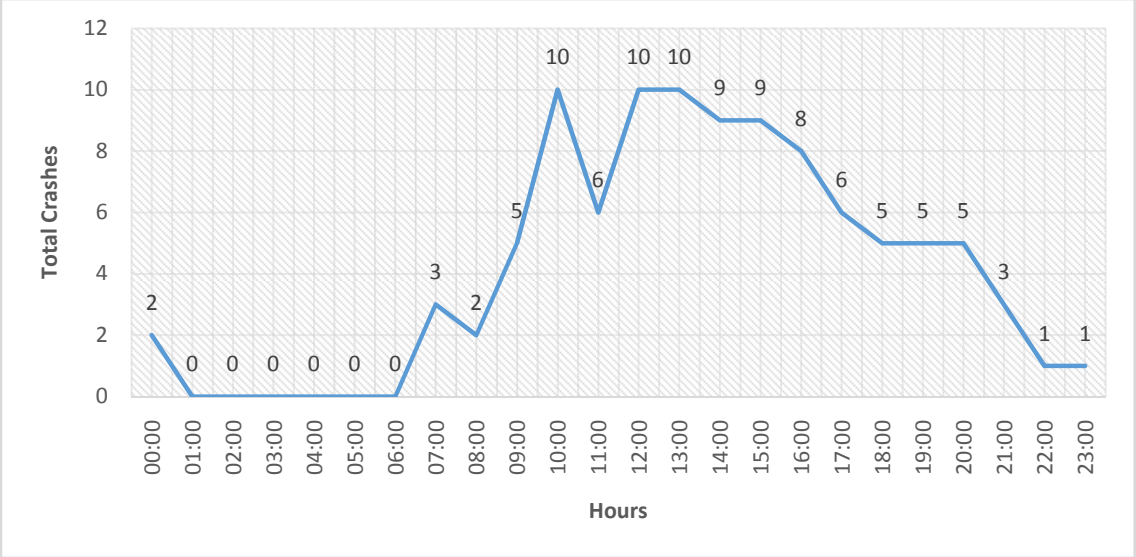


Figure (59): Distribution of Pedestrian Crashes in Zone 2 by Hour

As for the month of occurrence, Figure (60) illustrates the distribution during the period of analysis. There were two consecutive peak months, which were May and June with 25.1% of the crashes occurred in this zone. Moreover, 29.8% of the crashes occurred in the spring season, followed by the summer season, which is consistent with the city and governorate profiles.

The crashes in Zone 2 were mostly minor or moderate; they formed 99% of the total pedestrian crashes. The KSI indicator formed only 1% in the period of analysis, as shown in Figure (61). Although there was a high percent of pedestrian crashes in this zone, the slow motion of vehicles, due to congestion, and good awareness of drivers, which decreases the perception reaction time, made the percent of KSI low compared with other zones or all over the city.

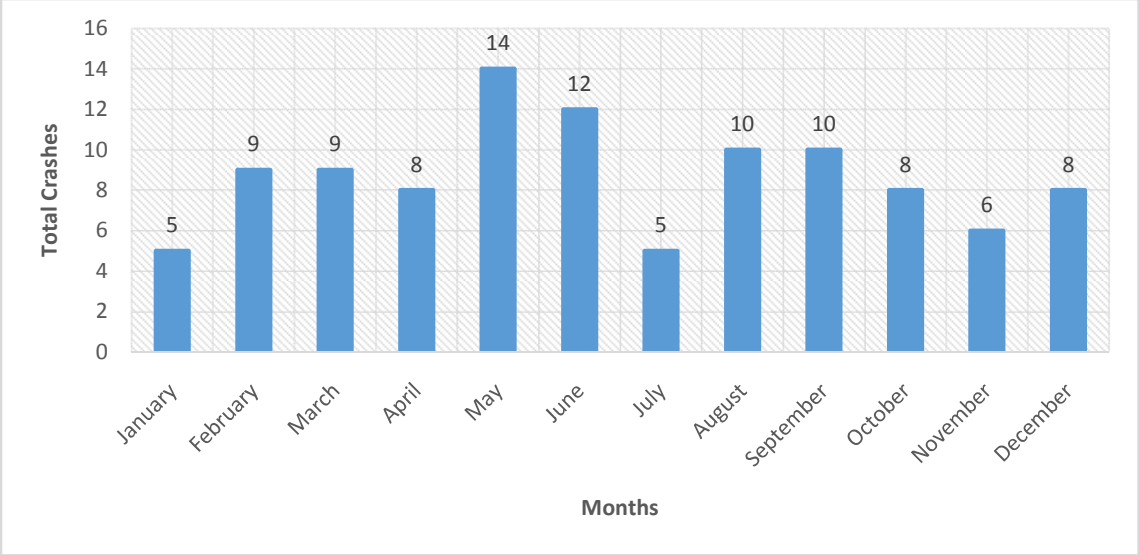


Figure (60): Distribution of Pedestrian Crashes in Zone 2 by Month

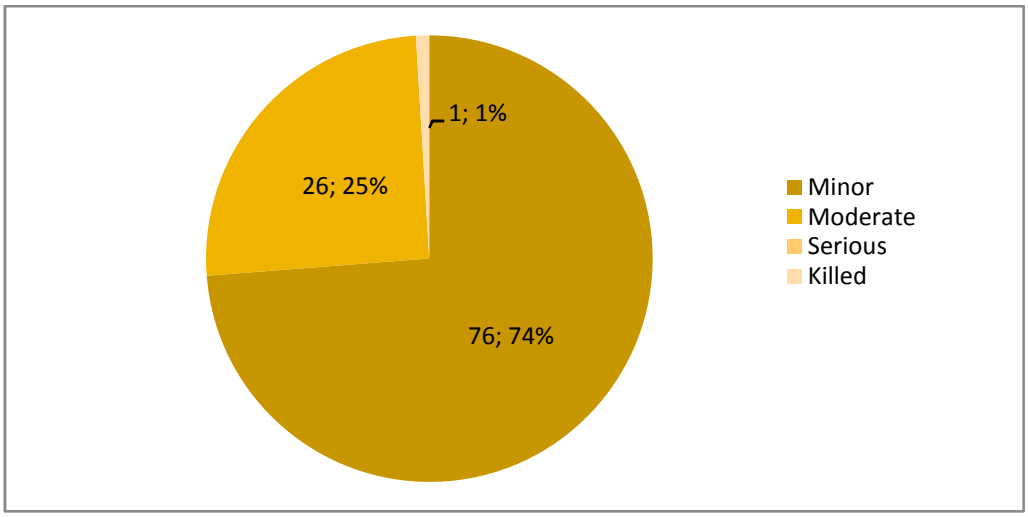


Figure (61): Analysis of Crashes in Zone 2 by Severity

Figure (62) shows the distribution of crashes by victim's age. It is clear that the most vulnerable group were for the ages between 6 and 30 years old with the highest for ages 6 to 10 years forming 12.5% of total crashes in this zone. Furthermore, the category between 16 and 30 years formed 33.7% of total crashes in this zone; this is consistent with zone 1.

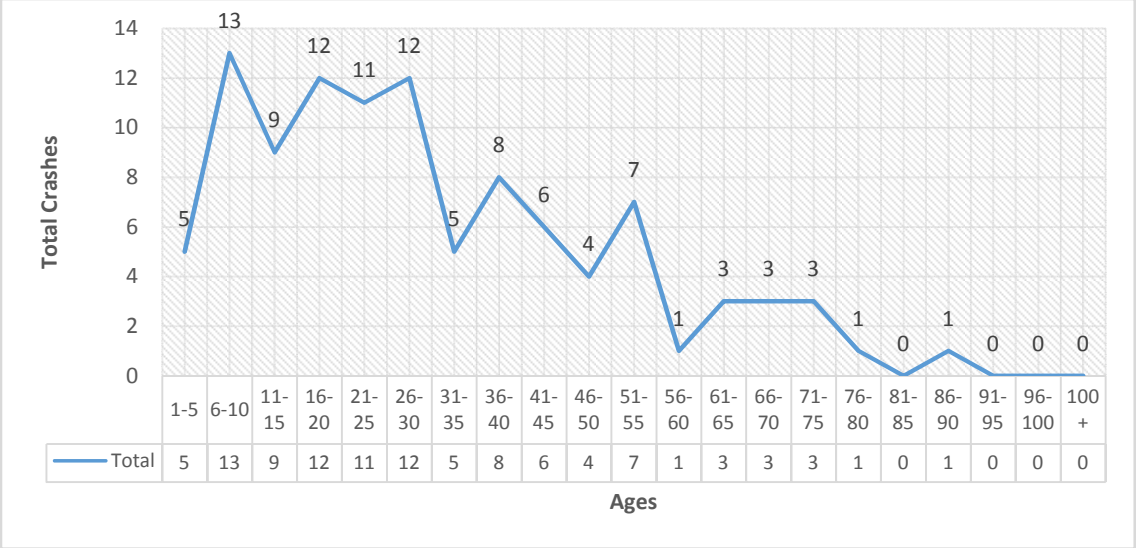


Figure (62): Distribution of Pedestrian Crashes in Zone 2 by Age

By analyzing the gender of victims or drivers, it is found that 70% of the victims were males and 30% were females. On the other hand, the drivers involved in the crashes in zone 2 were mostly males with a percent of 95% as shown in Figure (63) with a high percent of shared-taxi drivers as will be shown later.

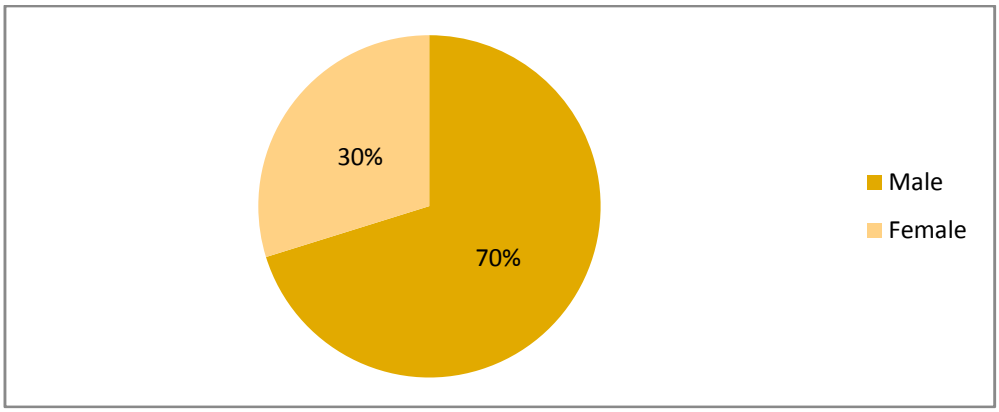


Figure (63): Analysis of Pedestrian Crashes in Zone 2 by Gender of Victims

Figure (64) shows the percentage of different types of vehicles involved in the crashes. The private cars formed 51.1% of total crashes, shared-taxis formed 38.3%, commercial vehicles formed 8.5%, and the bikes formed 2.1% only. The high percentage of shared-taxis is due to the

high number of this type of vehicle there, and that is because all the shared-taxis go to the west of Nablus towards Rafedia, New Campus, Al Makhfia, Southern Mountain, and other locations must pass through this zone.

In terms of spatial distribution of crashes, Figure (65) shows the distribution of pedestrian crashes in the zone. As shown, Sufian St. had the highest number of pedestrian crashes in this zone. Sufian St. is an active street with heavy commercial and pedestrian activities.

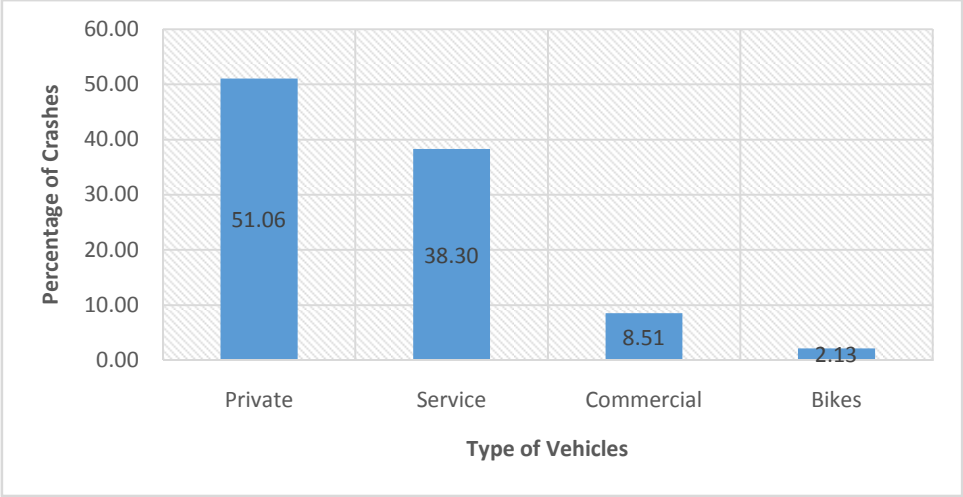


Figure (64): Analysis of Pedestrian Crashes in Zone 2 by Type of Vehicles

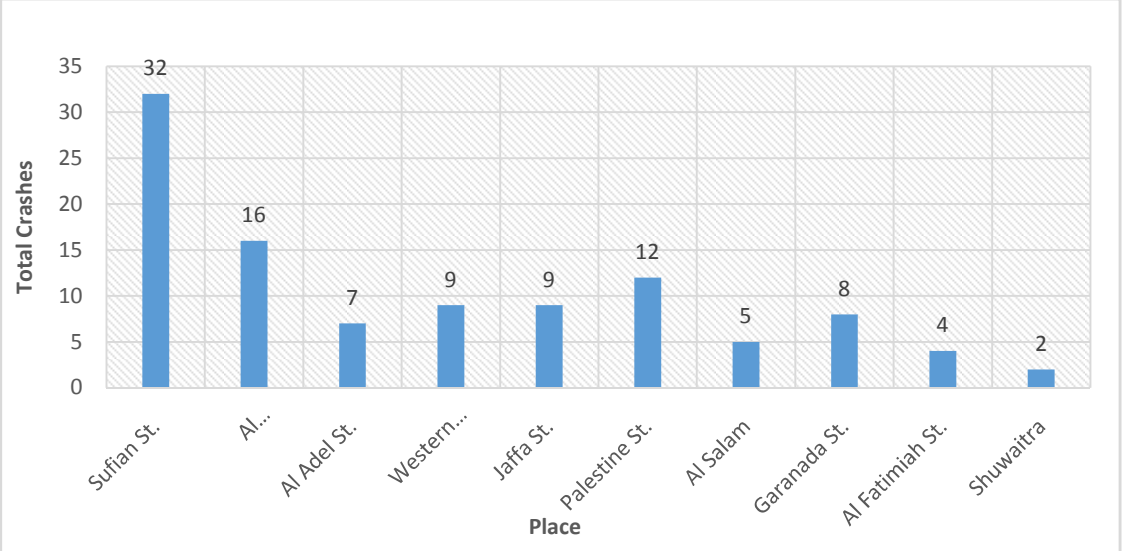


Figure (65): Distribution of Pedestrian Crashes in Zone 2 by location

5.4 Analysis of Zone 5

Zone 5 extents to the end of Nablus City from the west. It has the arterial road of Rafedia St., which is considered the 2nd main road after Faisal St. due to its function of linking the CBD with Rafedia area, which contains a concentration of schools, markets, offices, churches and mosques, residential areas, governmental offices, and the New Campus of An-Najah National University.

Temporally, the crashes in zone 5 had a relatively steady daily pattern, with no obvious distinct pattern for any day; even on Friday, there were crashes around the average, which means that all the days are similar and need attention, as shown in Figure (66). This consistency occurred due to the conditions of constant high traffic flow and pedestrian movement. The high movement of vehicles and pedestrians in the zone during evening hours explains the uncommon Friday's crashes.

