Traffic Accidents Trends and Characteristics in Jordan

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***Abstract*—Road traffic accidents are considered among the leading causes of death locally and globally. In Jordan, road traffic accidents were responsible for about 4.5% of fatalities during the year 2007 and were ranked as the third cause of death in the country during the year 2010.**

Jordan suffers from a serious traffic accidents problem that must get more attention from the decision makers. A total of 1,040,112 accidents have occurred over the study period (1998-2010) with an average of 80,008 accidents/year.

Traffic accidents in Jordan were continuously increasing over the study period as a result of continuous increase in population and auto ownership represented by the motorization level (number of registered vehicles/1000 population).

This study has utilized the traffic accidents data in Jordan for thirteen years period to mainly investigate their trends and characteristics over that period. Based on the available data, traffic accidents were analyzed considering several variables including accident type, driver age, speed limit, time of the day, day of the week, month of the year, weather condition, pavement surface condition, and severity level.

***Index Term*— traffic accident, Jordan, accidents trends, traffic model**

I. Introduction

Road traffic accidents are the leading cause of death for young people and the eighth leading cause of all deaths globally with an estimated 1.24 million people who are killed in road crashes each year [1]. About 85% of annual deaths are occurred in the developing countries. Males and those between 15 and 44 years old are the most affected parties with traffic accidents [2]. Traffic accidents cost countries about 1 to 2% of their gross national products [3].

Jordan is considered as one of the highest world countries in terms of traffic accidents, which were responsible for about 4.5% of fatalities during the year 2007 and ranked as the third cause of death during the year 2010. Furthermore, It was found that the costs of road accidents in Jordan were estimated to be about US$ 146.3 million in 1996 [4] and increased to US$ 440 million in 2010 [5]. Therefore, this problem is taken seriously by the governmental authorities that are concerned with traffic and road safety. In 2007, the government of Jordan has applied a new traffic law that intensified police activities and applied very high fines on the most dangerous traffic violations, and shortly replaced it by another law with reduced, but still relatively high, traffic violation fines in 2008 [6].

Furthermore, the Jordanian government has implemented a traffic safety strategy starting the year 2008 which included the following measures:

1. Implementing the new 2008 traffic law
2. Increasing enforcement measures and quality of traffic police
3. Coordination with other traffic safety agencies
4. Implementing intensive traffic awareness activities through media and educational institutions.

It is important to study the trend, characteristics and to define the causes of accidents periodically, furthermore, to define the target groups for further study and to provide data to be used by policy makers to adopt the appropriate policies regarding this serious problem. This study is conducted to mainly show the trend of traffic accidents, the number of fatalities and their characteristics over the study period from 1998 to 2010 (13 years period) for the all traffic accidents. Traffic accidents in this study were analyzed based on type, time, day, month, weather condition, pavement surface condition, age, and speed limit.

II. Literature Review

Several studies were conducted in the past to investigate the characteristics and trends of traffic accidents in Jordan. Reference [7] revealed that the problem of pedestrian accidents in Jordan is growing and becoming more serious over the years. The study was conducted on pedestrian accidents for three years period (1998-2000) considering pedestrian characteristics and the factors of time, location, weather and pavement surface conditions, faults from pedestrian and drivers and speed limit. The study revealed that elders and children have the highest contribution in pedestrian

accidents with a high percentage of casualties from males. According to time factor, pedestrian accidents occurred in higher rates on Thursdays at the time period between 12:00-15:00 during July. The majority of pedestrian accidents have occurred on roads with speed limits of 40-60 km/h, with a high involvement of small passenger cars and trucks.

Reference [8] used the GIS system to find out the characteristics of pedestrian accidents and accident prone locations in Irbid city. A regression analysis was performed to find out the effects of the major operational factors (speed, traffic volume and pedestrian volume) on pedestrian safety. It was found that those operational factors have significant effects on pedestrian safety for both sections and intersections, but it still cannot alone explain the variability in the number of pedestrian accidents. The analysis revealed that children (0-15 years) and elders (56-60) have the highest relative involvement in pedestrian accidents. The majority of pedestrian accidents have occurred at mid-blocks, intersections, and bus terminals respectively.

Reference [9] studied the characteristic of traffic accidents in Jordan for the year 2008 to evaluate the effect of safety impact of policy measures. Jordan has experienced huge human and economic losses. It was found that children (5-10 years) and elders (>60 years) are the highest age groups exposed to pedestrian accidents. As drivers, the youngers with less than 25 years old and elders have the highest involvement in traffic accidents. Furthermore, it was found that the main causes of accidents in Jordan are carelessness and aggressive driving behavior, especially by public transport means (buses and mini-buses) which had a high over-involvement in traffic accidents.

