

# Analyze of Slight & Sever Injury Resulted from Traffic Accidents in Jordan: Applied Statistics Study

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## Abstract

This study aims at show the size of the injuries , both slight and sever caused by traffic accidents on the roads in Jordan for the year 2014, and show the relationship of both slight and sever injuries caused by traffic accidents with the study variables used in this paper performed using the (SPSS). Based on the analysis made, the following are the main results:

There is statistical significant relationship between type of injury (slight, sever) and accident type, time, month, governorate, light condition, age group, speed limit at (0.05) level.

There is no statistical significant relationship between type of injury (slight, sever) and weekdays, territory, weather condition, gender.

This work has been carried out during sabbatical leave granted to the author (Adeeb A AL Rahamneh) from AL Balq'a Applied University (BAU) during the academic year(1/2/2015-1/2/2016).

**Keywords:** traffic accidents, slight injury, sever injury, accident type, time, governorate, light condition, age group, speed limit, weather condition

## 1. Introduction

The traffic accidents is considered of the most important and the most sever problems facing societies around the world, where it consumes a considerable amount of human and material resources. The statistics issued by the World Health Organization suggest that the world loses annually approximately 1.2 million people, are infected annually (20-50) million person in the world because of traffic accidents, as well as high material costs resulting from these accidents is estimated at 518 billion US dollars for all countries of the world and what constitutes (1%-3%) of the gross domestic product around the world.

Many countries of the world have come to the need to develop strategies and national mechanisms to address the safety challenges of traffic associated with many of the related sectors and bodies. The World Health Organization considered traffic accidents of the most important causes of death. The governments of the world appealed to deal with it, and that man has succeeded in eliminating many of diseases and epidemics and tempered the intensity and severity of these epidemics and diseases that kill humans, but he replaced them with traffic accidents.

In Jordan, one of the developing countries is suffering as the rest of the world from the scourge and secretions of this problem which has become an insurmountable problem; and this problem acquired a great interest from the Jordanian governments. The number of traffic accidents in Jordan for the year 2014, was (102441), of which (69395) traffic accidents is equivalent to (68%) in the capital, Amman alone, and resulted (688) deaths, including 193 deaths, equivalent to (28.05%) in the capital, Amman, alone and injured (14790) person, including (5689) injury which is equivalent to (38.47%) in the capital, Amman, distributed to (2063) sever injury and (12727) slight injury, including (698) sever injury which is equivalent to (33.83%) and (4991), slight injury which is equivalent to (39.22 %) in the capital Amman. The material costs for the whole of these incidents amounted to 239 million Jordanian dinars and equivalent (approximately 337) million US Dollars.

Jordan is a popular destination for many visitors and Summer vacationist from the world, whether from Arab countries or from foreign countries due to its security grace and stability , as well as laws governing and

legislation that encourage investment in Jordan , as well as a mild climate and strategic location. As a result of the continuing increase in the number of vehicles , as well as rapid population growth , the problem of traffic accidents have become a problem threatening the security and safety of the Jordanian society, and began to pose a sever consuming of the human and material energies, which adversely affects Jordan 's efforts in development and construction.

We will study both slight and sever injuries resulting from traffic accidents in Jordan for the year 2012 and its relationship with the following variables i:

### *1.1 The Research Problem*

The research problem lies in the growing and huge numbers of both slight and sever injuries caused by traffic accidents on the roads in Jordan, and the consequent consuming of enormous material resources represented by the huge material costs, as well as attrition obviously in human energies and tragedies of the secretions injuries represented by the loss of parents, despite of procedures of the relevant authorities.

### *1.2 The Research Objectives*

This research aims to:

- 1) Show the size of the injuries, both slight and sever caused by traffic accidents on the roads in Jordan for the year 2014.
- 2) Show the relationship of both slight and sever injuries caused by traffic accidents with the study variables using appropriate statistical methods.
- 3) Study variations in, both slight and sever injuries according to the study variables.
- 4) Contribute finding the best and most effective solutions to minimize the severness of the problem.

### *1.3 The Justification of the Study*

The aggravate of the size of the both slight and sever injuries caused by traffic accidents on the roads in Jordan for the year 2014, and the negative effects and consequences of this problem on the foreign currency assets and the Jordanian economy as a whole.