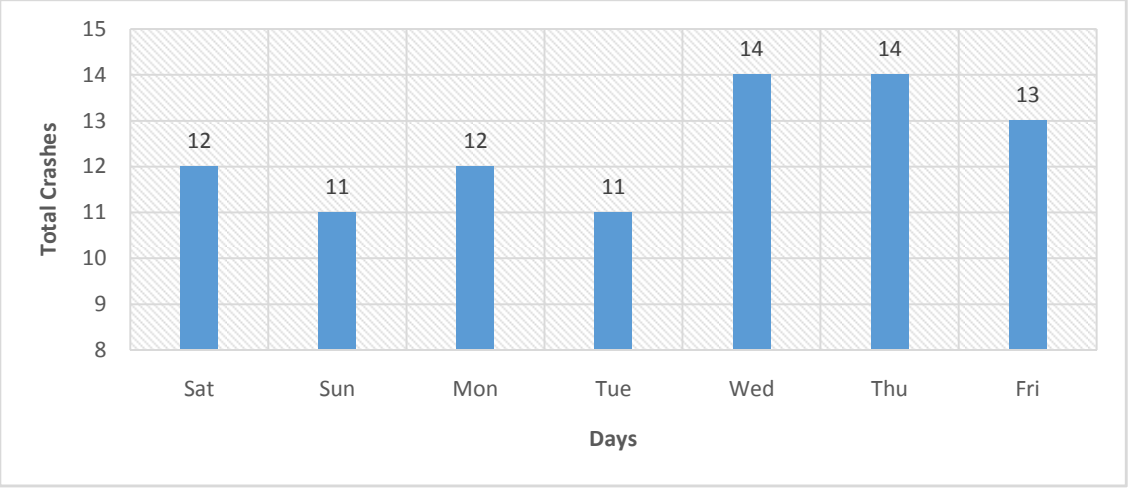


Figure (66): Distribution of Pedestrian Crashes in Zone 5 by Day

In terms of hours, there is a concentration in mid-days from 13:00 to 14:00, which formed 14.5% of the crashes in this zone, and continued until 16:00 to form 30.1%. In addition, there was a night peak concentration of pedestrian crashes from 17:00 to 21:00 forming 25.3%. This continued at a lower frequency up to the mid-night hour. This is due to the existing heavy traffic there during nighttime hours, as shown in Figure (67).

Figure (68) illustrates the monthly distribution of pedestrian crashes. There were several months having high frequency of crashes such as March, April, July, August, and October. For unexplained reasons, September had the lowest frequency of pedestrian crashes, and winter months had the lowest among the seasons forming 14.9% of pedestrian crashes in the zone.

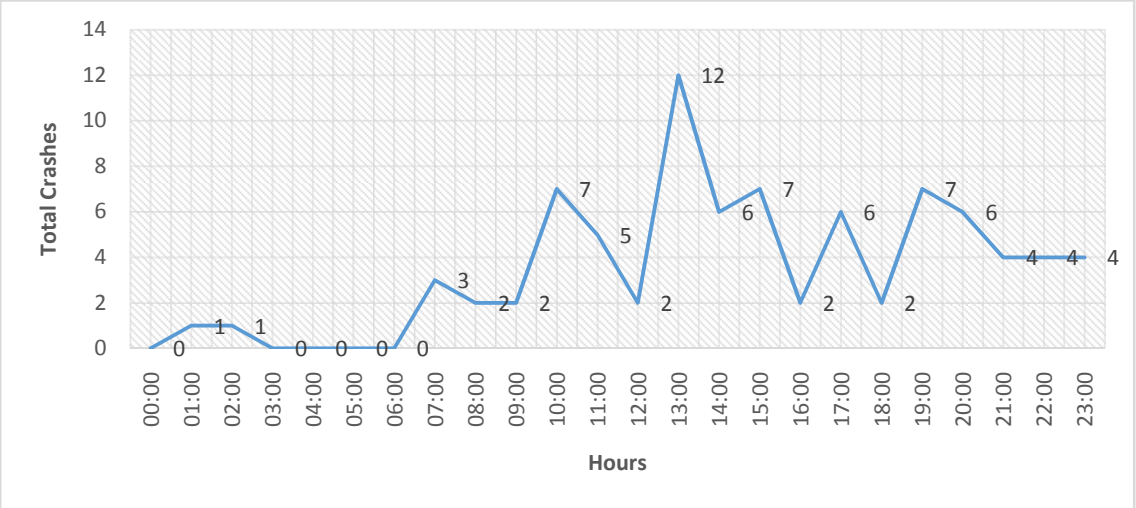


Figure (67): Distribution of Pedestrian Crashes in Zone 5 by Hour

The severity of crashes is analyzed as shown in Figure (69). The crashes in Zone 5 were mostly minor or moderate; they formed 99% of total crashes. The KSI indicator formed only 1% in the period of analysis, which is explained by the same reasons of Zone 2.

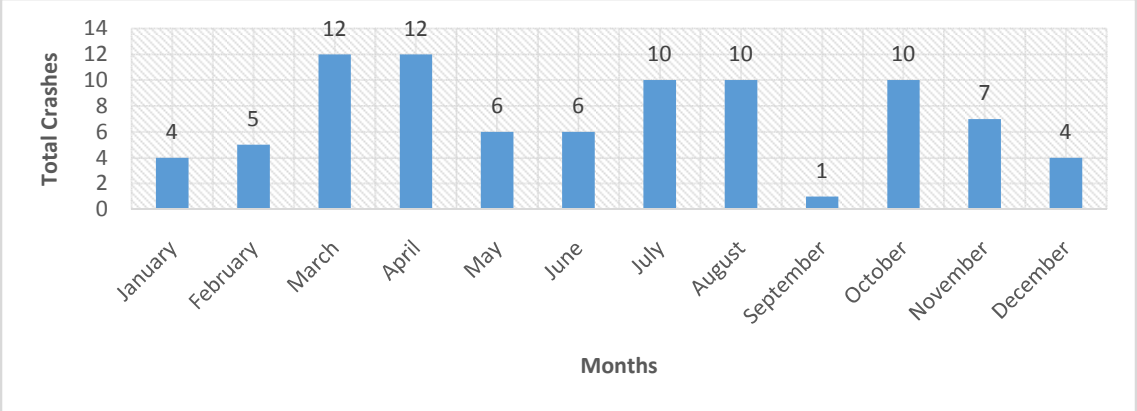


Figure (68): Distribution of Pedestrian Crashes in Zone 5 by Month

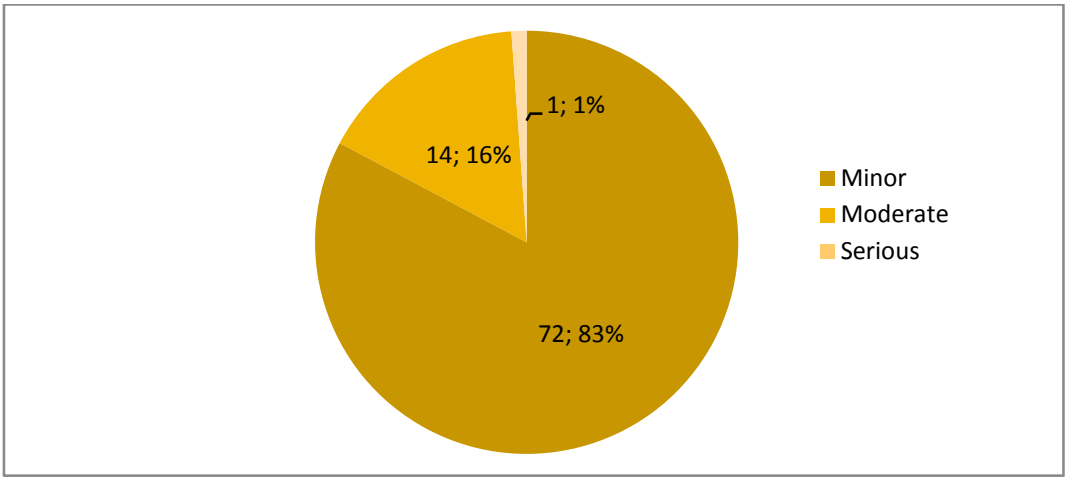


Figure (69): Pedestrian Crashes Severity in Zone 5

Figure (70) shows the distribution of pedestrian crashes by age of victims. People between 16 and 25 years old formed 43.7% of total pedestrian crashes in this zone. The category between 0 and 15 years formed 32.2%. This is due to that most of users are university students, schoolchildren, employees, and shoppers.

By analyzing the gender of victims or drivers, it is found that 51% of the victims were males, and 49% were females. These percentages describe the function of the zone; there is an equal level of use in this zone by both genders due to the educational, service, and commercial activities. On the other hand, the drivers who were involved in the crashes in Zone 5 were mostly males with a percent of 89%.

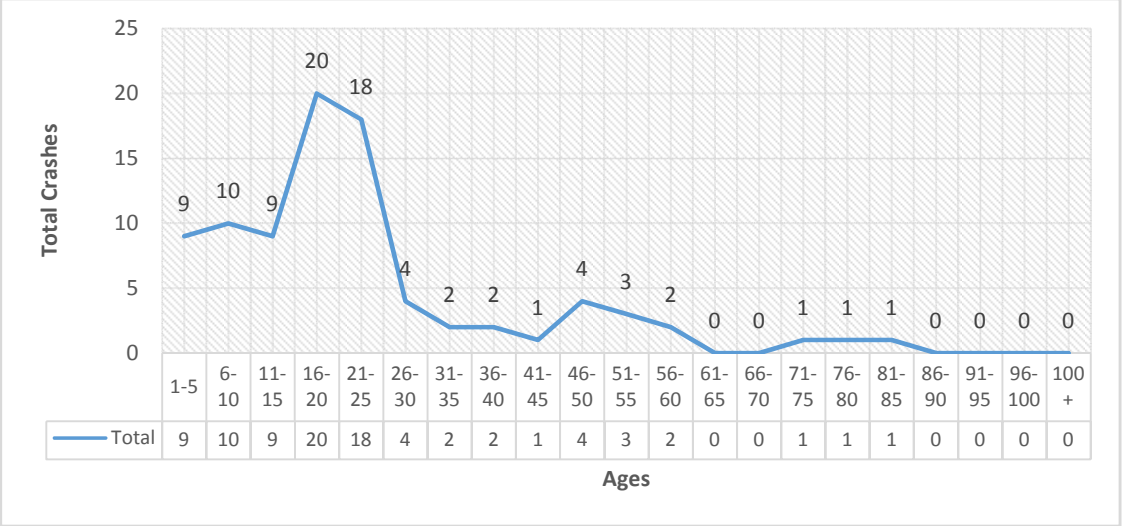


Figure (70): Distribution of Pedestrian Crashes in Zone 5 by Age

Figure (71) shows the percentage of different types of vehicles causing the crashes. The private cars formed 74.5% of total crashes, shared-taxis formed 23.4%, and commercial vehicles formed 2.1%.

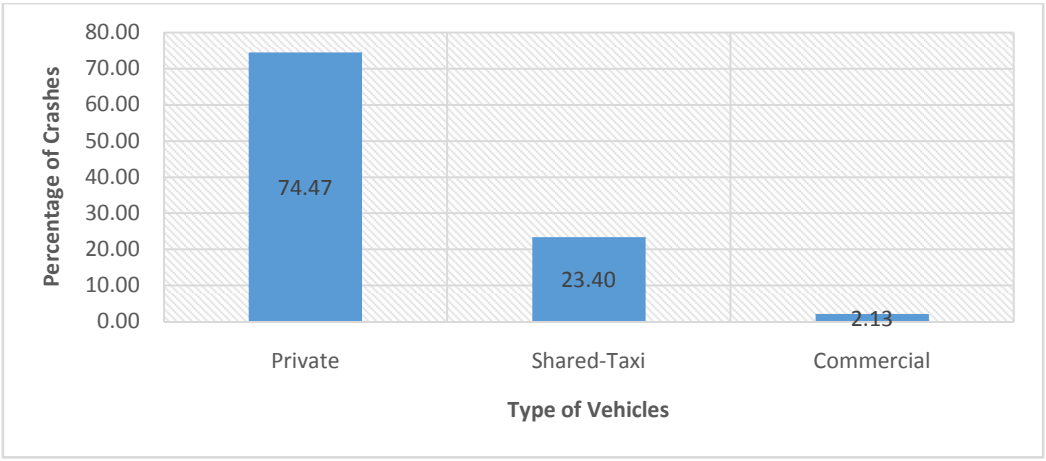


Figure (71): Analysis of Pedestrian Crashes in Zone 5 by Type of Vehicles

Spatially, and to zoom in the zone, it is found that 73 pedestrian crashes were in Rafedia St. in the last five years with 83.9% out of all pedestrian crashes in this zone. Twenty-two of them were in front of the Korean Academic Institute or the New Campus of An-Najah National University, and the rest are as shown in Figure (72). The high movement of people due to the mentioned activities was a main reason of this rate of

pedestrian crashes. On the other hand, the area in front of the New Campus of An-Najah National University is not properly designed as a pedestrian friendly location, and lacks proper pedestrian facilities.

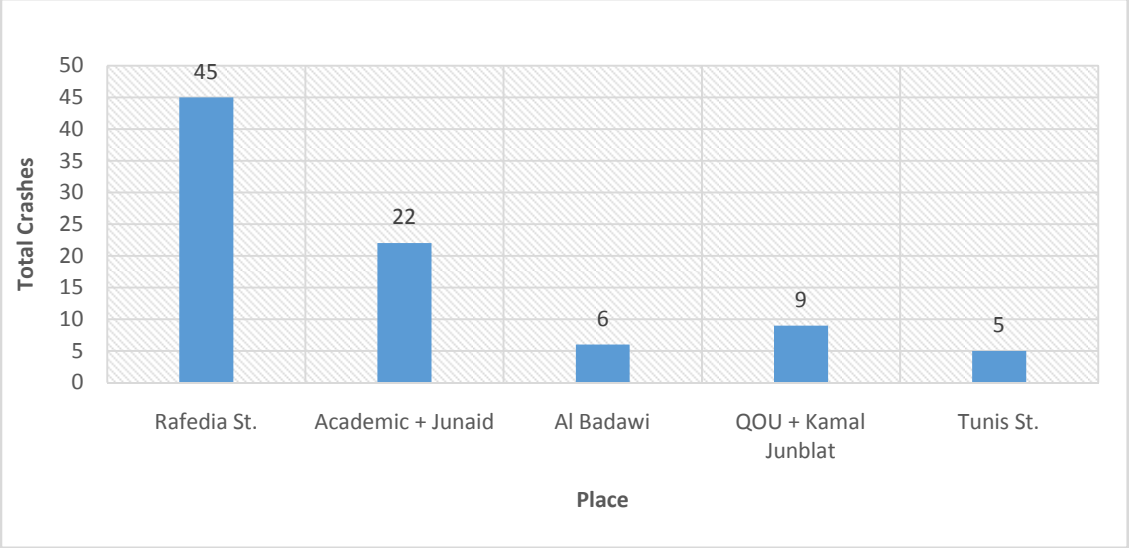


Figure (72): Distribution of Pedestrian Crashes in Zone 5 by Location

5.5 Analysis of Zones 19, 21, and 22

The Zones of 19, 20, and 21 have the same environment and nature. They are located in the south of the city, containing one of the most vital roads in the city (Al Quds St.), several residential neighborhoods with considerable densities (Balata Camp, Khallet Al Amoud, and Ras Al Ein), and active service areas such as the eastern public transport terminal and Schools St. This leads to similar conditions of movements for vehicles or pedestrians in these zones; the results of analysis were also so close.