Reference [10] revealed that, in the past few years, the number of registered vehicles in Jordan has considerably increased; as a result, traffic volumes and vehicle miles of travel have significantly increased leading to a noticeable increment in traffic accidents. A complete analysis of traffic accident statistical data was conducted and an evaluation of possible leading causes of traffic accidents in Jordan was also carried out. It was found that Jordan has high fatality and injury rates compared to several countries. The majority of traffic accidents in Jordan are collision accidents. Traffic accidents and casualties were observed to be high in summer times on roads with speed limits between 40-60 km/h. The study revealed that weather condition, pavement surface condition and light condition were not considered as major causes of traffic accidents in Jordan.

In this study, the accident trend in Jordan was investigated over the time period between 1998 and 2010. Traffic accidents are analyzed based on several factors such as accident type, driver age, speed limit, time of the day, day of the week, month of the year, weather condition, pavement surface condition, and severity level.

III. Research Scope

This study aimed at investigating traffic accidents trends in Jordan as an example for developing countries, to compare its safety levels with selected other countries, and to recommend the best and most practical measures for improving safety on Jordan roads. This research work was based on the traffic accidents data in Jordan for the years between 1998 and 2010. Although some of the obtained results may apply to other developing countries, however, the presented traffic accidents trends, derived conclusions and developed models are limited to Jordan conditions.

IV. Traffic Accidents Data

The traffic accidents data used in this study were obtained from the yearly reports prepared by the Jordanian Traffic Institute (JTI). The population for each governorate was taken from the estimates provided by the Jordanian Department of Statistics (DOS). All the data items were reviewed and reduced by Hasan [11].

V. General Trend in Traffic Accidents in Jordan

Jordan has suffered from traffic accidents in the last few years with a total of 1,040,112 accidents over the thirteen years (1998-2010) study period averaged with 80,008 accidents / year. Figure (1) shows the trend of traffic accidents in Jordan over the study period where they have increased from 43,343 accidents in 1998 to 140,014 accidents in 2010 with an increment of 223%.

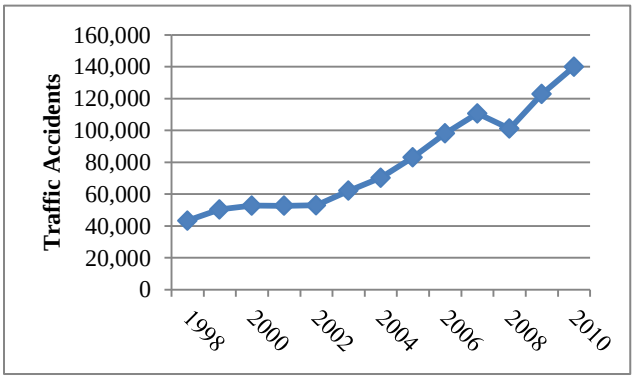

Fig. 1. Trend in traffic accidents over the study period (1998-2010).

It's worthy to mention that the year of 2008 witnessed a decrement in traffic accidents number (it seems to act out of the trend) if it's compared with the year 2007 with a percentage reduction of 10%. This can be referred to the series of measures that dictated to address the problem of traffic accidents after a series of severe traffic accidents occurred in the end of the year 2007 and the beginning of the year 2008 especially the popular bus accident on Amman-Irbid road which resulted in 20 fatalities and 50 injuries. Furthermore, the temporary high increase in fuel prices for few months during the year 2008 has reduced the private vehicles usage causing less exposure for traffic accidents.

VI. Effect of Population and Registered Vehicles

The increment in traffic accidents may be basically referred to the increment of both vehicles and population, as shown in Figure (2). The population has increased from 4,755,800 in 1998 to 6,113,000 in 2010 with an increment of 28.54%. This increment in population isn't only caused by the natural

increment, however, many political events that took place in the Middle East region during that period contributed to the Jordan's population increment such as the war in Iraq in 2003 (around 700,000 Iraqi refugees came and lived in Jordan as estimated by UNHCR). Also it can be seen from Figure (2) that there was an increment in the registered vehicles in Jordan from 389,196 vehicles in the year 1998 to 1,075,453 vehicles in 2010 with an increment of 176% over the thirteen years study period. This may be referred to the increment in the Jordanian individual income, the customs reduction on imported cars, and the increment of foreign residents in Jordan.

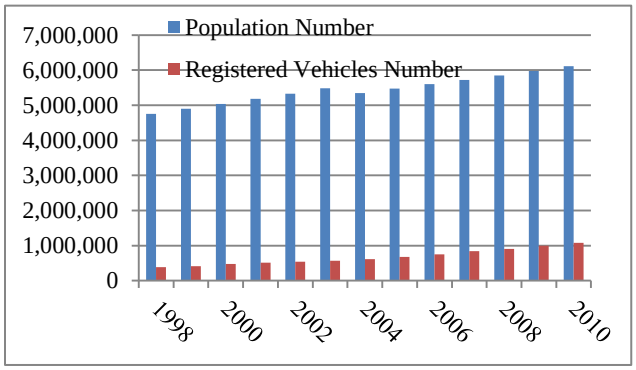

Fig. 2. Trend in Population and Registered Vehicles over the Study Period (1998-2010).