The need for more in-depth studies to examine the problem in all its aspects.

To acknowledge the size and causes of the problem in order to provide a sufficient indication of the magnitude and severness of the, both slight and sever injuries caused by traffic accidents .

The high financial cost of both slight and sever injuries caused by traffic accidents.

### *1.4 Methodology*

The descriptive statistics method represented by percentages and graphs is used, as well as the use of advanced statistical methods such as:

- I) Two-way Anova.
- II) Chi-Square Test.

### *1.5 Time Limits*

Both slight and sever injuries, caused by traffic accidents on the roads in Jordan for the year 2014 , the latest available data to date, will be analyzed .

### *1.6 Spatial Limits*

Both slight and sever injuries caused by traffic accidents on the roads in Jordan within the geographical border of the Jordanian Hashemite Kingdom border will be analyzed.

### *1.7 The Procedural Definitions*

The operation definition of the major concepts (Traffic Accident, Slight Injury, Sever Injury) derived from definitions in (<http://www.jti.jo>)

## **2. Previous Studies**

Deven Lefler and Hampton Gabler (2014). This Article investigated the effect of striking vehicle type on pedestrian fatalities and injuries. The paper presents and compares pedestrian impact risk factors for sport utility vehicles, pickup trucks, vans, and cars as developed from analyses of US accident statistics. The analysis revealed that given an impact speed, the probability of serious head and thoracic injury is substantially greater when the striking vehicle is an LTV rather than a car.

Hu and Xiang (2012). This paper explored the characteristics of traffic accidents on rural roads by quantitative analysis in terms of accident forms, road alignment, roadside protection, intersection types, regional economic situation, accident time, and vehicle features. The results showed that traffic accidents on rural roads were prone to the developed area. Driving without license and head-on collisions were overwhelmingly dominant Accident related casualties and vehicles including agricultural vehicle and motorcycle are local.

Li, Hu, and Cao (2012). This paper dealt with certain accident impact factors are often hidden in statistical models due to over-dispersion of traffic accident data. Using 7-year data from grievous accidents in China, this paper carried out a simulated calculation of the proposed model.

The empirical results show that compared to a fixed-parameters NB regression model, random-parameters models are quite enough to characterize the uncertainty of the accident and can greatly improve the validity of the empirical results.

Zhang, Yao, and Li, (2012). This paper first treats the overall situation of road traffic accidents, then goes further to analyze the intrinsic interdependence among four different lighting conditions and respective traffic accidents.

Ma, and Zhang et al. (2011). This paper applied a biochemical factorial experiment method to traffic accidents' inducement analysis, and describes the processes of modeling and data processing in detail.

Li (2011). In this paper, as an example to Harbin, choosing some road sections to observe continuously, based on the urban-rural continuum road conditions and traffic characteristics, using of engineering psychology and accident catastrophe theory, with the main effects of traffic accidents, to ensure the impact of the drivers workload in the road traffic accidents in central cities rural-urban continuum.

Hallvard Gjerde, et al. (2011). This research dealt with drivers fatally injured in road traffic accidents in southeastern Norway during the period 2003-2008. As controls, 10540 drivers selected in a roadside survey in the same geographical area during 2005-2006 were used. Blood samples were collected from the cases and oral fluid (saliva) samples from the controls. Samples were analyzed for alcohol, amphetamines, cannabis, cocaine, opioid analgesics, hypnotics, sedatives and a muscle relaxant; altogether 22 psychoactive substances. concentrations for blood and oral fluid were used. The risk for fatal injury in a road traffic accident was estimated using logistic regression adjusting for gender, age, season of the year, and time of the week.

Golob, and Recker (2003). This paper dealt with how the types of accidents that occur on heavily used freeways in Southern California are related both to the flow of traffic and to weather and ambient lighting conditions. The results indicate that the type of collision is strongly related to median traffic speed and to temporal variations in speed in the left and interior lanes.

Sandvik et al. (2000). The aim of this study was to develop a valid epidemiological instrument (a severity index) for assessing the severity of incontinence. The severity index is based on information about frequency (four levels) and amount of leakage (two or three levels). By multiplication, an index value (1-8 or 1-12) is reached. This index value is further categorized into a severity index of three or four levels. The index was compared with the results of 315 pad-weighing tests performed by 265 women in hospital and general practice. Data from an epidemiological survey were also re-analyzed by applying the four-level severity index.