Zone 21 is necessary passing through for all vehicles going to the east and southeast of Nablus City to localities and other governorates. It contains a critical block, which consists of the eastern terminal and in front of the Governorate Building, in addition to the neighborhood of Khallet Al

Amoud. Zone 22 was the fourth highest zone in Nablus City in terms of pedestrian crash frequency. It has the neighborhood of Ras Al Ein and the extension to Southern Mountain (Al Tour). Zone 19 consists of several local roads with a high residential density. Al Quds St. links Nablus City with the eastern localities has a heavy traffic volume, and passes through Balata Camp that has a very high population density of 68 capita per donnum. This creates a high probable environment for pedestrian crashes.

By analyzing the distribution of pedestrian crashes in these zones, it is noticed that the crashes occurred nearly all over the week, with the highest on Thursday and Saturday as the beginning and end of the week. Friday had the least number of pedestrian crashes, which corrisponds with the profile of the City, as shown in Figure (73).

In terms of hourly occurrence, Figure (74) shows that the crashes flocculated all over the day. Furthermore, there was continuity from the morning (7:00) to evening hours (20:00), with a concentration at 13:00. This happened due to the relevant continuous existence of movement there of people as pedestrians, vehicles with different classes, children in the schools' area, and commercial activities.

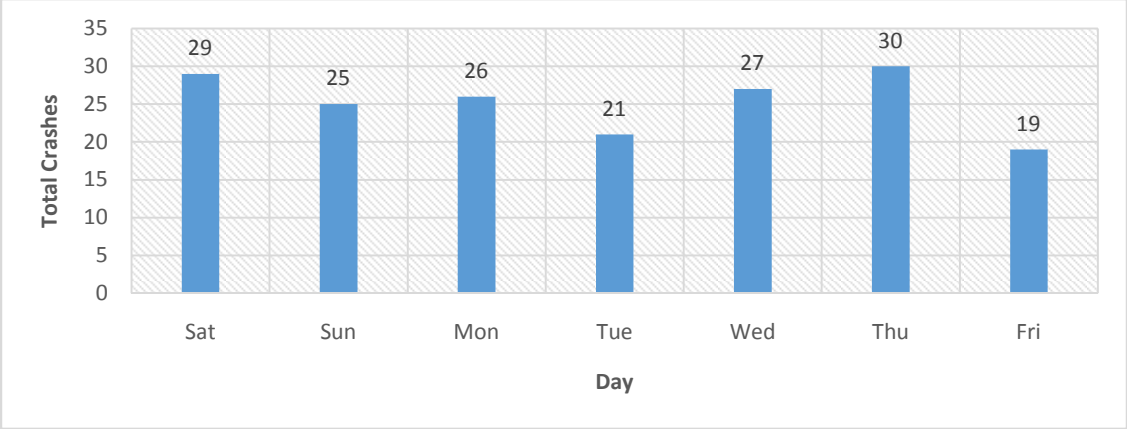


Figure (73): Distribution of Pedestrian Crashes in Zones 19, 21, and 22 by Day

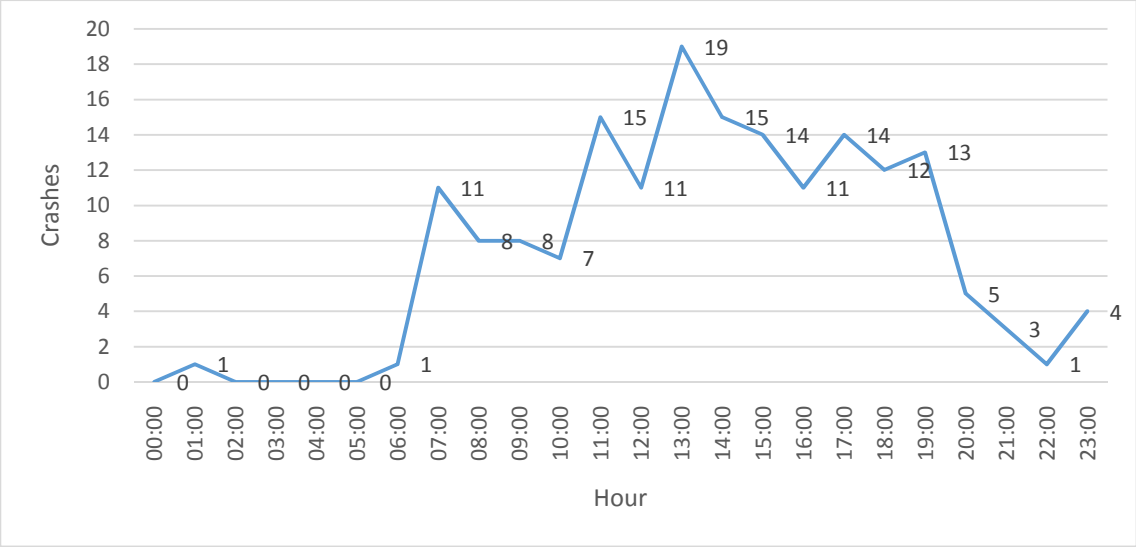


Figure (74): Distribution of Pedestrian Crashes in Zones 19, 21, and 22 by Hour

As for the monthly distribution, Figure (75) illustrates this. August had the highest crash frequency followed by March, while the remaining months were comparable. This could be explained by the nature of residence there, existing of several neighborhoods, and children's activities in the area during the summer vacation. When analyzing those 25 crashes, most of them involved children younger than 15 years old. Seasonally, winter and autumn had the least crashes, which confirm with the previous statement.

Severity of crashes is considered and analyzed, as shown in Figure (76). The crashes in these zones were mostly minor or moderate; they formed 95% of total crashes. The KSI indicator was 5% during the last five years, and most of them in Zone 19, specifically in Al Quds St. Therefore, this zone has to be taken into consideration in policies to make it more safe and friendly.

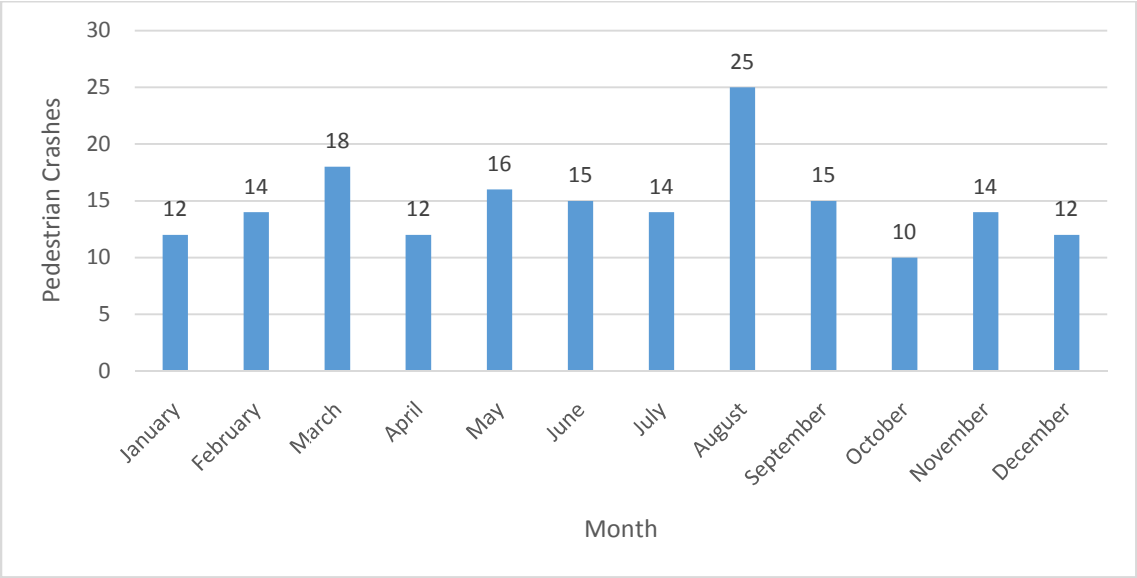


Figure (75): Distribution of Pedestrian Crashes in Zones 19, 21, and 22 by Month

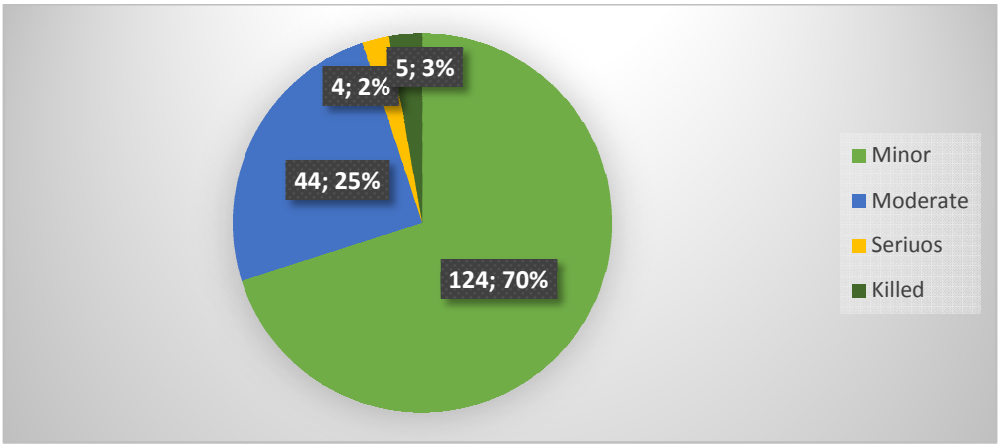


Figure (76): Severity of Pedestrian Crashes in Zones 19, 21, and 22

The distribution of crashes by age is shown in Figure (77). The age group of people, which had the highest pedestrian crashes, was from 6 to

10 years with 25.6% of total crashes in this zone due to existing of several schools there. The category between 0 and 10 years formed 38.6% of total crashes in this zone. Moreover, there was an existence of elderly pedestrian crashes due to the function of activities there.

By analyzing the gender of victims or drivers, it is found that in Zones 21 and 22, 69% of the victims were males and 31% were females. On the other hand, it is found that 77% of the victims were males and 23% were females in zone 19.

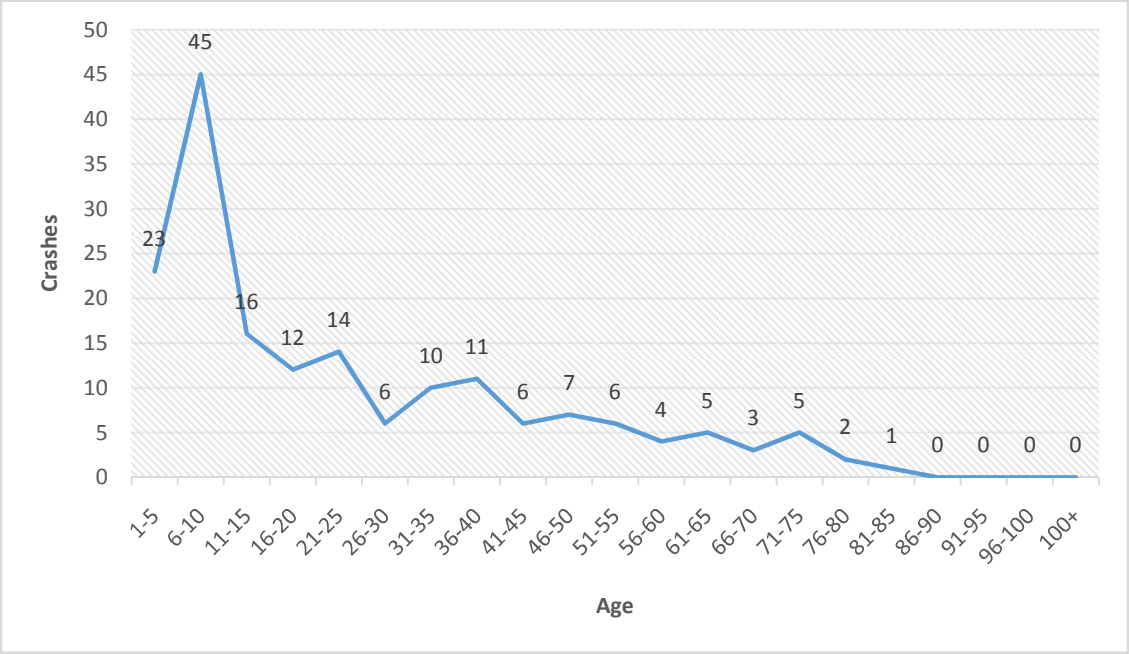
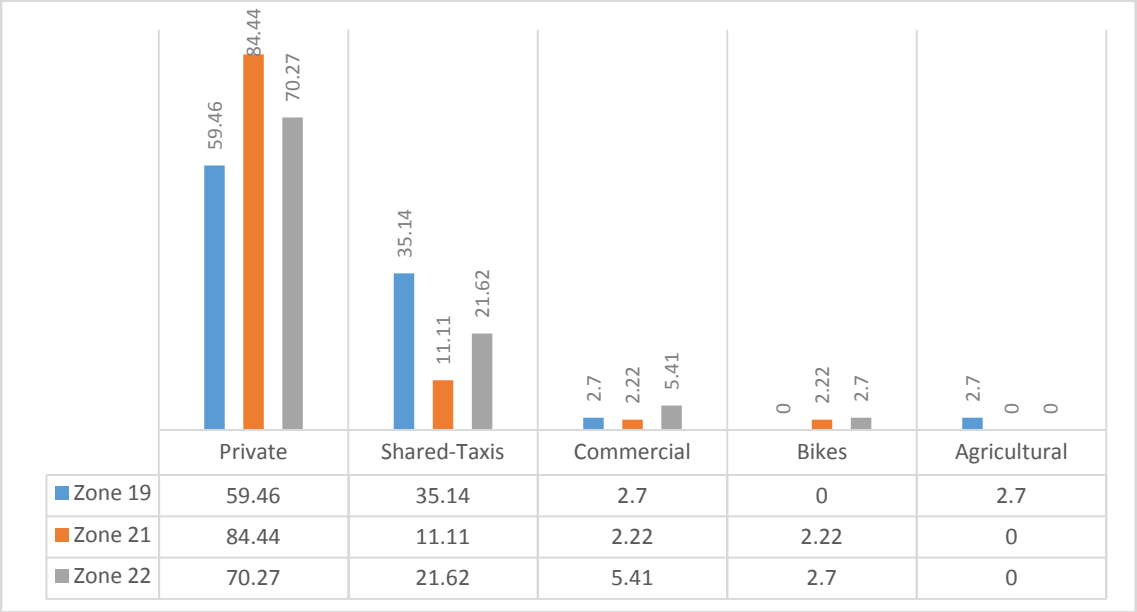


Figure (77): Distribution of Pedestrian Crashes in Zones 19, 21, and 22 by Age

Figure (78) shows the percentage of different types of vehicles involved in the crashes in each zone. The percentage of shared-taxis was relatively very high compared with other zones. This is due to concentration of this class of vehicles; and existence of public transport eastern terminal.

To be more detailed in these zones, Figure (79), Figure (80), Figure (81) show the spatial distribution of pedestrian crashes. As expected, the block containing eastern terminal was the most critical one in these zones because of the high number of conflict points between people and vehicles and lack of proper pedestrian facilities there.



	Private	Shared-Taxis	Commercial	Bikes	Agricultural
Zone 19	59.46	35.14	2.7	0	2.7
Zone 21	84.44	11.11	2.22	2.22	0
Zone 22	70.27	21.62	5.41	2.7	0

Figure (78): Analysis of Pedestrian Crashes in Zones 19, 21, and 22 by Type of Vehicles

The Schools St. also had a high crash frequency for the age group younger than 15 years old. Ras Al Ein in Zone 19 is a high-density residential neighborhood with several local narrow roads that lack proper pedestrian facilities. Finally, the high traffic volume in Al Quds St. leads to more pedestrian crashes especially there is no properly defined crosswalks.