Different methods can be used to evaluate the safety level by using exposure measures based on the number of accidents per 100,000 populations and per 10,000 registered vehicles. Figure (3) shows the effects of the population and registered vehicles exposure measures on the traffic accidents trends over the study period. It can be seen that the number of accidents/10,000 registered vehicles seem to increase from 1114 in 1998 to 1302 in 2010 with an increment of 16.9%. The number of accidents/100,000 population shows an increment over the study period; from 911 in the year 1998 to 2290 in the year 2010 showing an increment of 151%.

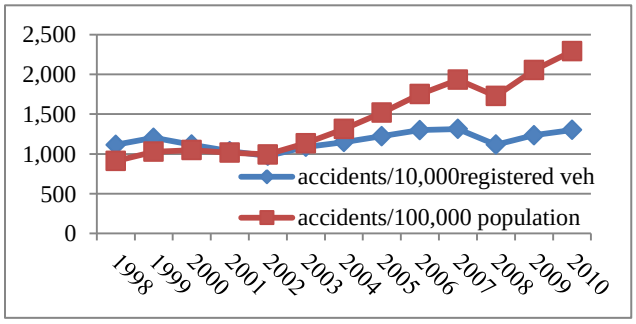

Fig. 3. Traffic Accidents Trends with Population and Registered Vehicles as Exposure Measures over the Study Period (1998-2010).

It is interesting to see the combined effect of the population and registered vehicles on the trend in traffic accidents through the calculation of the motorization level (number of registered vehicles /1000 population). Figure (4) shows the development of the motorization level over the study period, which has increased from 82 vehicle/1000 population in the year 1998 to 176 vehicle/1000 population in the year 2010 with an increment of 114.6%.

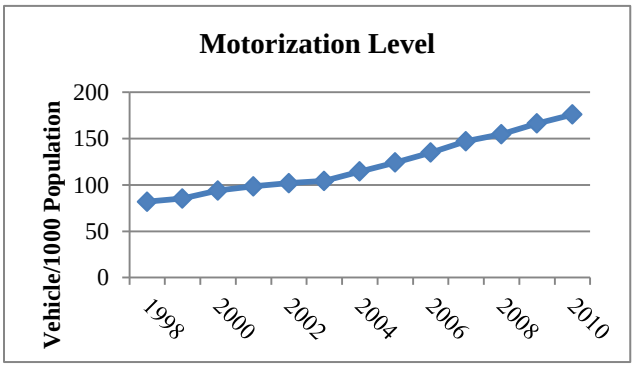

Fig. 4. Development of Motorization Level over the Study Period (1998-2010).

Al-Khateeb and Khedaywi [12] conducted a comparison study between traffic accidents in Jordan and some other developed countries between years 2000 and 2010. The average motorization level during the study period was about 130 in Jordan compared to about 800 in USA, 600 in Germany and 500 in UK.

Average number of fatalities per 100,000 populations for the same study period was about 7.2 for Germany, 13.5 for USA, 5 for UK and 14.5 for Jordan. Fatalities/10,000 registered vehicles is 12.2 for Jordan, while this number is less than 2 for USA, Germany and UK (it is worthy to mention that number of fatalities per 10,000 registered vehicles is 6.2 in the 2010 in Jordan. i.e. significant improvement is achieved).

Number of accidents for every 10,000 registered vehicles was about 400 for both Germany and USA, and 60 for UK while this number is about 1300 for Jordan.

As mentioned in the discussion above, even though Jordan has the lowest motorization level among the countries under consideration, number fatalities to 100,000 population or to 10,000 registered vehicles is still much higher than these countries.

VII. Trend in Accident Type

Figure (5) shows that the percentage of collision traffic accidents is the highest with continuous increase over the study period, while the percentages of pedestrian and turn over accidents are relatively low with continuous decrease over the study period.

VIII. Trend in Severity Level

Although traffic accidents in Jordan showed an increasing trend over the thirteen years (1998-2010) study period, but it's still to say that the severity level of accidents (number of casualties/ number of accidents) showed a reduction in its trend as represented in Figure (6) from 0.41 casualty/accident in the year 1998 to 0.13 casualty/accident in the year 2010.