Mary Tinetti et al. (1995). This research determined the frequency of, and risk factors for, experiencing serious fall injury events among older persons in the community. A representative sample of 1103 community-living persons aged 72 years and older underwent comprehensive baseline and 1-year evaluations. During a median 31 months of follow-up, fall data were obtained using fall calendars. Injury data were obtained from telephone interviews and from surveillance of emergency room and hospital records. At least one fall was experienced by 546 (49%) participants. A total of 123 participants, representing 23% of fallers and 12% of the cohort, experienced 183 serious fall injury events.

The factors independently associated with experiencing a serious injury during a fall included cognitive impairment.

### **3. Analysis Procedures**

To achieve the objectives of the study, we used the (SPSS) and Minitab ver. (17).

#### *3.1 Methodology*

In this paper, the researcher used chi-square, Two Way Anova (Abu-Salih & Awad, 1983). Two-Way (Analysis of Variance), the model:

$$Y_{ij} = \mu + \alpha_i + \beta_j + \xi_{ij}$$

$$i = 1, 2, \dots, r$$

$$j = 1, 2, \dots, c$$

$$\sum_i \alpha_i = \sum_j \beta_j = 0$$

Table 1. Notations

Rows	Columns			
	1	2	j	c
1	$Y_{11}$	$Y_{12}$	$Y_{1j}$	$Y_{1c}$
2	$Y_{21}$	$Y_{22}$	$Y_{2j}$	$Y_{2c}$
i	$Y_{i1}$	$Y_{i2}$	$Y_{ij}$	$Y_{ic}$
R	$Y_{r1}$	$Y_{r2}$	$Y_{rj}$	$Y_{rc}$

$E_{ij}$  are independent. For each I, j.  $E_{ij} \sim N(0, \sigma^2)$

Total Sum of Squares (SST):

$$SST = \sum_{i=1}^r \sum_{j=1}^c (Y_{ij} - Y)^2$$

$$SST = \sum_{i=1}^r \sum_{j=1}^c Y_{ij}^2 - rcY^2$$

With d.f = (rc-1)

Sum of Squares for Rows (SSR)

$$SSR = c \sum_{i=1}^r (\bar{Y}_i - \bar{Y}_{..})^2$$

$$SSR = c \sum_{i=1}^r \bar{Y}_i^2 - rc\bar{Y}_{..}^2$$

With d.f = (r-1)

Sum of Squares for Columns (SSC)

$$SSC = r \sum_{j=1}^c \bar{Y}_j^2 - rc\bar{Y}_{..}^2$$

With d.f = (c-1);

Sum of Squares for Errors (SSE);

$$SSE = \sum_{i=1}^r \sum_{j=1}^c (Y_{ij} - \bar{Y}_i - \bar{Y}_j + \bar{Y}_{..})^2$$

$$SSE = SST - (SSR + SSC)$$

With degrees of freedom(d.f) = (r-1)(c-1), Where r : no. of rows & C: no. of columns.

Table 2. ANOVA

F-Statistic	Mean Squers	Sum of Squares	d.f	Source of Variation
FR = MST/MSE	$MSR = \frac{SSR}{r-1}$	SSR	r - 1	Between Rows
FC = MSB/MSE	$MSC = \frac{SSC}{c-1}$	SSC	c - 1	Between Columns
	$MSE = \frac{SSE}{(r-1)(c-1)}$	SSE	(r-1)(c-1)	Error
		SST	rc - 1	Total

Chi-Square Test for Independence (M. Abu-Salih & A. Awad, 1983; Gerald Keller, 2010).

Chi-square for independent test which is used to determine whether there is a significant relationship between two categorical variables.

### Test steps

State the null hypotheses (Ho), and alternative hypotheses (H1), as:

H0: Variable A and variable B are independent.

H1: Variable A and variable B are not independent.

Find the critical value as the following:

$$\chi^2_{tab} = \chi^2 [(r-1)(c-1), 1-\alpha]$$

Where is:

r: No. of rows.

c: No. of columns.

$\alpha$  : significant level.

1) Compute the test value as:

$$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

Where is:

O<sub>i</sub>= Observed value.

