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Study of Driver Faults and Type of Intersection Contributing to Traffic Accident in Jordan

Osama Albdour [1] and Mohammad N. Marafi [2]

[1] Civil Engineering Department, Jordan University, Jordan

[2] Civil Engineering Department, Tafilah Technical University, Jordan

Abstract

This paper present a study for the driver faults and intersection type contributing to traffic accidents in Jordan, driver faults is the main factors that led to traffic accident, then environment factors and the last one is vehicle factor, data was collected from Jordan traffic institute, for driver faults data from 2009 to 2012, and for intersection type from 2004 to 2006, due to available data, statistical tables are introduced to perform data analysis, using SPSS software a statistical model was developed for the driver faults with fatality, slight and sever injury, the model for fatality was Y1 = 1.1483 X3 + 402.365, where Y1 is the total fatality number for all driver faults except those from other faults and X3 : is the fatality number for using incorrect lane, with coefficient of correlation value R^2 equal to 0.890,a suggested solution to decrease traffic accident and its result of fatality and injury, Drivers must be appropriately trained before licensing to operate their vehicles safely and Increase traffic education in schools and university.

Keywords: Accidents severity, contributing factor, regression model, counter-measure

Introduction

Safety is the main goal for highway and traffic engineers that should be provided for drivers, road users and pedestrians. Road traffic accidents with their end results of

fatalities and injuries are significantly related to safety on highways. One of the key measures of safety on a highway is the number of traffic accidents occurring on it. Consequently, records and statistics of traffic accidents should be available at traffic departments and agencies in each country for the country's highway network.

Road traffic accidents get plenty of local attention where and when they occur, especially when they involve fatalities or injuries. Traffic accidents are considered obvious reminders of the harm which vehicles and their users can cause any time when there is a tragedy.

Globally, traffic accidents on roads are influential. Traffic fatalities and injuries resulting from road accidents are so high worldwide. According to the most recent estimates, road traffic accidents kill 1.2 million victims worldwide and injure 50 million each year. Ninety percent of them occur in developing countries, and more than half of all victims globally are between the ages of 15 and 44. In addition to human suffering which traffic accidents cause, they result in considerable additional costs to societies. This global loss has enormous implications for the security of families. Estimates show that road traffic injuries cost nations as much as two percent of their gross national product

Jordan is located in the heart of the Middle East, has a total area of about 89 sq. Km and population of about 6 million with a gross domestic product of about $20.4 billion in2008. The number of vehicles increased from 473339 in 2000 to 994753 in 2009 when the vehicle ownership reached 166 veh./1000 person. This large increase in the number of vehicles without significant change or development in the present traffic system led to high increase in traffic accidents.

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 and increased to US$ 440 million in 2010 Therefore, this problem is taken seriously by the governmental authorities that are concerned with traffic and road safety.

Literature Review

This section covers selected papers about analysis of traffic accident, analysis of accidents in Jordan, and an analysis of factors contributing to traffic accidents:

Al-balbissi and Zahrawi (1987) have investigated the impact of lighting on traffic safety in Irbid city and found that the streets with little or no illumination were found to have substantially higher (poorer) night-day accident ratios than the average for all streets in the same roadway functional classification and type of abutting land use. The type of abutting land use appeared to be more of a factor in accident illumination relation than the type of street. It was also found that pressure sodium lamp appears to be most favorable than mercury clear lamp for both economic and safety point of view. Priority for systematically upgrading illumination of major and collector streets in Irbid to minimize night time accidents was established.

Retting et al. (1999) reported that about 40% of motor vehicle accidents in US are at intersections or are deemed intersection-related. During their study period, fatal crashes at traffic signals increased 19%, whereas the number of all other fatal crashes increased 6%. They found that the main factor contributing to multiple-vehicle crashes at intersections, as well as those involving pedestrians, is non-compliance with traffic control devices, such as stop signs and traffic signals. In their study of a sample of intersections in British

Koushki et al. (2001) have analyzed pedestrian accidents in Kuwait for three years (1996 – 1998), based on random sampling of 443 pedestrian injury/fatality road accidents. The majority of victims were male. Most frequent accidents occurred at night and in the morning. High speed was cited as the cause in the largest percentage of pedestrian fatalities, and the use of mobiles and reckless driving were the second and the third.