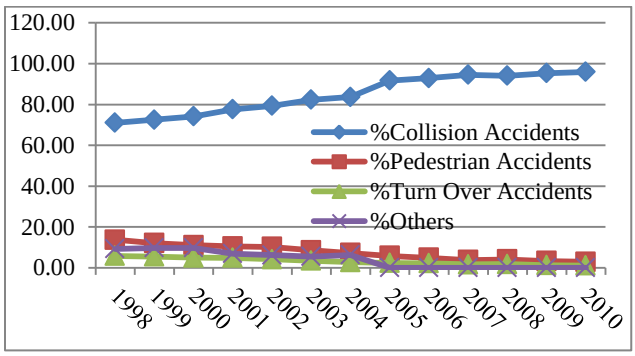

Fig. 5. Percentage of Accidents by Type over the Study Period (1998-2010).

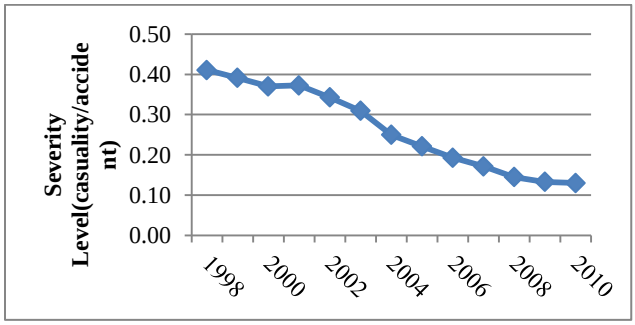

Fig. 6. Severity Level over the Study Period (1998-2010).

IX. Trend in Fatal Traffic Accidents

An accident is considered fatal if it results in a fatality(s). Figure (7) shows that the number of fatal traffic accidents showed an increasing trend until 2007 and then started decreasing. However, if the fatal traffic accidents are classified according to the accident type as shown in Figure (8), then the trend in the percentage of collision fatal traffic accidents seems to move upward while the trend in the percentage of pedestrian fatal traffic accidents seems to move downward and no remarkable trend can be observed for the percentage of the turn over fatal traffic accidents over the study period.

Figure (9) shows that the number of fatalities/10,000 registered vehicles showed a decreasing trend, while the number of fatalities/100,000 population showed an increasing trend until 2007 and then started decreasing.

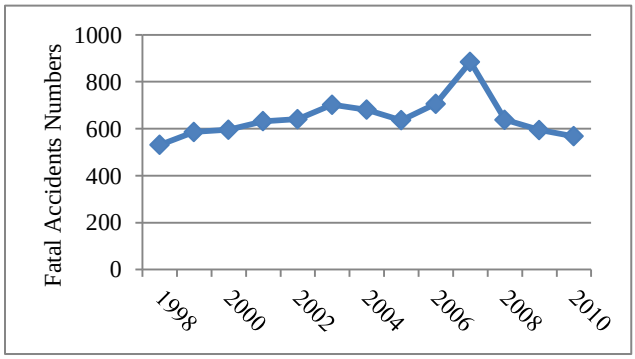

Fig. 7. Numbers of Fatal Accidents over the Study Period (1998-2010).

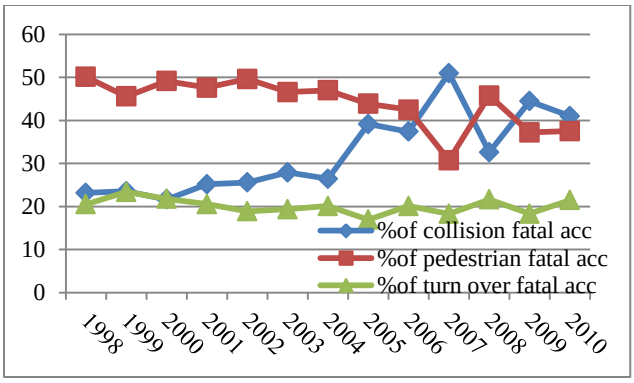

Fig. 8. Percentages of Fatal Accidents by Type over the Study Period (1998-2010).

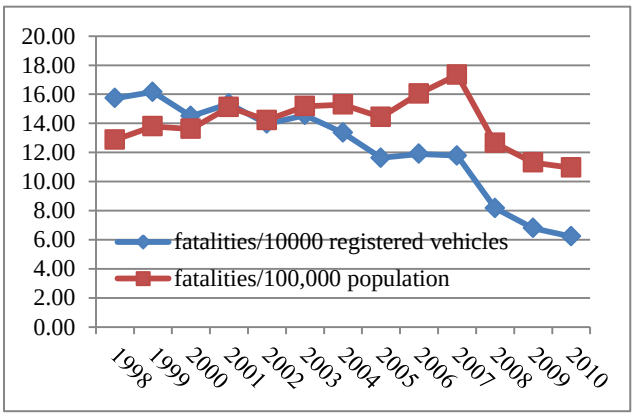

Fig. 9. Fatalities Exposure Measures over the Study Period (1998-2010).