E<sub>i</sub> = Expected value, and  $E_i = \frac{\text{RowSum} \times \text{ColumnSum}}{\text{GrandTotal}}$

2) Make the decision

Criteria: If P-value  $\leq$  significant level, we reject null hypothesis and accept alternative hypothesis.

### 3.2 Assumptions

The data are obtained from a random sample

The expected value in each cell must be 5 or more.

### 3.3 The Hypotheses

Groupe (I)

▼Two-way anova

H01: There is no statistical significant relationship at between type of injury (slight, sever) and traffic accident type (Collision, Pedestrian, Turnover) at (0.05) level.

H02: There is no statistical significant relationship at between type of injury (slight, sever) and time (0.00-00.59, 01.00-01.59.....23.00-23.59) at (0.05) level.

H03: There is no statistical significant relationship at between type of injury (slight, sever) and weekdays (Saturday, Sunday.....Friday) at (0.05) level.

H04: There is no statistical significant relationship at between type of injury (slight, sever) and month (January, February.....December) at (0.05) level.

H05: There is no statistical significant relationship at between type of injury (slight, sever) and governorate (Amman, Irbed .....Ajoun) at (0.05) level.

H06: There is no statistical significant relationship at between type of injury (slight, sever) and Territory (Central Region, North Region, South Region) at (0.05) level.

H07: There is no statistical significant relationship at between type of injury (slight, sever) and weather condition (Clear, Fog.....Dust) at (0.05) level.

H08: There is no statistical significant relationship at between type of injury (slight, sever) and road surface condition (Dry, Wet.....Sandy) at (0.05) level

H09: There is no statistical significant relationship at between type of injury (slight, sever) and light condition

(Day Light, Night with Sufficient Light.....Sunset) at (0.05) level.

H10: There is no statistical significant relationship at between type of injury (slight, sever) and age group (0-2, 3-5,.....60+) at (0.05) level.

H11: There is no statistical significant relationship at between type of injury (slight, sever) and speed limits (10, 20,.....120) at (0.05) level.

H12: There is no statistical significant relationship at between type of injury (slight, sever) and gender (Male, Female) at (0.05) level.

Hypothesis testing results as the following:

Table 3. Shown the Chi-Square test for (Ho1, Ho2.....H012)

Hypothesis No(Ho)	Variables	The Calculated Value	D.F	P-Value	Decision
1	Accident type & injury type	132.488	2	0.0	Reject
2	Time and injury type	55.910	23	0.0	Reject
3	weekdays and injury type	2.104	6	0.910	Accept
4	Month& injury type	29.971	11	0.02	Reject
5	Governorate and injury type .	254.951	11	0.0	Reject
6	Territory and injury type .	5.147	2	0.076	Accept
7	weather condition and injury type	11.043	5	0.05	Reject
8	Road surface condition and injury type	15.562	6	0.016	Reject
9	Light Condition and injury type	24.291	5	0.0	Reject
10	Age group and injury type	57.252	20	0.0	Reject
11	Speed limit and injury type	73.485	11	0.0	Reject
12	Gender and injury type	3.262	1	0.07	Accept

Note. The expected value of each cell >5.

#### Groupe (II)

H13: There is no difference in:

I) The means of factor (accident type) at (0.05) level.

II) The means of factor (injury type) at (0.05) level.

H14: There is no difference in:

I) The means of factor (time ) at (0.05) level.

II) The means of factor (injury type) at (0.05) level

H15: There is no difference in

I) The means of factor (Weekdays) at (0.05) level.

II) The means of factor (injury type) at (0.05) level.

H16: There is no difference in

I) The means of factor (Month) at (0.05) level.

II) The means of factor (injury type) at (0.05) level.

H17: There is no difference in:

I) The means of factor (Governorate) at (0.05) level.

II) The means of factor (injury type) at (0.05) level.

H18: There is no difference in:

I) The means of factor (Territory) at (0.05) level.

II) The means of factor (injury type) at (0.05) level.

H19: There is no difference in:

I) The means of factor (weather condition) at (0.05) level.

II) The means of factor (injury type) at (0.05) level.

H20: There is no difference in:

I) The means of factor (Road surface condition) at (0.05) level.

II) The means of factor (injury type) at (0.05) level.

H21: There is no difference in:

I) The means of factor (Light Condition ) at (0.05) level.