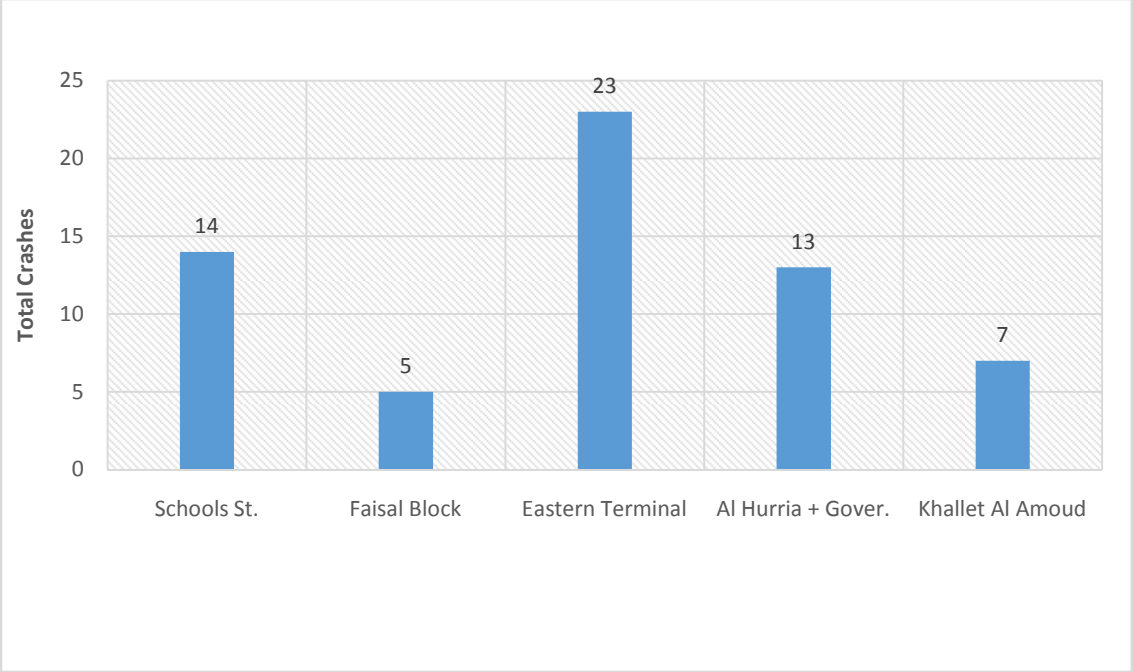


Figure (79): Distribution of Pedestrian Crashes in Zone 21 by Location

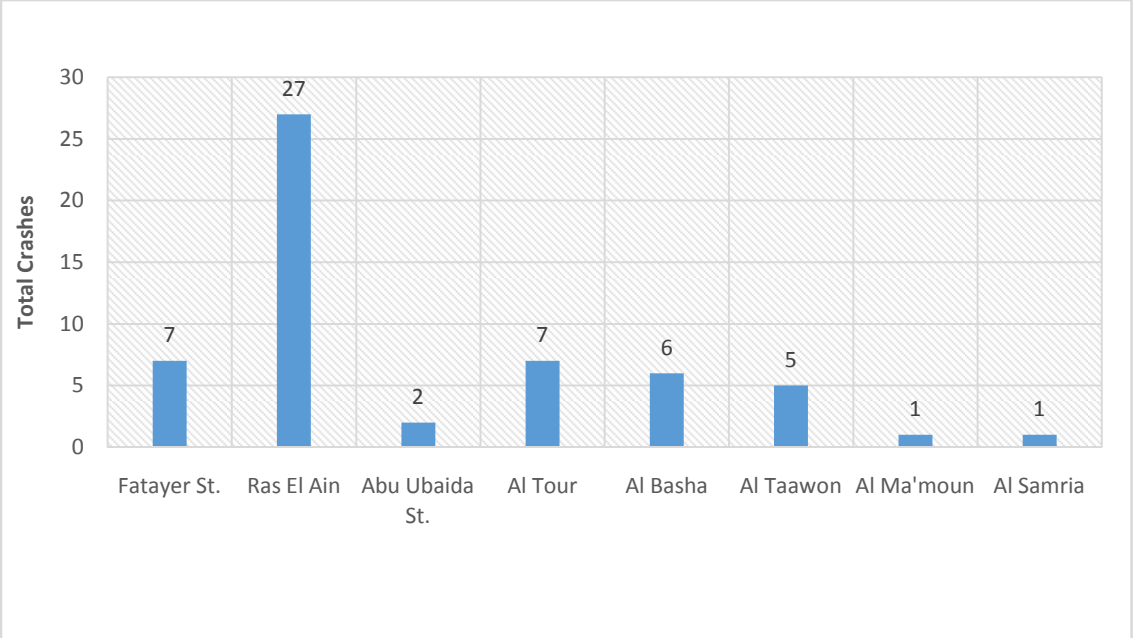


Figure (80): Distribution of Pedestrian Crashes in Zone 22 by Location

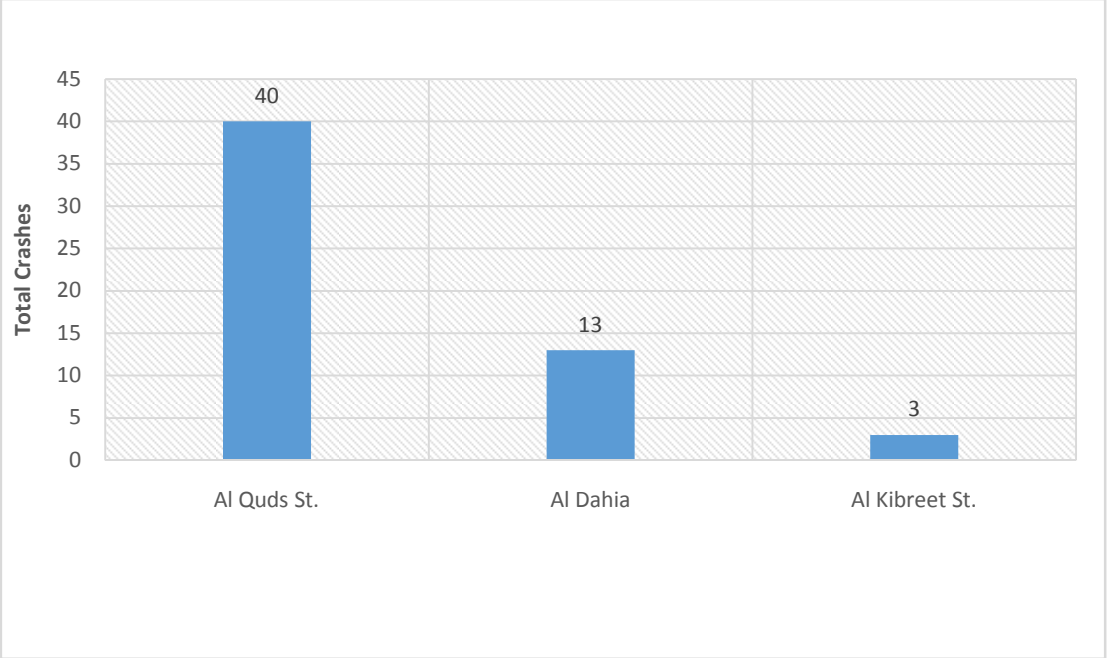


Figure (81): Distribution of Pedestrian Crashes in Zone 19 by Location

5.6 Analysis of Zone 3

Zone 3 is located between the critical zones of 1, 2, 5 and 22. Its boundaries are from Al Fatmia Intersection in the east, Al Salam Intersection in the west, and between Rafedia St. and Omar Bin Khattab St. This zone contains two critical locations out of the 20 dangerous locations in the City (Higher Traffic Council, 2015), which are the Western Graveyard and the Old Campus of An-Najah National University. The zone is considered as a passing area for shared-taxis, which are going to Al Makhfia neighborhood, in addition to Tell and nearby localities.

To answer the question of when the pedestrian crashes happened, Figure (82) shows the temporal distribution in Zone 3. The crashes happened more frequently on Wednesday, Sunday, and Thursday as start and end of week days.

In terms of hour of occurrence, Figure (83) shows that the crashes concentrated in two hours in the afternoon from 15:00 to 16:00 (17%) and from 18:00 to 19:00 (19.2%). Furthermore, there was a constant hourly distribution of crashes from 10:00 to 14:00 forming 38.3%.

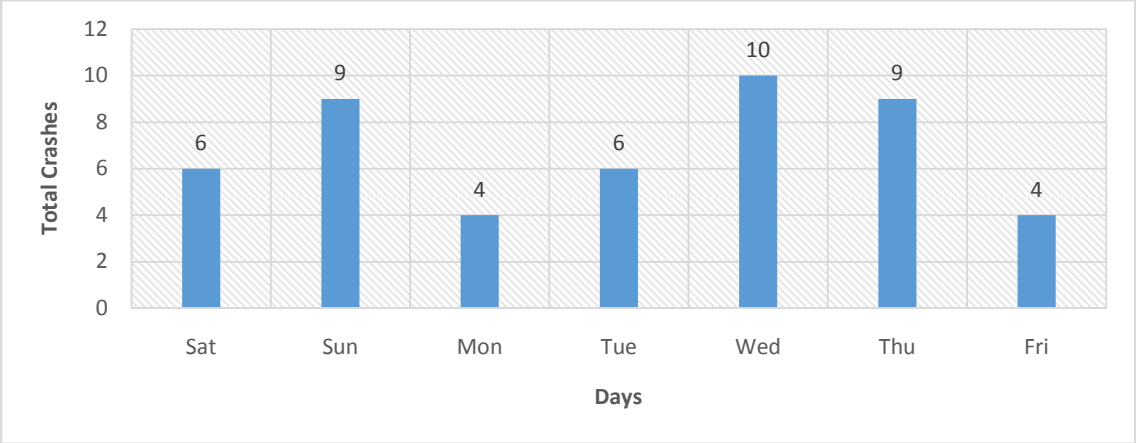


Figure (82): Distribution of Pedestrian Crashes in Zone 3 by Days

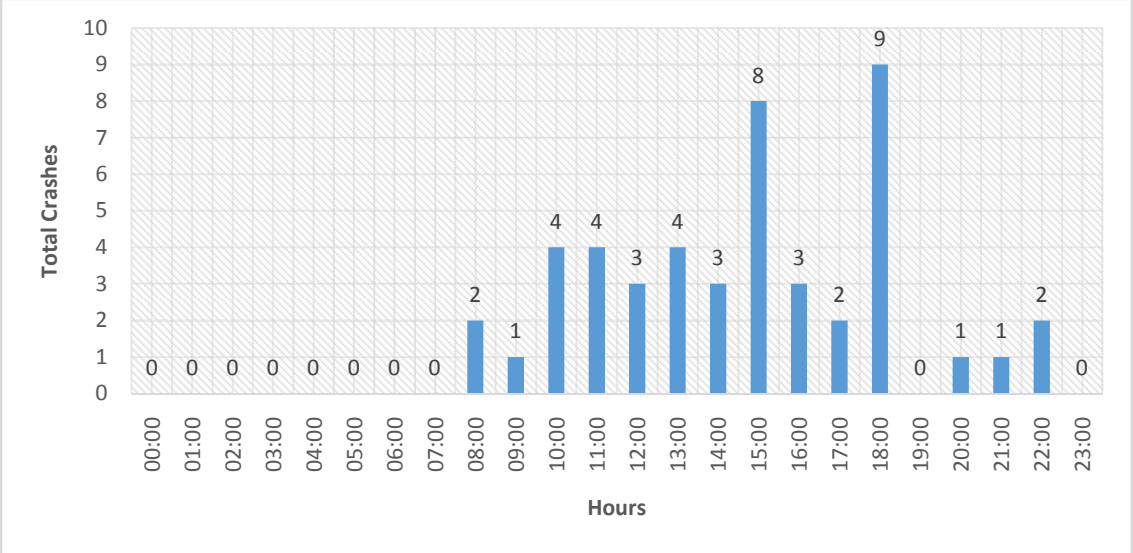


Figure (83): Distribution of Pedestrian Crashes in Zone 3 by Hour

By analyzing the crashes by months, Figure (84) illustrates the distribution during the last five years. The highest months were November and April forming 12.5% for each. However, there was no obvious trend for a single month.

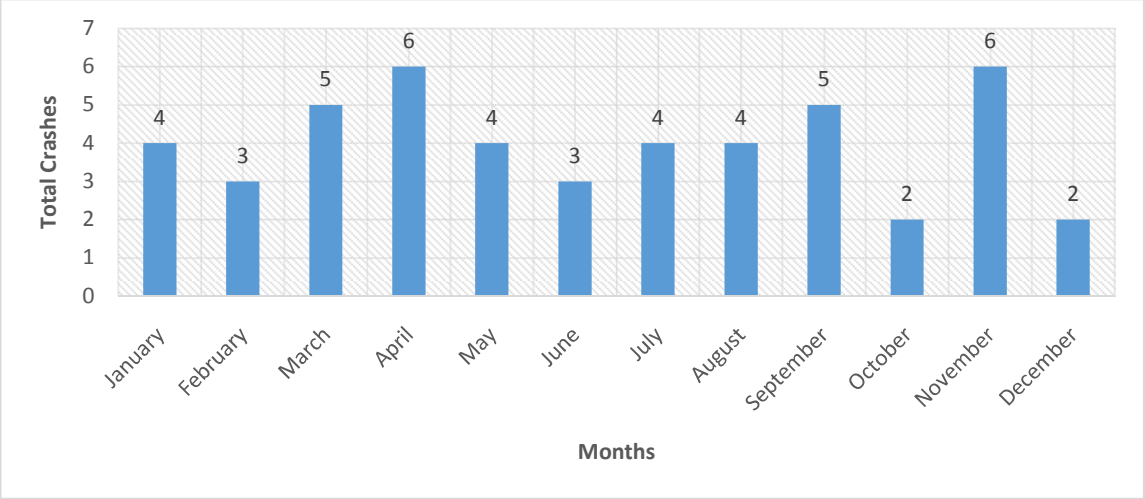


Figure (84): Distribution of Pedestrian Crashes in Zone 3 by Month

Severity of crashes is considered and analyzed as shown in Figure (85). The crashes in Zone 3 were mostly minor or moderate; they formed 98% of the total crashes. The KSI indicator formed only 2% in the period of analysis.

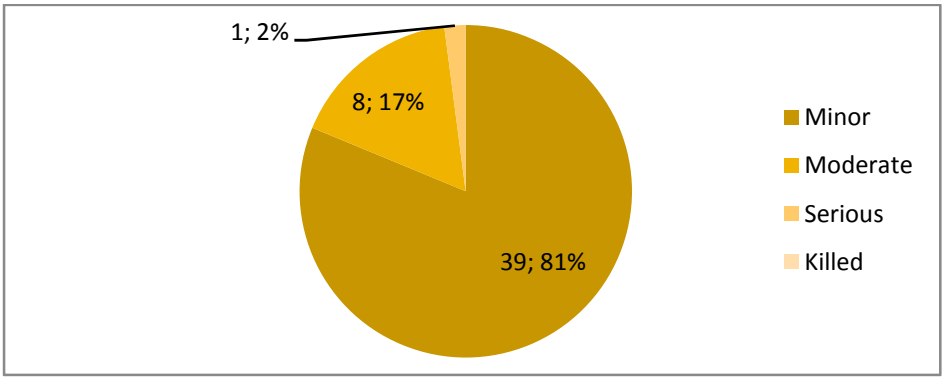


Figure (85): Pedestrian Crashes Severity in Zone 3

Figure (86) shows the distribution of crashes by age. The age group, which was mostly involved in pedestrian crashes, was from 6 to 10 years with 22.9% of total pedestrian crashes in this zone. The category between 16 and 25 years formed 27.1% of total crashes in this zone.