X. Analysis of Traffic Accidents Casualties by Age Groups

To study the trend in the distribution of traffic accidents casualties (including injuries and fatalities of drivers, passengers and pedestrians) over different age groups, they were divided into thirteen age groups over the study period as shown in Figure (10). It can be seen that the largest proportions of casualties are concentrated in the two age groups (21-25) and (26-30) which may be referred to the fact that people in those age groups are young, active, and have more tendency for making trips for educational, work and social purposes than other age groups. Basically, casualties start to increase from the age group (11-15) years till the age group (26-30) years then decrease till the age group of (56-59) and then increase at the age group of (≥ 60) years old. This trend of casualties is constant with age groups all over the study period with slight differences between years.

By dividing the number of fatalities by the number of casualties, Figure (11) shows that the highest (fatalities/casualties) rates are in the eldest age groups (starting from the age of 51) followed by the youngest age group (0-5) years old. This means that elders and young kids are more at risk and have more chance of fatalities due to traffic accidents because of their weak bodies.

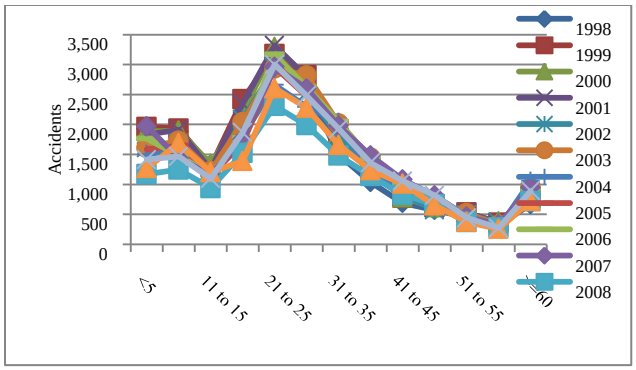

Fig. 10. Total Traffic Accidents Casualties versus Age Groups over the Study Period (1998-2009).

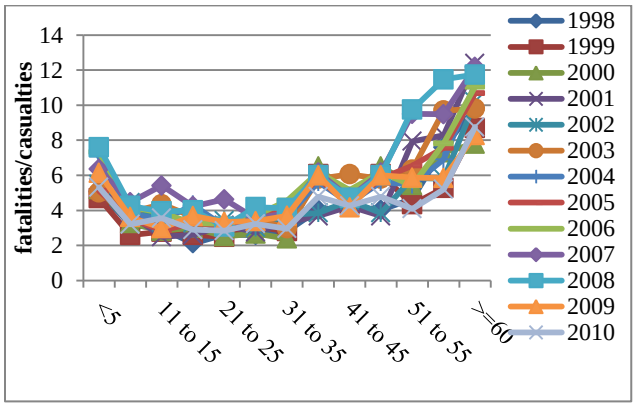

Fig. 11. Total Fatalities/Total Casualties versus Age Groups over the Study Period (1998-2010).

XI. Analysis of Traffic Accidents by Speed Limits

Figure (12) shows the numbers of traffic accidents by speed limits for the study period excluding the two years (1998 and 2008) due to problems with their speed limit data. It can be seen that the majority of traffic accidents have occurred at the lowest speed limit of ≤ 50 km/hour and the trend is decreasing as the speed limit increases. This high contribution of roads with low speed limits in traffic accident occurrence may be referred to the fact that most of the low speed limit roads are located in urban areas with high potential for traffic conflicts and pedestrians presence.

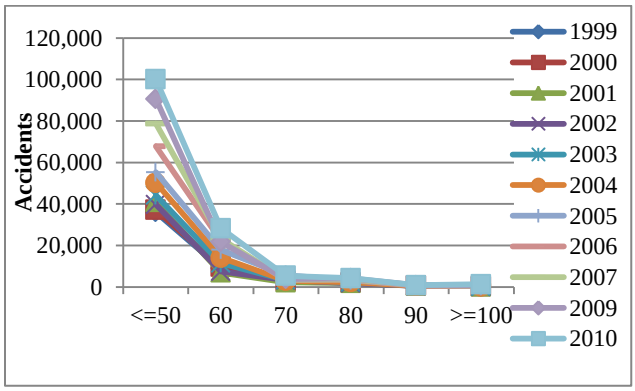

Fig. 12. Numbers of accidents by Speed Limit (1999-2010).

XII. Analysis of Traffic Accidents by Time, Day, and Month

By dividing the day into eight time intervals, Figure 13 shows that the largest numbers of traffic accidents have occurred during the time period (12-14:59) followed by the time period (15-17:59). This may be referred to the fact that schools and most of the public and private agencies end their working hours during these times. This is consistent with some other countries like USA where most of the fatal accidents occurred during the time period from 3 to 6 PM (end of the work day), [13]. It was also found that the largest numbers of collision accidents have occurred during the time period (12-14:59) and (15-17:59) with an increasing trend over the study period. Furthermore, most of the fatalities are concentrated between (9AM-20:59 PM) and tend to show no remarkable trend over the study period.