II) The means of factor (injury type) at (0.05) level.

H22: There is no difference in:

I) The means of factor (Age group) at (0.05) level.

II) The means of factor (injury type) at (0.05) level.

H23: There is no difference in:

I) The means of factor (Speed limit) at (0.05) level.

II) The factor ( injury type) at (0.05) level.

H24: There is no difference in:

I) The means of factor (Gender ) at (0.05) level.

II) The means of factor (injury type) at (0.05) level.

Hypothesis testing results as the following:

Table 4. Shown the test of two-way Anova

Hypothesis No(H <sub>0</sub> )	Source	Type II Squares	Sum of df	Mean Square	F-Ratio	P-value	Decision
13	Accident Type	79314790915.650	2	39657395457.825	51367.596	0.0	Reject
	Injury Type	38577460686.245	1	38577460686.245	49968.773	0.0	Reject
14	Time	397429230.067	23	17279531.742	5188.678	0.0	Reject
	Injury Type	473093943.570	1	473093943.570	142060.103	0.0	Reject
15	Weekdays	73955741.572	6	12325956.929	26750.916	0.0	Reject
	Injury Type	4137866031.124	1	4137866031.124	8980374.245	0.0	Reject
16	Month	145138092.301	11	13194372.027	11909.422	0.0	Reject
	Injury Type	1427657434.981	1	1427657434.981	1288623.282	0.0	Reject
17	Governorate	43706035560.398	11	3973275960.036	11382.433	0.0	Reject
	Injury Type	7189777381.760	1	7189777381.760	20596.898	0.0	Reject
18	Territory	56607141014.131	2	28303570507.066	64270.906	0.0	Reject
	Injury Type	36791467282.519	1	36791467282.519	83544.970	0.0	Reject
19	Weather Condition	48335268678.581	5	9667053735.716	31657.417	0.0	Reject
	Injury Type	180573584916.526	1	180573584916.526	591337.697	0.0	Reject
20	Road Surface Condition	56569515705.298	6	9428252617.550	22550.791	0.0	Reject
	Injury Type	174623462163.212	1	174623462163.212	417669.894	0.0	Reject
21	Light Condition	155488298086.374	5	31097659617.275	31635.400	0.0	Reject
	Injury Type	72926876014.746	1	72926876014.746	74187.928	0.0	Reject
22	Age Group	978693030.015	20	48934651.501	6557.143	0.0	Reject
	Injury Type	665758408.954	1	665758408.954	89210.264	0.0	Reject
2	Speed Limit	16790035629.429	11	1526366875.403	10421.079	0.0	Reject
	Injury Type	8468264633.486	1	8468264633.486	57816.018	0.0	Reject
24	Gender	88434154021.917	1	88434154021.917	148594.926	0.0	Reject
	Injury Type	80468570242.478	1	80468570242.478	135210.444	0.0	Reject

#### 4. Results

Based on the analysis made, the following are the main results:

There is statistical significant relationship between type of injury (slight, sever) and traffic accident type (Collision, Pedestrian, Turnover).

Time (0.00-00.59, 01.00-01.59.....23.00-23.59).

Month (January, February.....December) Governorate (Amman, Irbed.....Ajloun).

Light condition (Day Light, Night with Sufficient Light.....Sunset).

Speed limits (10, 20.....120).

Age group (0-2, 3-5.....60+).

There is no statistical significant relationship between type of injury (slight, sever) and Weekdays (Saturday, Sunday.....Friday).

Territory (Central Region, North Region, South Region).

Weather condition (Clear, Fog.....Dust).

Gender (Male, Female).

The chi-square test is inconclusive to test the following hypotheses:

There is no statistical significant relationship at between type of injury (slight, sever) and road surface condition (Dry, Wet.....Sandy) at (0.05) level.

There is no difference in the means of the following factors: Accident Type, Time, Weekdays, Month, Governorate, Territory, Weather Condition, Road Surface Condition, Light Condition, Age Group, Speed Limit, Gender, at (0.05) level.

There is difference in means of factor X2 (injury type) at (0.05) level.

#### 5. Conclusions

Based on the results, the researcher recommended the following:

- Harsher penalties on perpetrators traffic accidents.
- Reregulation's in legislation and laws governing drivers.
- Take advantage of these results in future traffic studies.

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