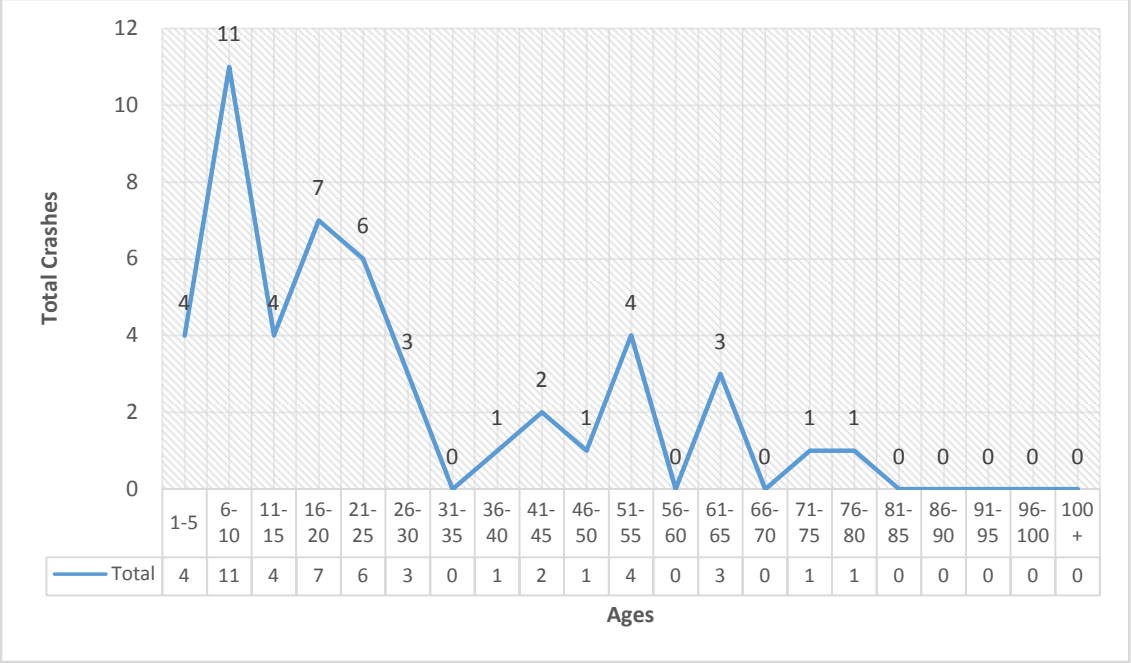


Figure (86): Distribution of Pedestrian Crashes in Zone 3 by Age

By analyzing the gender of victims or drivers, it is found that 62% of the victims were males and 38% were females, as shown in Figure (87).

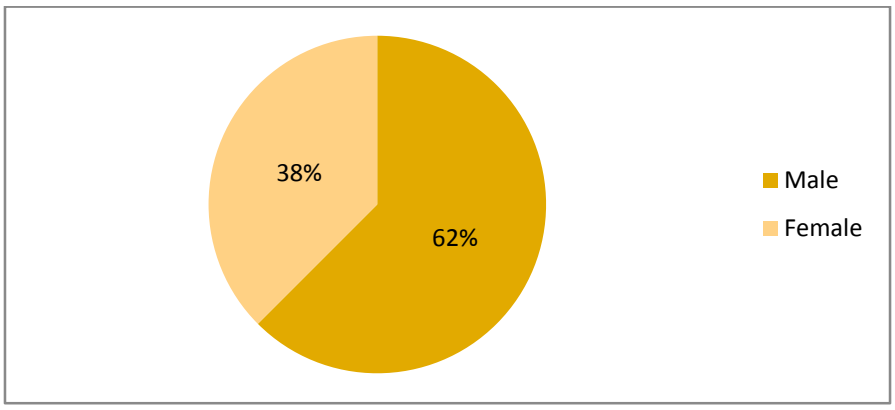


Figure (87): Analysis of Pedestrian Crashes in Zone 3 by Gender of Victims

Figure (88) shows the percentage of different types of vehicles involved in the crashes. The private cars formed 64.3% of total crashes, shared-taxis formed 32.1%, and commercial vehicles formed 3.6%.

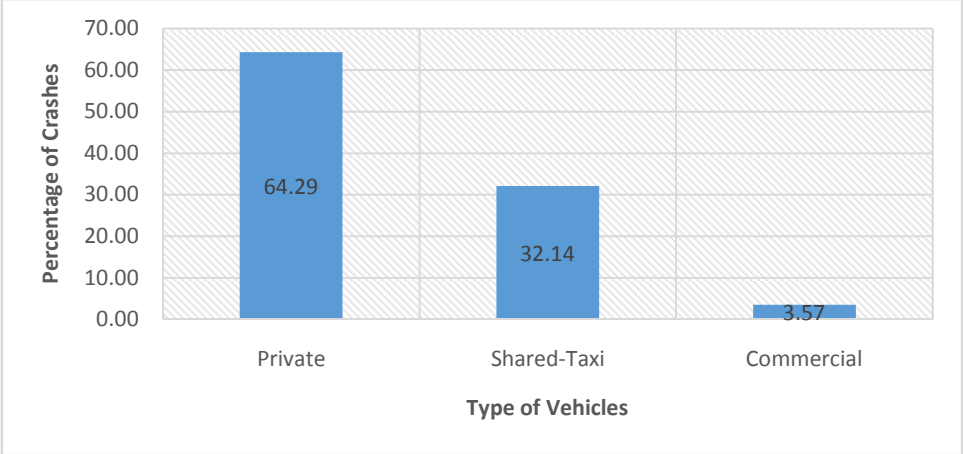


Figure (88): Analysis of Pedestrian Crashes in Zone 3 by Type of Vehicles

As mentioned before, Omar Bin Khattab St. is expected to have high pedestrian crashes than other roads in the zone. The zone had the block of the Western Graveyard with 35% of pedestrian crashes in the zone during the last five years.

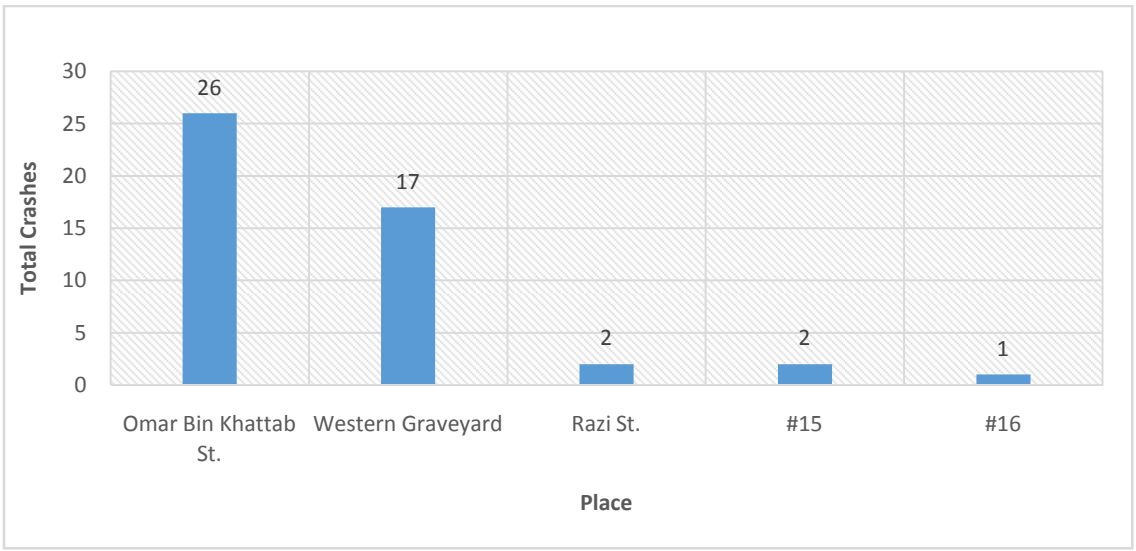


Figure (89): Distribution of Pedestrian Crashes in Zone 3 by Location

Chapter Six

KSI Analysis for Nablus (Governorate & City)

Chapter Six
KSI Analysis for Nablus (Governorate & City)

6.1 KSI analysis for Nablus Governorate

As mentioned before KSI (Killed or Seriously Injured), is used as an indicator where safety policies might be formulated.

Nablus Governorate had 93 killed or seriously injured in all the localities with a KSI of 4.89 per 100,000 capita. For the governorate, the most hazardous day was Saturday with 18.5% of the total KSI crashes. On the other hand, Friday had the least with 9.8% of the crashes, as shown in Figure (90).

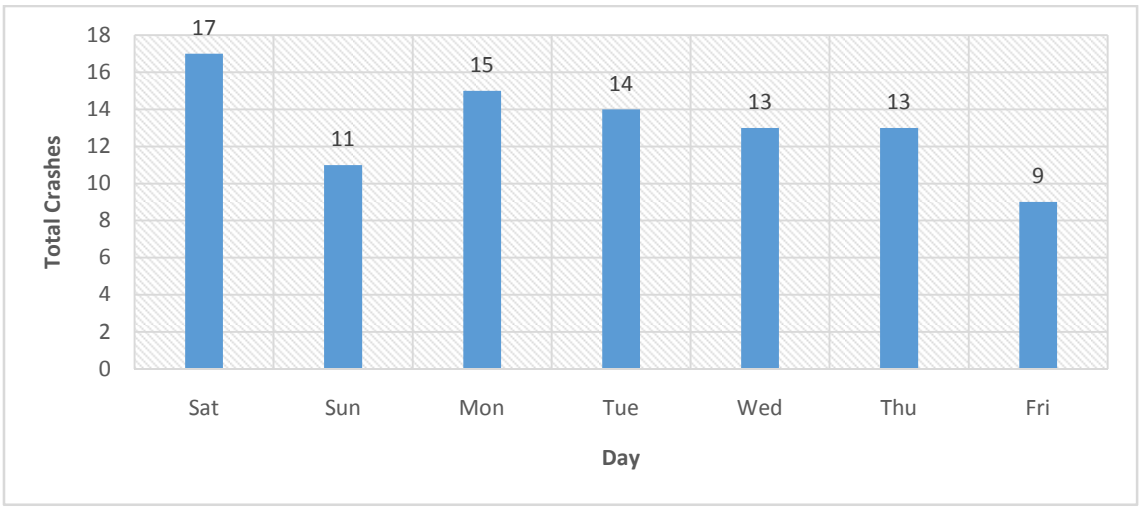


Figure (90): KSI Pedestrian Crashes Analysis in Nablus Governorate by Day

As for the hour of occurrence, it is clear that there were two peak hours as shown in Figure (91), from 18:00 to 19:00 forming 17.2% and from 13:00 to 14:00 forming 11.5% of total KSI pedestrian crashes.

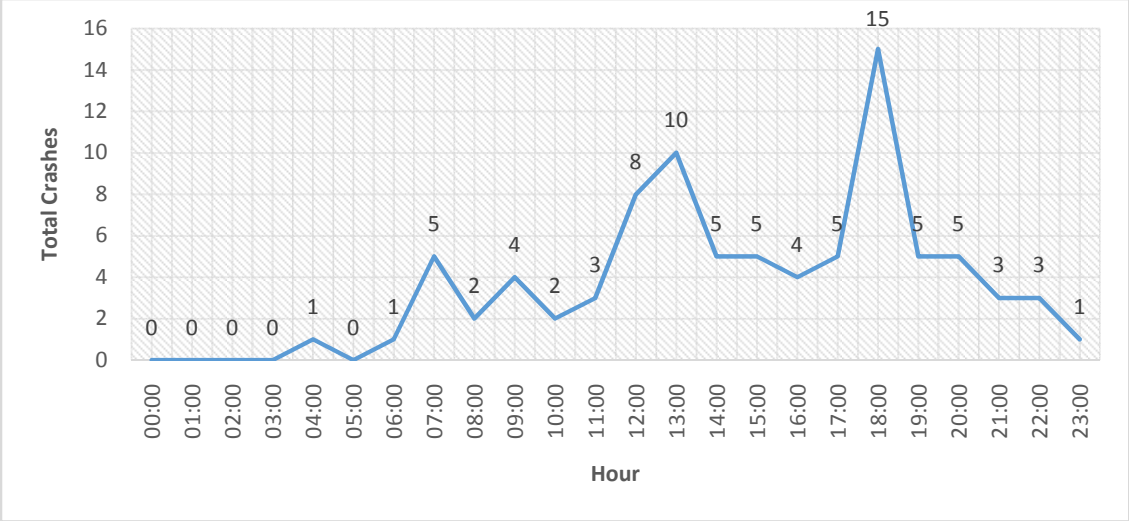


Figure (91): KSI Pedestrian Crashes Analysis in Nablus Governorate by Hour

In terms of monthly distribution, the most critical months were August (13 crashes), July (12), and May (11), as shown in Figure (92), forming together 39.6% of the total KSIs. On the other hand, December was the safest month in terms of KSI pedestrian crashes.

Figure (92): KSI Pedestrian Crashes Analysis in Nablus Governorate by Month

Figure (93) shows the distribution of KSI pedestrian crashes by age. The age group most vulnerable for KSI pedestrian crashes was those younger than 10 years with 43.5% of the total. The age group older than 60 years formed 16.3% of total KSI pedestrian crashes in the governorate. This leads to the necessity of giving more attention to these critical age

groups who need more care and appropriate pedestrian facilities in road networks.

By analyzing the gender of victims or drivers, it is found that 73% of the victims were males and 27% were females. On the other hand, the drivers who were involved in the KSI crashes in the governorate were mostly males with a percent of 98%, which means that females are more careful than males, as shown in Figure (94).

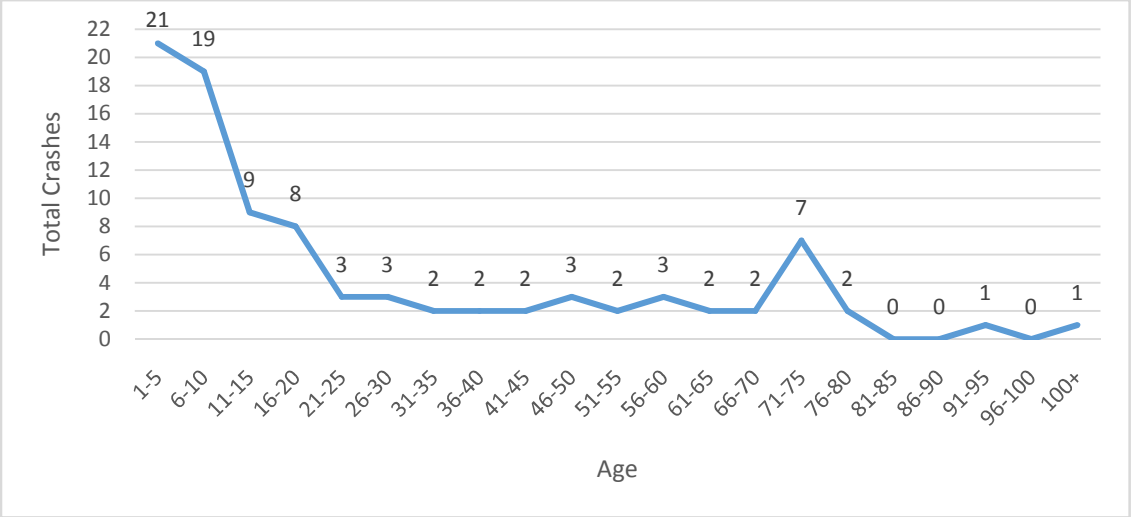


Figure (93): KSI Pedestrian Crashes Analysis in Nablus Governorate by Age

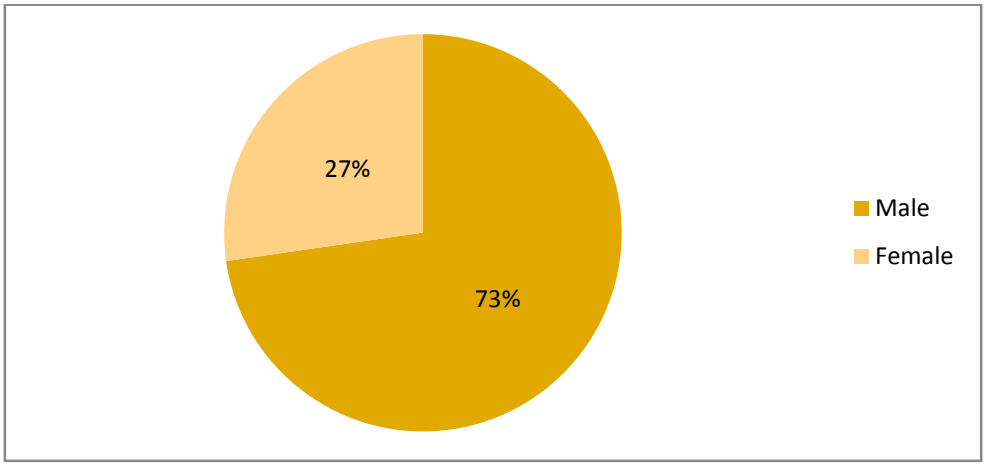


Figure (94): KSI Pedestrian Crashes Analysis in Nablus Governorate by Gender of Victims

As Nablus Governorate contains Nablus City and other communities, Figure (95) shows the location of KSI crashes in the governorate.