By calculating the severity level (number of casualties/number of accidents), it was found that the highest severity level is amongst the group (3-5:59 AM) with a decreasing trend for all time intervals over the study period as shown in Figure 14.

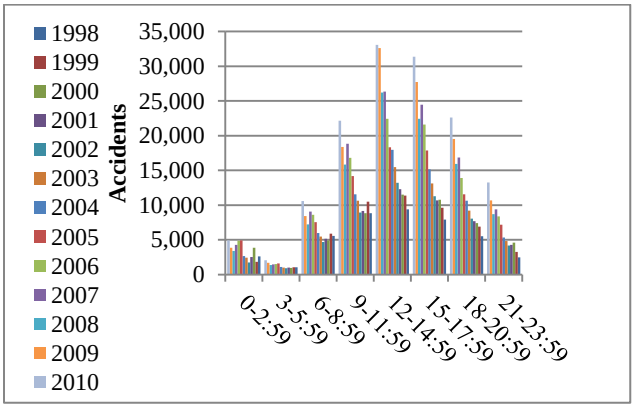

Fig. 13. Numbers of Traffic Accidents by Time over the Study Period (1998-2010).

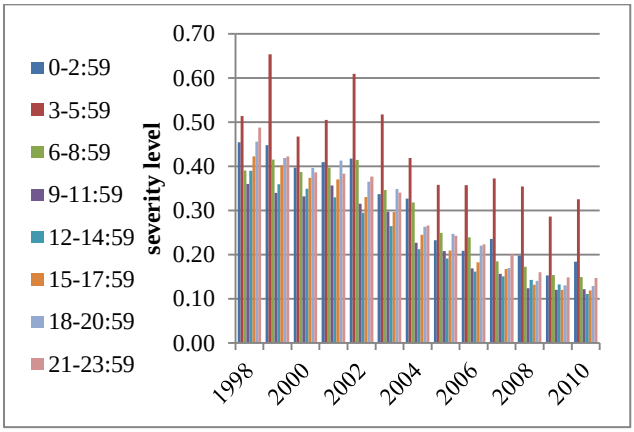

Fig. 14. Traffic Accidents Severity Level by Time Interval over the Study Period (1998-2010).

Figure (15) shows that the largest numbers of traffic accidents have occurred on Thursdays, followed by Sundays which represent the last and first working days respectively in Jordan

and have more mobility than other working days as many Jordanians work in the major Cities and spend their weekends with their families at their hometowns. This trend is close to that in USA where most of fatal accidents occur in Saturdays followed by Fridays which represents the end of the week in US were many outdoor activates took place at these days [13].

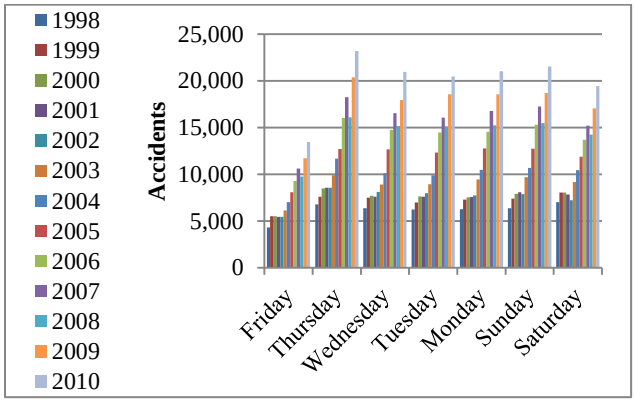

Fig.15. Traffic Accidents by Days over the Study Period (1998-2010).

Severity levels were calculated for different days of the week over the study period as shown in Figure (16), and it was found that Friday has the largest severity levels as compared to other days of the week although it is the national holyday in Jordan with the lowest average daily traffic volumes. This is due to the high proportion of non-commuter traffic on Fridays as many Jordanians tend to have more outdoor activities and travel for tourism purposes. Further analysis was conducted for traffic accidents by the months of the year over the study period and it was noticed that the largest numbers of traffic accidents have occurred during summer months with the highest during the month of August. This is due to the more non commuter trips that take place during summer by Jordanian expatriates who work outside Jordan and spend their vacations in Jordan, in addition to the visitors from neighboring countries who visit Jordan for tourism purposes.

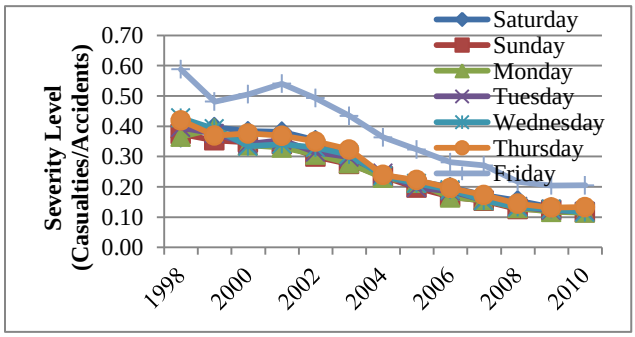

Fig. 16. Severity Levels by Days over the Study Period (1998-2010).