Choueiri et al. (2002) realized after comparing many traffic accidents in different countries that traffic accidents are mainly by: roads are not proper, drivers attitude and behavior is not appreciable, pedestrian alertness is not notable, obstructions on the road (vegetable carts), unauthorized parking. And also it was found that traffic situation is getting even worse due to: lack of coordination, lack of definite national policies and strategies, poor public awareness of the extent of the problem, insufficient traffic safety training, and non-existence of deterrent legislation severe penalties for traffic offenders.

Al Ghamdi (2003) found that among the major causes for severe accidents, excess speed ranked first, followed by driving the wrong way and failing to yield. On the other hand, the major causes for Property Damage Only (PDO) accidents are failing to yield, excessive speed and following too closely.

Al-Suleiman.T et al. reported that According to the statistics of (Jordan traffic institute 2004), it was found that 70,266 traffic accidents occurred during the year of 2004, which have resulted in 818 fatalities, 2451 sever injuries and 14,276 slight injuries. Roundabouts involved during the same year in 663 traffic accidents (0.94% of total traffic accidents and 17% of traffic accidents at intersections) with one fatality, 34 slight injuries and 2 sever injuries. The results of this study indicated a remarkable reduction in accident severity at roundabouts locations. 92.87% of the accidents were classified as property damage only, 7.09%injury and only 0.04% fatality accidents. The reduction in accident severity comes from the unique shape of roundabouts, which forces drivers to slow their speeds to merge with circulating traffic. Also, severity reductions come from the reduction of conflicting points of vehicles at roundabouts, where the traffic circulates around the central island. The most common driver faults were not giving priority for vehicles at roundabouts (58.78%), close following (9.13%), failure in changing lane (8.90%) and wrong stopping (6.53%). Other types of faults included not following traffic regulation or traffic signals and not taking care during merging.
Koushki, and Deaiji (2005) observed and recorded the violation behavior of a sample of 1000 drivers during random daily trips in Kuwait and they concluded that there is a high frequency of traffic violations by all drivers. Younger drivers, and Kuwaitis, violated the regulations of traffic more (with statistical significance) than older drivers, and non- Kuwaiti nationals, as was expected. No statistically significant difference in the mean number of violations however, was found to exist between the sample male and female drivers.

The National Center for Statistics and Analysis (USA) (2008) reported that speeding is one of the most prevalent factors contributing to traffic crashes. And the economic cost to society of speeding-related crashes is estimated by NHTSA to be $40.4 billion per year. In 2007, speeding was a contributing factor in 31% of all fatal crashes, and 13,040 lives were lost in speeding-related crashes. The report announced that motor vehicle crashes cost society an estimated $7,300 per second. In 2000, the cost of speeding-related crashes was estimated to be $40.4 billion — $76,865 per minute or $1,281 per second. Also the center showed that speeding

reduces driver's ability to steer safely around curves or objects in the roadway, extends the distance necessary to stop a vehicle, and increases the distance a vehicle travels while the driver reacts to a dangerous situation.

Al-Khateeb, G (2010) 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.

Significance and Objectives of the Research

The costs of road traffic accidents in Jordan were estimated to be about JD 267 million (us$ 378) in the year 2012 according to Jordan traffic institute. The financial, economical, cultural and sociological losses associated with traffic accidents increases the engineering responsibility to conduct studies to have a better understanding of the causes and find the solutions. The main objectives of this study are:

1. To identify and describe driver faults and type of intersection contributing to traffic accident in Jordan

2. To identify the highest driver faults that led to highest traffic accident, and the type of intersection led to highest traffic accident

3. Suggest a suitable solution to minimize the accident rate for the major driver and intersection type led to accident

4. To develop models relating the traffic accident to driver faults and intersection type.

Methodology

The process started by collecting the traffic accidents data caused by driver faults from 2009 to 2012 and for intersection type from 2004 to 2006 a from Jordan traffic institute. Analysis was made to the data by define the main driver faults and the intersection type and then for each fault and intersection type identify how many accidents, fatalities, and injures occurred. Statistical graph will be used to represent these data for all driver faults and intersection type, then using SPSS software a statistical model for driver faults for fatality, slight injury, and for severe injury will be developed, and also for intersection type.

Data Collection and Analysis

The following tables represent the data that was collected for driver faults and intersection type contributing to traffic accidents in Jordan.

Table 1.1: Traffic accidents and Casualties by Drivers Faults 2009.