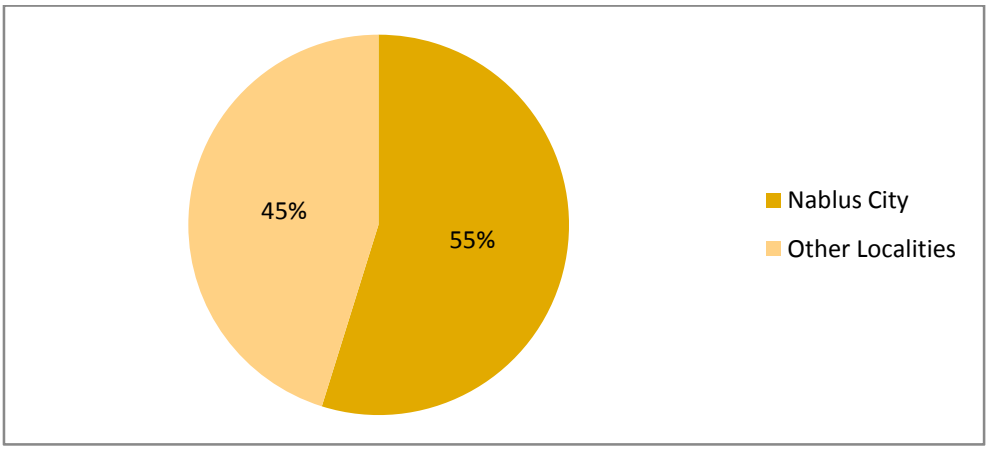


Figure (95): Distribution of KSI Crashes in Nablus Governorate

Spatially, Huwwara had the most number of KSI crashes (7 KSI crashes); Al Badan and Roujeeb had 4 for each, and Beita and Jammain had 3 for each. When analyzing by the KSI rate per 100,000 capita, Al Badan was the most critical locality in the governorate (after Nablus City) with KSI of 26.5 per 100,000 capita, and Huwwara came second with 20.7. As known, Huwwara is the southern entrance for Nablus City. In addition Road 60 passes through it; therefore, the high KSI rate is reasonable, and this leads to pay more attention to the safety for pedestrians there. On the other hand, Al Badan is the Northern Eastern entrance for the City, and a must movement for vehicles going to or from Tubas Governorate. After checking the pedestrian crashes, the most of KSI crashes happened after 18:00, which could be explained by the low lighting and, more importantly, the low traffic volume and high speed. Figure (96) shows the KSI rates.

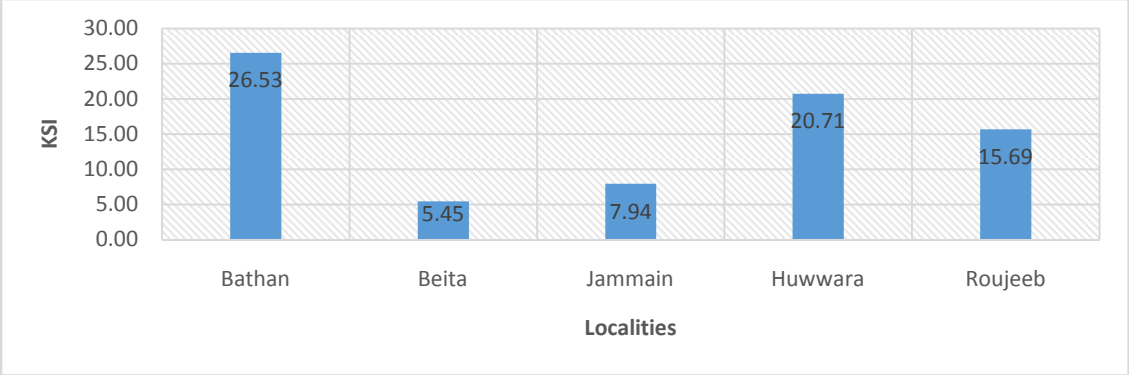


Figure (96): KSI Rates (per 100,000 Capita) in Most Critical Localities in Nablus Governorate

6.2 KSI Analysis for Nablus City

For Nablus City, there were 51 KSI crashes during the last 5 years, with KSI of 5.60 per 100,000 capita. Similar to the governorate profile, the day with the highest KSI crashes was Saturday with 21.7% from total KSI crashes; the least was Friday with 6.5%, as shown in Figure (97).

Figure (98) illustrates the hourly distribution. There were two peaks: From 13:00 to 14:00 and from 17:00 to 19:00 (consistent with the governorate profile) forming 34.1% of total KSI crashes. The low movement of vehicles and their high speed, which increase the chance for crashes, could explain this.

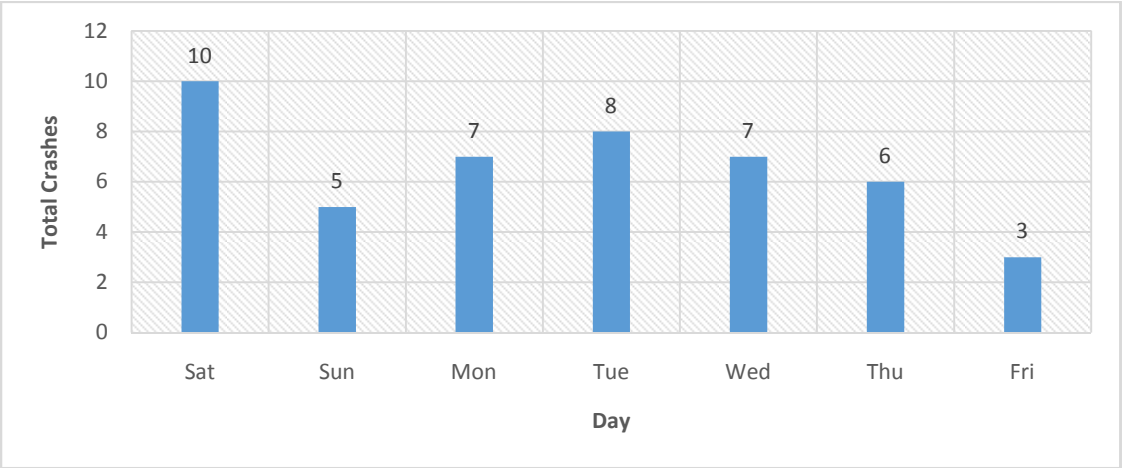


Figure (97): KSI Crashes Analysis in Nablus City by Day

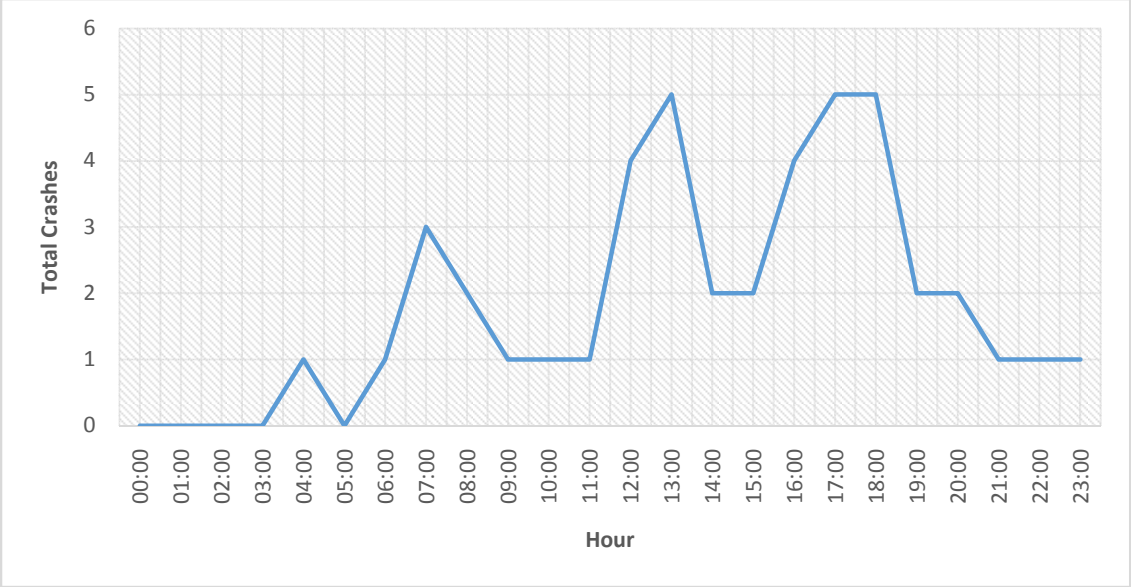


Figure (98): KSI Crashes Analysis in Nablus City by Hour

The most hazardous month was August (8 crashes), and the safest was December without any KSI crashes, as shown in Figure (99).

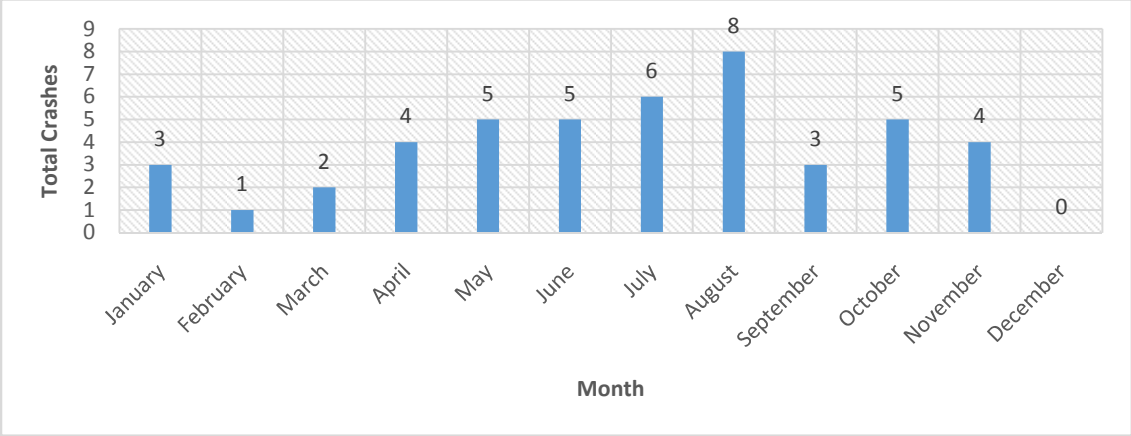


Figure (99): KSI crashes analysis in Nablus City by month

In terms of age distribution of KSI crashes, Figure (100) shows that the age group, which was mostly involved in pedestrian crashes, was from 1 to 10 years with 39.1% of total crashes in this zone. The age category older than 40 years formed 43.5% of total KSI crashes in the city. The low attention of traffic rules and vehicles movements by the youngest and oldest groups lead to be more involved in pedestrian KSI crashes.

By analyzing the gender of victims or drivers, it's found that 76% of the victims were males and 24% were females. On the other hand, the drivers who were involved in the KSI crashes in the governorate were mostly males with a percent of 96% as shown in Figure (101).

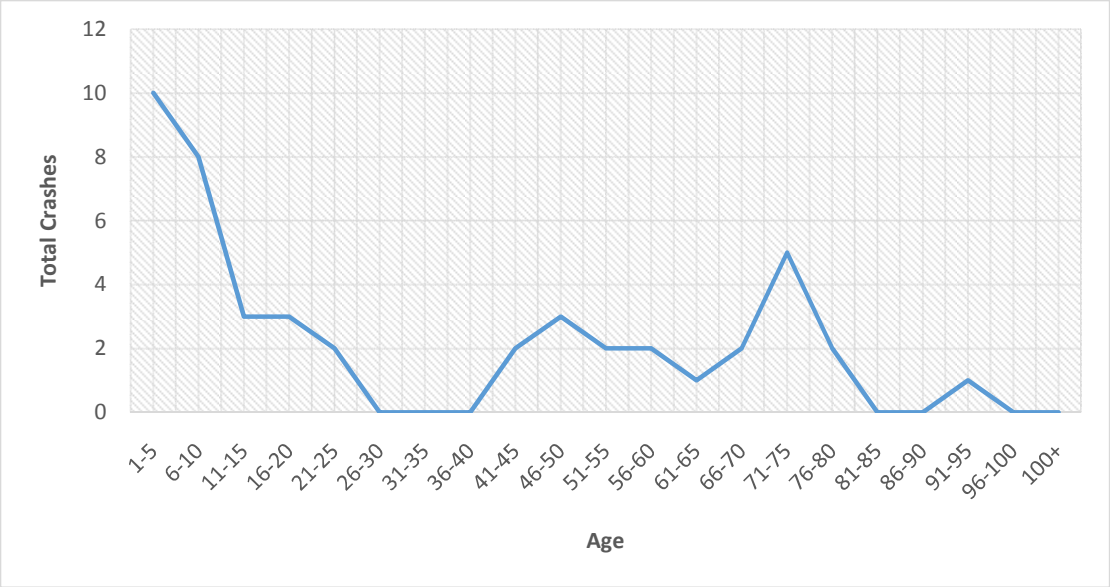


Figure (100): KSI Crashes Analysis in Nablus City by Age

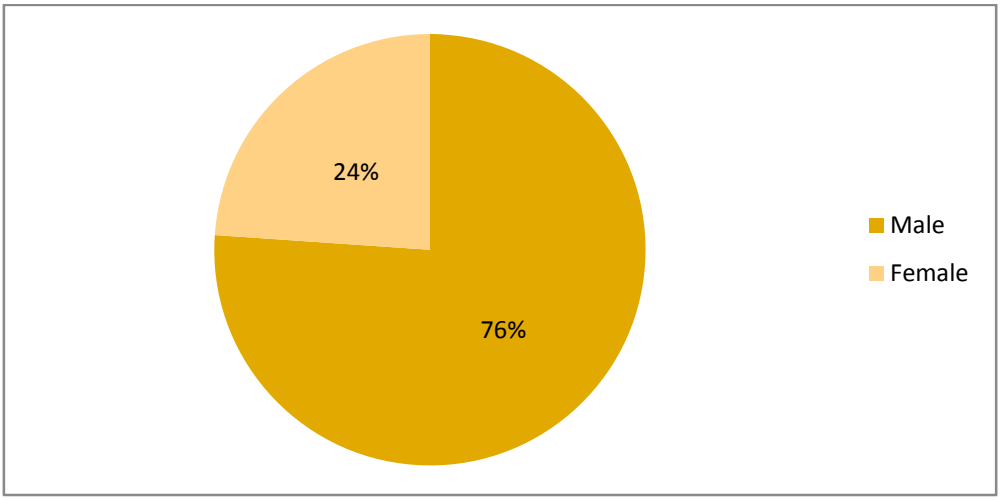


Figure (101): KSI Crashes Analysis in Nablus City by Gender of Victims

Spatially, the zones of 1 (Down Town) and 19 (Al Quds St.) had the most number of crashes (5 crashes), zone 200 (Balata Camp) had 4 KSI crashes, and the zones 14 (Al Masaken), 16, 17 (The eastern zones near the

industrial area), and 21 (Faisal St.) had 3 crashes each. Figure (102) shows the KSI number of crashes.