XIII. Analysis of Traffic Accidents by Weather and Pavement Surface Conditions

Traffic accidents reports classify weather conditions that are more common in Jordan into six categories including clear, rain, fog, snow, dust, and high wind. By investigating the distribution of traffic accidents over these weather conditions during the study period (1998-2010), it was noticed that most of the traffic accidents (95.3%) have occurred during clear weather conditions which refers to the fact that more mobility occurs during clear weather condition. Furthermore, it was found that most of the traffic accidents (94.1%) have occurred on dry pavement surface condition, while the highest severity levels have occurred on oily and sandy pavement surface conditions.

XIV. Modeling Traffic Accidents and Fatalities with Motorization Level

As presented in the previous sections of this paper, the number of traffic accidents has increased during the study period from 43,343 in 1998 to 140,014 in 2010. Also, the motorization level has increased during the same period from 81.8 in 1998 to 176 in 2010. Table I presents the data for the population, number of registered vehicles, traffic accidents (numbers, fatalities, and injuries), motorization level, the ratio of fatalities to the number of registered vehicles (F/V), and the severity level over the study period.

XV. Modeling Traffic Accidents with Motorization Level

Figure (4) has shown the development of the motorization level (number of registered vehicles /1000 population) over the study period, which has increased from 82 vehicle/1000 population in the year 1998 to 176 vehicle/1000 population in the year 2010 with an increment of 114.6%. By modeling this relationship using regression analysis and trying different types of models, the following power model was developed (with $R^2 = 0.97$ and 99% significance level: N = 13, F = 370, SE = 1517):

$$ACC = 56.47M^{1.51} \quad (1)$$

Where:

ACC = number of traffic accidents per year

M = motorization level (number of registered vehicles/1000 population).

TABLE I
TRAFFIC ACCIDENT MOTORIZATION DATA OVER THE STUDY PERIOD

Year	Popul. X 1000	Regist. Vehicles	Traffic Accidents		
			Numbers	Fatalities	Injuries
1998	4,755.8	389,196	43,343	612	17,177
1999	4,900	418,433	50,330	676	19,015
2000	5,039	473,339	52,796	686	18,842
2001	5,182	509,832	52,662	783	18,832
2002	5,329	542,812	52,913	758	17,381
2003	5,480	571,498	62,115	832	18,368
2004	5,350	612,330	70,266	818	16,727
2005	5,473	679,731	83,129	790	17,579
2006	5,600	755,477	98,055	899	18,019
2007	5,723	841,933	110,630	992	17,969
2008	5,850	905,592	101,066	740	13,913
2009	5,980	994,753	122,793	676	15,662
2010	6,113	1,075,453	140,014	670	17,403

Table I cont.

Year	Motor. level	F/V	Severity Level
1998	81.8	1.572	0.410
1999	85.4	1.616	0.391
2000	93.9	1.449	0.370
2001	98.4	1.536	0.372
2002	101.9	1.396	0.343
2003	104.3	1.456	0.309
2004	114.5	1.336	0.250
2005	124.2	1.162	0.221
2006	134.9	1.190	0.193
2007	147.1	1.178	0.171
2008	154.8	0.817	0.145
2009	166.3	0.680	0.133
2010	175.9	0.623	0.129

XVI. MODELING TRAFFIC ACCIDENTS FATALITIES WITH MOTORIZATION LEVEL

Another Model was developed to predict the traffic accidents fatalities per year with motorization level, where a power model was only good for the period from 1998 to 2007. The model was not good when the entire range of the study period was considered as traffic accidents fatalities have decreased during the period from 1998 to 2010 as compared to the year 2007. Therefore, polynomial model was used to better predict this relationship considering the entire range of the study period (with R^2 = 0.68, N = 13, F =23, SE = 16.6):

$$F = -9.109M^2 + 28.47M - 987.9 \quad (2)$$

Where:

F = traffic accidents fatalities per year
M = motorization level

A better model was developed to predict traffic accidents fatalities per year per number of registered vehicles (in thousands) with motorization level (R^2 = 0.87, N = 13, F =70.1, SE = 0.038):

$$F/V = 287.65M^{1.15} \quad (3)$$

Model 3 is preferred over model 2 as it has higher R^2 value with higher F value and lower SE value. This is in agreement with the findings of other studies [9, 14].