Drivers Faults	No. Faults	Fatality	Slight Injury	Sever Injury
Tail Gating	27211	9	984	51
Not taking the necessary precautions while driving	25894	222	3484	512
Using Incorrect Lane	25847	227	4134	544
Priorities false	18413	34	1888	116
Reversing Incorrect	15171	22	231	16
Failing to Comply with Obligatory sings	4403	20	594	24
Speed Limit Exceeding	2620	63	735	80
Loss of Control While Driving	1956	22	521	78
Incorrect Bending and Turning	2482	47	948	139
Disregarding A Traffic Light Signal	667	7	434	36
Driving Opposite To Traffic Direction	234	3	70	5
Priority to Disallowing Pedestrian	155	11	130	13
Others	3992	103	1306	184

Table 1.2: Traffic accidents and Casualties by Drivers Faults 2010

Drivers Faults	No. Faults	Fatality	Slight Injury	Sever Injury
Tail Gating	30720	4	1070	90
Not taking the necessary precautions while driving	29761	224	4315	1066
Using Incorrect Lane	25417	269	4406	1016
Priorities false	21137	31	1945	302
Reversing Incorrect	17692	23	282	40
Failing to Comply with Obligatory sings	3637	2	173	7
Speed Limit Exceeding	2125	66	777	131
Loss of Control While Driving	2145	30	467	107
Incorrect Bending and Turning	3478	43	812	141
Disregarding A Traffic Light Signal	636	5	463	34
Driving Opposite To Traffic Direction	225	9	48	30
Priority to Disallowing Pedestrian	132	6	45	15
Others	6209	53	1666	282

Table 1.3: Traffic accidents and Casualties by Drivers Faults 2011.

Drivers Faults	No. Faults	Fatality	Slight Injury	Sever Injury
Tail Gating	33041	9	1175	84
Not taking the necessary precautions while driving	33328	220	4337	824
Using Incorrect Lane	26019	254	4762	843
Priorities false	21757	37	1991	192
Reversing Incorrect	19735	18	299	43
Failing to Comply with Obligatory sings	4537	9	388	29
Speed Limit Exceeding	2915	47	509	101
Loss of Control While Driving	2249	20	463	87
Incorrect Bending and Turning	4268	40	713	118
Disregarding A Traffic Light Signal	754	5	500	32
Driving Opposite To Traffic Direction	241	4	63	18
Priority to Disallowing Pedestrian	152	1	12	1
Others	6693	101	1683	206

Table 1.4: Traffic accidents and Casualties by Drivers Faults 2012

Drivers Faults	No. Faults	Fatality	Slight Injury	Sever Injury
Tail Gating	23553	8	1412	93
Not taking the necessary precautions while driving	29044	270	4667	709
Using Incorrect Lane	19892	384	4659	735
Priorities false	18544	29	1995	145
Reversing Incorrect	11163	14	272	25
Failing to Comply with Obligatory sings	2901	0	134	13
Speed Limit Exceeding	2557	47	311	36
Loss of Control While Driving	1971	38	440	108
Incorrect Bending and Turning	3054	42	615	85
Disregarding A Traffic Light Signal	859	4	545	32
Driving Opposite To Traffic Direction	225	9	87	11
Priority to Disallowing Pedestrian	165	3	35	21
Others	2511	23	328	45

Table 1.5: Casualties by Intersection Type 2004

Intersection Type	Accidents	Fatalities	Slight Injuries	Sever Injuries
Not on an Intersection	66397	813	13824	2419
Intersection+	1876	3	318	13
T Junction	1275	1	97	17
Y Junction	62	0	2	0
Round about	663	1	34	2
multi leg junction	8	0	1	0
Total	70266	818	14276	2451

Table 1.6: Casualties by Intersection Type 2005

Intersection Type	Accidents	Fatalities	Slight Injuries	Sever Injuries
Not on an Intersection	80786	777	14651	2580
Intersection+	1274	8	214	13
T Junction	622	3	59	0
Y Junction	107	2	43	4
Round about	333	0	7	1
multi leg junction	7	0	7	0
Total	83129	790	14981	2598

Table 1.7 Casualties by Intersection Type 2006

Intersection Type	Accidents	Fatalities	Slight Injuries	Sever Injuries
Not on an Intersection	94750	893	14638	2918
Intersection+	1486	1	283	14
T Junction	1287	4	116	7
Y Junction	74	1	17	1
Round about	452	0	24	1
multi leg junction	6	0	0	0
Total	98055	899	15078	2941

Results and Analysis

The analysis of data was made by using SPSS software, for the driver faults part all of driver faults are taking in consideration except the other fault was not taking in consideration because it does not identify the driver fault enough it's just general category, by define each fault as independent variables taking variable from X1 to X12 and the following statistical models was developed.