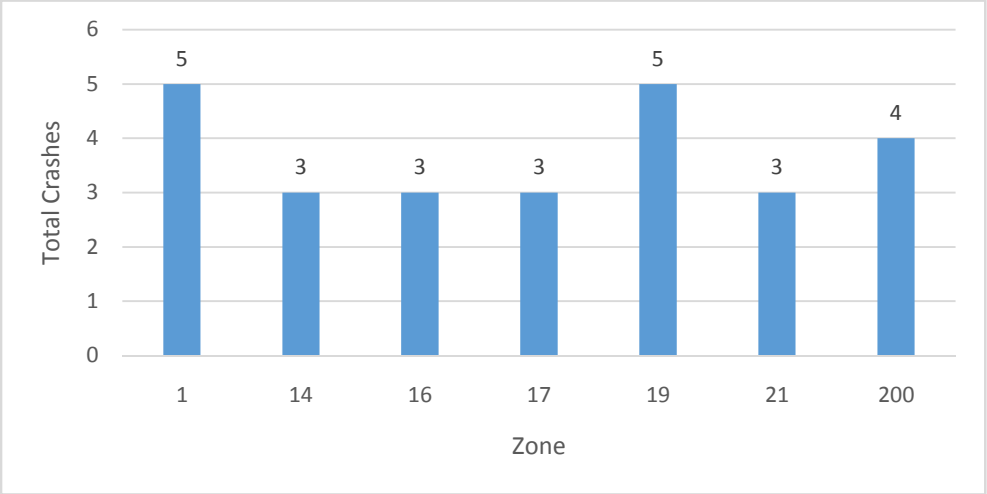


Figure (102): KSI Rates in Most Critical Zones in Nablus City

6.3 Fatalities in Nablus Governorate and Nablus City

During the last five years, Nablus Governorate had 37 people killed in pedestrian crashes, 19 of them were in Nablus City, and the rest were distributed in the other localities.

Outside Nablus City, the 18 killed pedestrians were in 16 localities, 1 in each of Badan, Al Sawia, Al Nassaria, Beit Dajan, Beit Wazan, Beita, Telfeet, Jaloud, Huwwara, Talluza, Awarta, Ourif, Qabalan, and Yitma. Roujeeb and Beit Foureek had 2 fatalities during the last 5 years with the highest rates after Nablus City in the governorate.

By analyzing Nablus City's fatalities, Figure (103) describes the profile of the city. There were 19 ones during the last 5 years, with a fatality rate of 2.09 per 100,000 capita.

The day with the highest fatalities was Saturday with 31.6% of the total fatalities; the least was Friday without any.

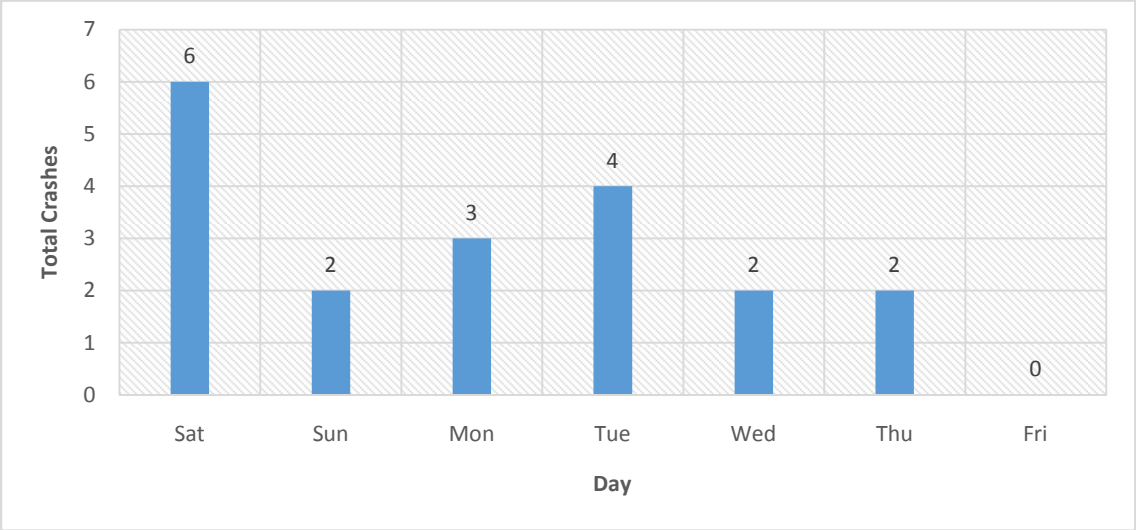


Figure (103): Fatalities Crashes Analysis in Nablus City by Day

By analyzing the total crashes by hour, it's clear that there was a peak extending from 17:00 to 19:00 forming 31.6% of total fatalities (6 fatalities).

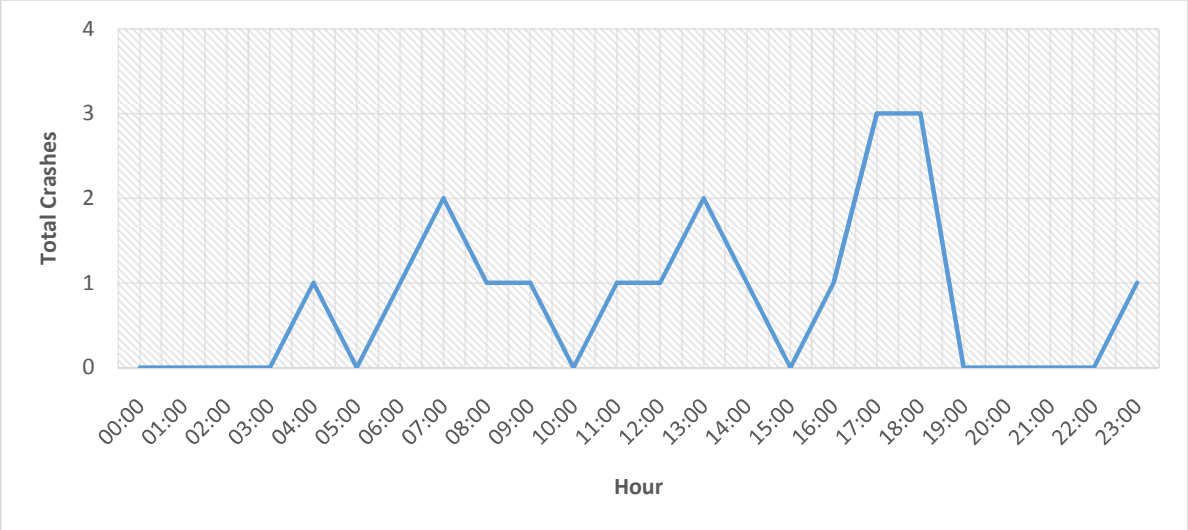


Figure (104): Fatalities Crashes Analysis in Nablus City by Hour

The most hazardous months were April and July (4 fatalities), as shown in Figure (105). In other words, from spring to mid-summer, there

were the highest fatalities, which was consistent with the number of crashes all over the city.

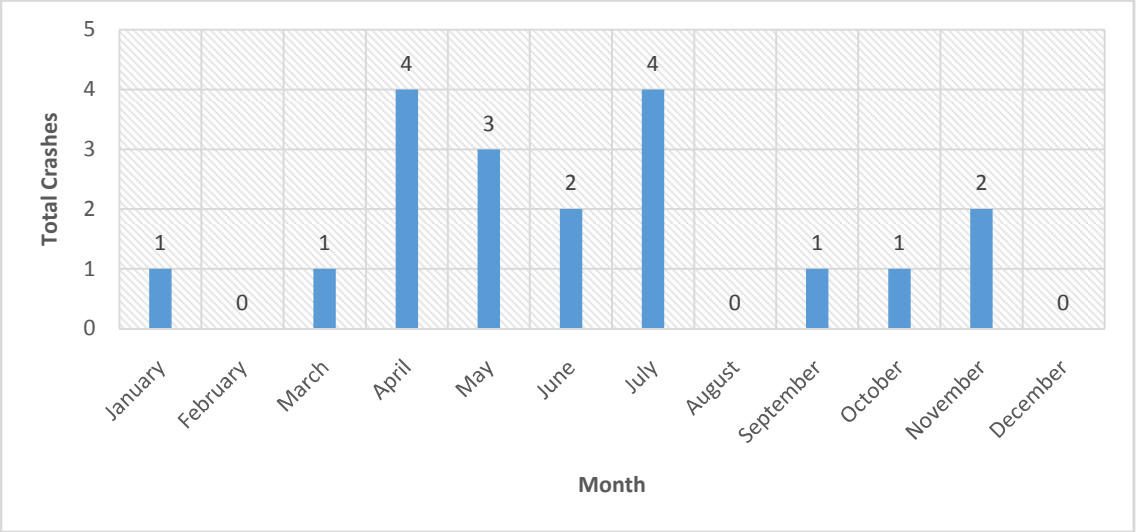


Figure (105): Fatalities Crashes Analysis in Nablus City by Month

Figure (106) shows the distribution of fatalities by Age. The age group most involved in pedestrian crashes was from 1 to 10 years with 42.1% of total crashes in the city. The age category older than 40 years formed 52.6% of total fatalities crashes in the city.

By analyzing the gender of victims, it's found that 79% of the victims were males and 24% were females. On the other hand, the drivers who were involved in fatalities crashes in the city were mostly males with a percent of 95% as shown in Figure (107)

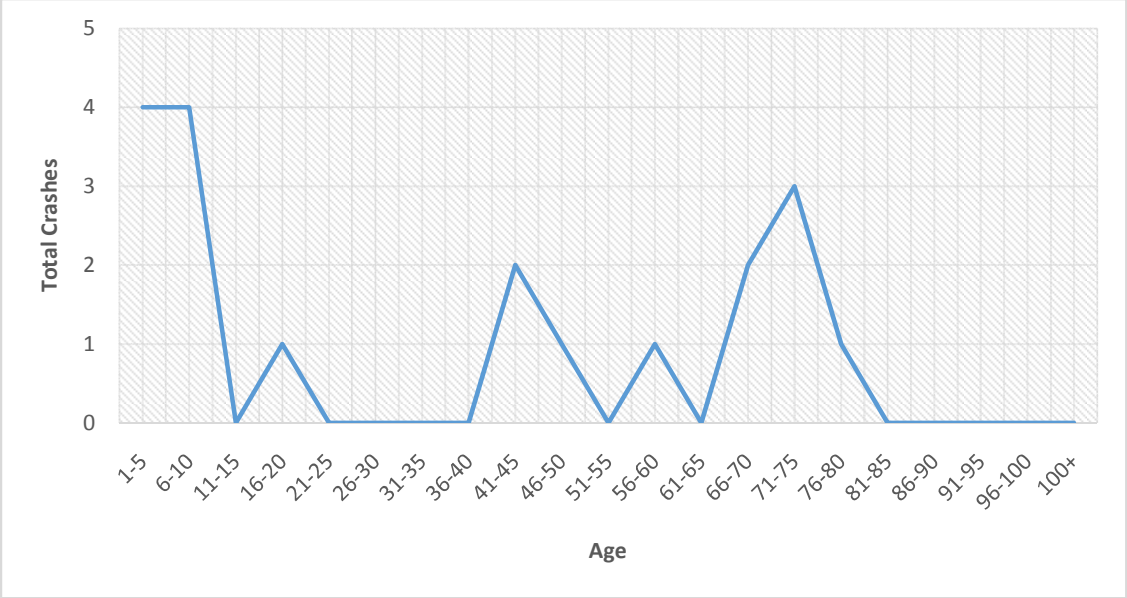


Figure (106): Fatalities Crashs Analysis in Nablus City by Age

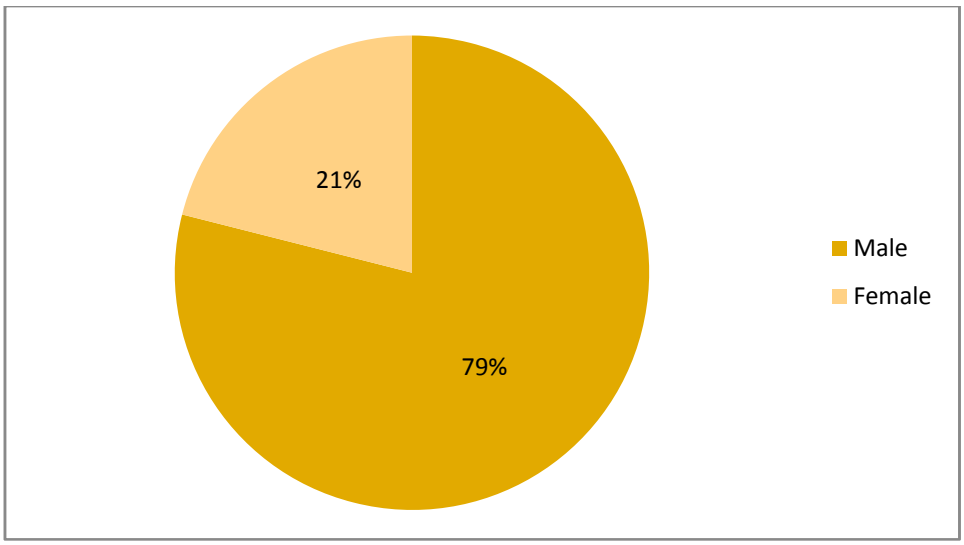


Figure (107): Fatalities Crashes Analysis in Nablus City by Gender of Victims

Zone 1 (Down Town) has the highest number of fatality crashes (4 crashes) followed by zones 14 (Al Masaken), 16 (Industrial Zone), 19 (AlQuds St.) and 21 (Faisal St.) which have 2 fatalities in crashes for each, Figure (108) shows the number of fatalities by zone.

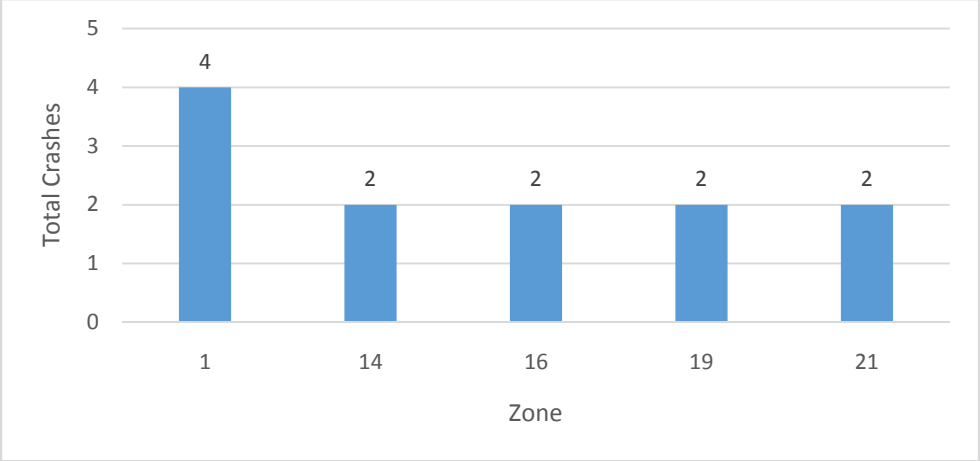


Figure (108): Fatalities in Most Critical Zones in Nablus City

Chapter Seven

Conclusions and Recommendations

Chapter Seven
Conclusions and Recommendations

7.1 Introduction

Palestine does not have complete and specialized documents that provide engineers and planners the current situation of pedestrian crashes at the national and local levels. There is somehow updated statistics of the overall crashes at the national and governorate levels produced annually by the Palestinian Central Bureau of Statistics. This research establishes the first step towards a comprehensive Action Plan for Pedestrian Crashes that could be used by the relevant stakeholders to improve pedestrian safety. The aim of this research is to study, analyze, and evaluate the pedestrian crashes in Nablus Governorate. Some of main results emerged from this study are summarized here.