XVII. CONCLUSIONS

Based on the investigated traffic accidents data over the study period 1998-2010, the following conclusions can be drawn:

1. The numbers of traffic accidents have increased over the study period (1998-2010) with a total increment of 223% as a result of increased population, auto ownership, and motorization level (registered vehicles/1000 population).
2. Analysis of traffic accident types over the study period showed that an average of 88% were of collision type with an increasing trend, 6.3 % were of pedestrian type with a decreasing trend, and 2.7 % were of turn over type with a decreasing trend.
3. The severity level for traffic accidents (number of casualties/ number of accidents) showed a decreasing trend over the study period.
4. The number of fatal traffic accidents showed an increasing trend until 2007 and then started decreasing.
5. The number of fatalities/10,000 registered vehicles showed a decreasing trend, while the number of fatalities/100,000 population showed an increasing trend until 2007 and then started decreasing.
6. The young age group of 21-30 years old had the highest involvement in traffic accidents casualties.
7. The highest rates of Fatalities/Casualties were for the elders (> 50 years old) and kids (0-5 years old) age groups.
8. The majority of traffic accidents have occurred at the lowest speed limit of ≤ 50 km/hour and the trend is decreasing as the speed limit increases.
9. The majority of traffic accidents have occurred during the time period 12:00 – 5:00 PM, with the highest severity levels during the time period (3:00 - 6:00 AM).
10. The largest numbers of traffic accidents have occurred on Sundays and Thursdays (the first and last working days in Jordan), while Friday (the national holyday) had the highest severity level.

11. The largest numbers of traffic accidents have occurred during the summer months with the highest during the month of August.
12. Most of the traffic accidents have occurred during clear weather with dry pavement surface conditions, while the highest severity levels have occurred on oily and sandy pavement surface conditions.
13. Good regression models were developed to predict the number of traffic accidents per year and the number of traffic accidents fatalities per year per registered vehicles as a function of the motorization level.

Further research is recommended to include data from other similar developing countries to get more international results. This study results may be updated by the most recent traffic accidents data in Jordan, such that more accurate accidents prediction models may be developed. Jordan should benefit from the results of this study to adopt more efficient strategies, policies, and measures to improve the overall traffic safety in the country.

REFERENCES

[1] WHO (2013) "Global status report on road safety 2013: supporting a decade of action" Geneva, World Health Organization.

[2] Worley, H. Road Traffic Accidents Increase Dramatically Worldwide. Available on the internet on March 2006 from: http://www.prb.org/Articles/2006/RoadTrafficAccidentsIncreaseDramaticallyWorldwide.aspx

[3] Peden, M. (2004) "World Report on Road Traffic Injury Prevention" Geneva, World Health Organization.

[4] Al-Masaeid, H., Al-Mashakbeh, A. and A. Qudah (1999) "Economic Costs of Traffic Accidents in Jordan" Accident Analysis and Prevention, Volume 31, July, pp. 347-357.

[5] Yearly traffic accidents reports (1998-2010) published by the Jordanian Traffic Institute.

[6] Ghuzlan, K., Al-Khateeb, G., and M. Hadad, "Evaluation of 2008 Traffic Safety Policies in Jordan", Jordan Journal of Civil Engineering, Volume 6, No. 1, 2012, pp 122-133.

[7] Al-Omari, B. "Characteristics of Pedestrian Accidents in Jordan" Proceeding of the Conference "Safety on Roads: International Conference" Bahrain, October 2002.

[8] Al-Omari, B. and I. Obiedat "analysis of Pedestrian Accidents in Irbid City, Jordan" Proceeding of the International Conference on Sustainable Development of Transportation Systems", Amman, Jordan, April 2004.

[9] Al-Masaeid, H. "Traffic Accidents in Jordan", Jordan Journal of Civil Engineering, Volume3, NO.4, 2009.

[10] Al-Khateeb, G. "Analysis of Accidents Data and Evaluation of Leading Causes for Traffic Accidents in Jordan", Jordan Journal of Civil Engineering, Volume 4, NO.2, 2010.

[11] Hasan, H. 2012. Traffic Accidents Trends and Characteristics in Jordan from 1998 to 2010. Graduation Project at the Civil Engineering Department, Jordan University of Science & Technology, Irbid – Jordan.

[12] Ghazi Al-Khateeb and Taisir S. Khedaywi, "Comparison of Traffic Accidents between Jordan and Other World Countries", International Traffic Safety Conference, Amman, Jordan. September 2012.

[13] U.S. Department of Transportation, National Highway Traffic Safety Administration, National Center for Statistics and Analysis, Fatality Analysis Reporting, April 2012. http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/index.html.

[14] Smeed, R.J. and Jeffcoate, G.O. 1970. Effect of Changes in Motorization in Various Countries on the Number of Road Fatalities. Traffic Engineering and Control, 12: 150-151. Smeed, R.J. and Jeffcoate, G.O. 1970. Effect of Changes in Motorization in Various Countries on the Number of Road Fatalities. Traffic Engineering and Control, 12: 150-151.