Driver fault	X value	Driver fault	X value
Tail Gating	X1	**Speed Limit Exceeding**	X7
Not taking the necessary precautions while driving	X2	**Loss of Control While Driving**	X8
Using Incorrect Lane	X3	**Incorrect Bending and Turning**	X9
Priorities false	X4	**Disregarding A Traffic Light Signal**	X10
Reversing Incorrect	X5	**Driving Opposite To Traffic Direction**	X11
Failing to Comply with Obligatory sings	X6	**Priority to Disallowing Pedestrian**	X12

1. Regression Models between the Total Number of fatality per year Y_1 and the Independent Variables (Driver Fault) as follow:

Model No.	**Regression Model**	**Adjusted R^2**
1	Y1 = 1.1483 X3 + 402.365	0.890

Where:
Y_1: is the total fatality number for all driver faults.
X_3: is the fatality number for using incorrect lane.

Model validation:

For the year 2013 the total fatality number was 768, and by using the model the number of fatality equal:
Y_1= 1.1483 * 305 + 402.365 = 753 fatality which is close to the real number768

2. Regression Models between the Total Number of slight injury per year Y_2 and the Independent Variables (Driver Fault) as follow:

Model No.	Regression Model	Adjusted R^2
2	$Y_2 = 0.909X_2 + 11014.688$	0.811

Where:
Y_2: is the total number of slight injury for all driver faults.
X_2: is the slight injury number for not taking the necessary precautions while driving

Model validation:

For the year 2013 the total slight injury was 15954, and by using the model the number of slight injury equal:
$Y_2 = 0.909 \times 4587 + 11014.688 = 15184$ which is close to the real number15954 and this model is a fair model with R^2 of 0.811

3. Regression Models between the Total Number of severe injury per year $Y_3$and the Independent Variables (Driver Fault) as follow:

Model No.	Regression Model	Adjusted R^2
3	$Y_3 = 2.903\ X3 - 33.262$	0.973

Where:
Y_3: is the total number of severe injury for all driver faults
X_3: is the severe injury number for using incorrect lane.

Model validation:

For the year 2013 the total severe injury was 2258, and by using the model the number of the severe injury equal:

Y_3 = 2.903 x 815 - 33.262= 2333 which is close to the real number 2258 and this model is a strong model with R^2 of 0.973

Summary and Conclusions

Traffic accident happen as a result of the following factors: human factors, vehicle factors, environment factors, human factors are the biggest factors followed by environment factors with and vehicle factors. The main human factors Tail Gating, Not taking the necessary precautions while driving, Using Incorrect Lane, Priorities false, and Reversing Incorrect**.**

Number of accidents has increased five old-fold between 1995 and 2009 reaching 122,793 in 2009 with an estimated cost of JOD 336 million (equivalent to about $504 million),and the number of vehicles increased from 473339 in 2000 to 994753 in 2009 when the vehicle ownership reached 166 veh./1000 person. This large increase in the number of vehicles without significant change or development in the present traffic system led to high increase in traffic accidents.

The major traffic accidents in Jordan occurred at street not on an Intersection, so that fatality and injury as a result are highest for street not on an Intersection

The highest accident ,fatality, slight, sever injury number occurred on the four leg "+" and T intersection false with an average number of 1545,1061 accident per year respectively, 4,3 fatality per year respectively, 272, 91 slight injury per year respectively, and 13, 8 sever injury per year respectively.

The models results for fatality number explained that the Using Incorrect Lane for driver faults show a correlation value R^2 equal to 0.890, which is a good correlation value that relate fatality number with using incorrect lane.

General Recommendations

- Drivers must be appropriately trained before licensing to operate their vehicles safely.

- As data show, the driver faults is the main factors contributing to traffic accident, so the government mostly ministry of education in Jordan should Increase traffic education in schools and university.

- Concentrate in the driving test on both the written and applicable part.

- As data show also, there are a high number for traffic violation, like Using Incorrect Lane Priorities false, Reversing Incorrect, Speed Limit Exceeding Driving Opposite To Traffic Direction, so increasing the penalty for traffic violation is should be taking in consideration.

- Speed is one the main contributor and the most devastating factor of fatal traffic accidents, so police enforcement and traffic calming measures are urgently needed.

- For the intersection, Maintenance of traffic signs and removing the obstacles that obscure vision, also provide traffic calming measurement at the entrance of the intersection are very important for reducing traffic accidents.

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