This research provides a wealth of information about pedestrian crash frequencies, rates, types, severity, etc., in Nablus Governorate during the years from 2012 to 2016.

As a general observation, police enforcement is generally weak and is concentrated in the critical locations of city centers, major intersections, and near school areas; the available human resources is limited. It is common that pedestrians do not strictly abide by the traffic rules within the roadway network. Pedestrians usually cross streets randomly and from undesignated areas. They might sometimes even cross the street at signalized intersections before waiting for the pedestrian signal. In addition, the pedestrian facilities (signs, markings, sidewalks, etc.) are

generally in weak conditions and need maintenance. Pedestrian crossings are not well placed in the proper locations and sometimes non-existing. Furthermore, awareness of traffic rules is not common among young children.

7.2 Conclusions

7.2.1 Observations about Crash Reporting

Based on data collected and analyzed, the following inferences are the main conclusions about the outputs of this thesis:

- Traffic crash data are recorded manually in papers using crash forms, which needs more elaboration. The crash reports include information about details of crash conditions related to drivers, vehicles, information about driver(s), date and time of crash, location, in addition to information about injuries. This process of collecting data manually is exhaustive and takes a considerable time, including reviewing and examining each crash report during the study years.

- The forms are different from one to another; the policemen who record don’t commit to all of items; therefore, this makes some forms lack some information. Furthermore, some words weren’t read due to the poor handwriting.

- Some of the information in the crash report are not recorded accurately. General terms are used in these crash reports, which sometimes cause difficulty in distinguishing between these terms.

7.2.2 Pedestrian Crashes Profiles' Conclusions

- The results indicated that Thursday, which is the day before the weekend with active shopping and entertainment activities, had the highest number of crashes while Friday, being the weekly holiday with a very low traffic volume and pedestrian activities, was the lowest. The period from noontime to the late afternoon was the peak for pedestrian crashes, with 3:00-4:00 been the most dangerous hour for pedestrians. This is the period when schoolchildren start exiting their schools and is the end of working hours and the start of afternoon shopping activities. The spring season had the highest number of pedestrian crashes, followed by summer season, while the winter season had the lowest.

- Young children of less than 10 years old were the most vulnerable group to be involved in pedestrian crashes (36%); the majority was males (68%). This also coincided with the peak period of pedestrian crashes, which was the time young children start exiting their elementary schools. This further coincided with the Schools Area being one of the highest areas in Nablus City in pedestrian crashes.

- Private cars were involved in the majority of crashes with 64.5%. Although public transportation vehicles form only 6% of the total vehicles in Nablus Governorate, they were involved in 25% of these crashes; public transportation vehicles drives were generally observed with reckless driving behavior. On the other hand, they travel for much longer distances than other vehicles.

- According to the police reports, 80.6% of the causes of these crashes was “not taking the safety standards for road”, which is a vague description, followed by reversing movement (13.9%), and deviating from the traffic lane (5.5%).

- Nablus City, although the largest urban center in the governorate with the highest traffic volume and number of crashes, its pedestrian crash severity is not high. Due to the high level of congestion within most of the road network in the city, traffic speed is generally low. Therefore, pedestrian crash severity is low. Al Bathan and Huwwara localities, which had the highest severity of pedestrian crashes, are located immediately to the northern and southern borders of Nablus City, respectively. Their population sizes are low; however, they both have one common character. Heavy traffic to and from Nablus City crosses these towns through a major arterial from and to the neighboring localities and other governorates. Therefore, pedestrians there are highly exposed to traffic crashes.

- Huwwara locality was ranked second after Nablus City in terms of pedestrian crashes frequency, and had the highest rate. Beita was third in terms of frequency and Biet Wazan was the second in terms of crash rate per capita.

- The following observations showed the differences in profiles of pedestrian crashes as compared to the Governorate’s profile.

- Huwwara was opposite to the governorate in terms of critical days in frequency; the highest pedestrian crashes occurred in mid-weekdays and on Fridays, and the least were on Sundays and Thursdays. The highest age category to be involved in pedestrian crashes in Huwwara was 35 to 40 years old, and victims were mostly males with 77%. Private cars were the highest among vehicles' class to be involved in pedestrian crashes with 86%. The KSI of Huwwara reached 21.5 per 100,000 capita.

- Beita had pedestrian crashes all over the year with somehow steady weekly and monthly frequencies. The peak time was from 19:00 to 20:00. The age category was similar to the Governorate, and KSI was also close. Children playing after school times without safety consideration is the main reason. On the other hand, victims were mainly males with percent close to Huwwara, and the same situation regarding the involvement of private cars.

- Nablus City had the highest pedestrian crashes in the zones 1, 2, 5, 3, 21, 22, and 19 (Down Town, Sufian St, New Campus, Rafedia, Faisal St, Ras El Ein, and Al Quds St., respectively). The most hazardous roads were Faisal, Rafedia, Omar Khattab, Quds, Sufian, and Ras Alein. Nablus City is the major locality in the Governorate with the highest number of people and vehicles; therefore, the results were generally similar to the Governorates'. The following table summarizes the results in the critical zones on Nablus City.

Table (4): Overall Results in the Critical Zones

	1	**2**	**5**	**19, 21, and 22**	**3**
Highest Days	Thu, Sat, Sun	Thu, Sat	Thu, Wed, Fri	Thu, Sat	Wed, Thu, Sun
Lowest Days	Fri	Mon, Fri	Sat, Sun, Mon, Tue	Tue, Fri	Fri, Mon
Highest Hour	12, 13, then 8	10-16	13	13	18, 15
Highest Month	May, Nov	May, Jun	Mar, Apr	Aug	Apr, Nov
Lowest Month and Season	June, winter	July, winter	Sep	Oct, Win	Winter
%KSI	3%	1%	1%	5%	2%
Highest Age Group	21-30, 41-45	6-30	16-25	1-10	6-10
%Male Victim	61%	70%	51%	76%	62%
%Private Vehicles	57.1%	51.1%	74.5%	71.4%	64.3%
%Shared Taxis	31.3%	38.3%	23.4%	28.6%	32.1%

- As noticed in Table 3, the afternoon hours were the critical ones, which need more considerations and police enforcement, especially in the zones of 19, 21, and 22 that have 5% KSI of pedestrian crashes.

- Regarding the ownership of vehicles, shared taxis in these critical zones form more than fourth to 40% of pedestrian crashes although they form less than 6% of the vehicles. This has to be taken into consideration and more laws should be enforced on them.

- Regarding the pedestrian crashes with the severity of killed or seriously injured (KSI), they could be described as: the day having highest pedestrian crashes was Saturday. They occurred mainly in the hours of 18:00 and 13:00. The age categories that were highly involved in these crashes were 1 to 10 and 71 to 75 years old. Most of the pedestrians

were males with 73%. s for Nablus City, the zones that had the highest KSI of pedestrian crashes were 19, 11, and 200.

- The rate of crashes (crash/100,000 people) was highest in Nablus City, the largest urban center in the governorate, and in communities in its immediate vicinity. Approximately, 7% of pedestrian crashes resulted in serious injury or fatality. Although, the majority of pedestrian crashes occurred in urban areas, their severity was higher in rural areas and in off-peak traffic periods. These are areas and times where traffic volume is relatively low and driving speed is relatively high.

- Furthermore, a deeper look at the KSI crashes in Huwwara and Beita showed that these crashes were concentrated in the period from mid-afternoon to early nighttime. In addition, the majority occurred in off-peak days such as middle of the week or on Fridays. These are the times when traffic volume is relatively low, thus traveling at a relatively high speed. Therefore, traffic crashes resulted in serious or fatal injuries.

7.3 General Recommendations

The results of pedestrian crashes analysis raise several issues that deserve to be followed up and further investigated by decision makers and researchers. This research serves as a road map for pedestrian safety studies and researches in Nablus Governorate as well as other governorates in the West Bank. The followings are study recommendations or issues to be further investigated and studied:

- It is highly recommended that traffic police records be fully computerized and the technology is available at a minimal cost. In addition, it is recommended to use a sound methodology in recording crash data and develop new enhanced data sheet for each crash to include more items reduce inaccuracies, and limit individual's perception by holding several in recognizing the importance of complete and accurate crash reporting, or/and connecting the pedestrian crashes with GPS system

- National level studies should be conducted to investigate the reasons for the increase in the number of pedestrian crashes and fatalities in the West Bank, and identify ways to reduce them.

- The responsible authority (Ministry of Transport, Higher Council for Traffic, etc.) should develop an action plan for the pedestrian safety program at the national level and provide for the appropriate regulatory environment (laws and regulations) in this regard.

- The responsible authorities (Ministry of Transport, Higher Council for Traffic, Traffic Police, Ministry of Education, etc.) should conduct comprehensive traffic safety awareness campaigns targeting drivers and pedestrians, and hold trainings in understanding the factors related with pedestrian crashes, and roles and relationships between pedestrians and drivers. The emphasis should be on priority of the road and compliance to safety measures.

- The Ministry of Transport, Higher Council for Traffic, and police enforcement should join efforts to implement the traffic law and stiff penalty should be exerted to reduce these crashes. Appropriate countermeasures, such as traffic calming, engineering solutions, etc., should be implemented to mitigate pedestrian crashes. In addition, existing pedestrian facilities should be maintained and proper facilities (sidewalks, crosswalks, handrails, etc.) should be installed at locations where pedestrians are active and crashes occur frequently.

- It is well known that the available human resources at the traffic police in Nablus are very limited. Therefore, the results of this study could be useful for the traffic police to reallocate the limited available resources and intensify their efforts in the areas and periods that are critical in terms of road safety, particularly for pedestrians; for example, on Thursdays, during the afternoon time, and at the locations of high pedestrian crashes.

7.4 Future Research

The results of this research are valuable and can be developed to be comprehensive and highly reliable to be used in Palestine. The following points will enrich the study and open new opportunities for forthcoming researchers:

- Similar studies could be done in other governorates and at the national level; therefore, evaluation and comparisons between West Bank areas can be conducted.

- Similar study for 2017 and 2018 could be added to this study to achieve 7-year profiles for Nablus Governorate and City.

- The results of this could be used to relate the pedestrian crashes with their behaviors and the available pedestrian facilities (cross walks, crossings, pedestrian signals, etc.) and their appropriateness.

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جامعة النجاح الوطنية
كلية الدراسات العليا

دراسة سلامة المشاة في محافظة نابلس

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د. خالد الساحلي

قدمت هذه الأطروحة استكمالا لمتطلبات الحصول على دراجة الماجستير في هندسة الطرق والمواصلات بكلية الدراسات العليا في جامعة النجاح الوطنية في نابلس،فلسطين
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الملخص

تعتبر سلامة المشاة في محافظة نابلس أحد الاهتمامات الرئيسية لمهندسي المرور وصناع القرار. في هذا البحث تم اختيار محافظة نابلس وذلك بعد أن أظهرت الدراسات السابقة معدلات عالية لحوادث المشاة في المحافظة. ولذلك سيكون هذا البحث بمثابة دراسة أولية للباحثين والمهتمين لتطوير خطة شمولية لسلامة المشاة في نابلس.

الهدف من هذا البحث هو دراسة وتحليل وتقييم حوادث المشاة في محافظة نابلس خلال الفترة من 2012 إلى 2016. وذلك من خلال معرفة التوزيع الجغرافي لحوادث المشاة في محافظة نابلس وخصائصها، وعمل دراسة تفصيلية للتجمعات ذات معدلات حوادث المشاة الأعلى في المحافظة، والمناطق الأكثر خطورة في مدينة نابلس. علاوة على ذلك، سوف تقدم هذه الدراسة تحليلا للحوادث بناء على خطورتها وتحليلها زمانياً ومكانياً. تم جمع البيانات من مصادر مختلفة وتشمل ما يلي: وقت وتاريخ الحوادث، مواقع حوادث المشاة، المتغيرات الديموغرافية، الخطورة، تصنيف المركبات المسببة للحوادث، تقسيمات المدينة و توزيع السكان.

أشارت النتائج إلى أن حوادث المشاة تكثر يوم الخميس بينما كان يوم الجمعة هو الأدنى. وكانت الفترة من وقت الظهيرة حتى وقت متأخر من بعد الظهر هي فترة الذروة لحوادث المشاة، أما الساعة 3:00 – 4:00 فتعد الأكثر خطورة بالنسبة للمشاة. عمريًا، فالذين تقل أعمارهم عن 10 سنوات هم الفئة الأكثر عرضة للإصابة بحوادث المشاة (36%)؛ وكانت غالبية المصابين من الذكور (68%)، وكانت نسبة المركبات الخاصة في هذه الحوادث تشكل 64.5%. وعلى الرغم من أن مركبات النقل العام تشكل 6% فقط من إجمالي مجموع المركبات

في محافظة نابلس، إلا أن نسبة الحوادث التي اشتملت هذه المركبات تصل إلى 25%. بشكل عام، وكانت خطورة حوادث المشاة خفيفة إلى متوسطة الخطورة.

مدينة نابلس تعد التجمع الرئيسي في المحافظة وتضم العدد الأكبر من السكان والمركبات، لذلك من المنطقي أن تكون النتائج متشابهة ما بين المدينة والمحافظة. إحتلت بلدة حوارة المرتبة الثانية بعد مدينة نابلس من حيث تكرار حوادث المشاة. أما بلدة بيتا فقد كانت في المرتبة الثالثة من حيث العدد، وبلدة بيت وزن هي الثانية من حيث معدل عدد الحوادث بالنسبة لعدد السكان. نتائج بلدة حوارة تختلف نوعًا ما عن نتائج المحافظة من حيث الأيام الأكثر خطورة، والفئة العمرية الأعلى، ونسبة خطورة الحوادث والوفيات. بلدة بيتا احتوت حوادث مشاة على مدار العام بنسبة شبه ثابتة أسبوعيا وشهريا، وقريبة من نتائج المحافظة. المناطق الأكثر خطورة في مدينة نابلس هي المناطق التي تضم الطرق التالية: شوارع فيصل ورفيديا وعمر بن الخطاب والقدس وسفيان ورأس العين.

كان معدل حوادث المشاة لكل 100,000 شخص هو الأعلى في مدينة نابلس. وما يقارب من 7% من حوادث المشاة كانت خطيرة أو أدت إلى حالات وفاة. وعلى الرغم من أن غالبية حوادث التصادم وقعت في المناطق الحضرية، إلا أن شدتها كانت أعلى في المناطق الريفية وفي خارج أوقات الذروة.

ينبغي إجراء التدابير المناسبة، مثل إدارة حركة المرور، وزيادة كفاءة عمل الشرطة، وتحسين مرافق المشاة في المناطق الحرجة حيث تتكرر فيها حوادث المشاة بشكل ظاهر. يجب على السلطات المسؤولة وضع خطة عمل لبرنامج سلامة المشاة على المستوى الوطني وتوفير البيئة التنظيمية المناسبة. هذا وينبغي إجراء حملات توعية شاملة بالسلامة المرورية تستهدف السائقين والمشاة. يمكن لشرطة المرور إعادة توزيع الموارد البشرية التابعة لها في المناطق والأوقات الحرجة. كما ويلزم التعاون بين أصحاب العلاقة المختصين في السلامة المرورية، بما في ذلك المجتمع ومسؤولي وسائل النقل العام لزيادة الوعي في موضوع السلامة المرورية.