Traffic Safety in Jordan: Magnitude, Cost and Potential Countermeasures

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***Abstract*—Accident statistics show a relatively low level of traffic safety in Jordan compared to developed countries producing large socio-economic losses. The 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). This study investigates the present and future magnitude of road traffic accidents in Jordan in order to provide a better understanding of the road safety trauma and assist strategic planning and optional allocation of resources. Potential countermeasures are identified and evaluated by examining the attitudes of road users toward the effectiveness and favorability of these measures.**

***Index Terms*—Accident costs, countermeasures, Jordan, Road user attitudes.**

I. Introduction

Road traffic accidents (RTA) constitute a major global public health problem resulting in over 1.2 million deaths and 15-20 million injuries annually [1] the majority of which(about 70%) occur in low and middle income developing countries with a global direct economic costs being estimated to exceed US$ 500 billion annually[2], [3].

The magnitude of road safety includes such parameters as number of accidents and casualties, a measure of risk and accident costs. All over the world have been trying to improve safety and awareness about it [4].

This paper investigates the present and future magnitude of RTA in Jordan and their costs in order to provide a better understanding of the road safety trauma then to identify the most effective and favorable potential countermeasures.

II. Accident Trends, Rates and Characteristics

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 in 2008.The number of vehicles increased from 473339 in 2000 to 994753 in 2009when 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. [4]. Statistics show that the level of traffic safety in Jordan falls well behind developed countries as the fatality rate per vehicle, for example, is approximately 8-9 times higher [5].

Traffic accidents in Jordan increased from 52796 in 2000 to 122793 in 2009; the resulting casualties (fatalities and injuries) have improved leading to a reduction in severity rates from 0.37 to 0.13 casualty/ accident during the same period. However, the fatality index (fatalities/casualties) has slightly increased from 0.035 to 0.041.

Table I shows the variation in the number and rates of accidents and resulting casualties between 2000 and 2009. It can be seen that the number of casualties (fatalities + injuries) per 10,000 vehicles has fell in general but fluctuated when related to population. This could be correlated to the trend of annual growth of both parameters.

Detailed analysis of traffic accidents that occurred in 2009 revealed that the highest percentage of accidents (11.5%) occurred during the afternoon peak hour (2-3pm), on Thursday (9.5% of total week) and during the summer months of July and August (each 9.6%of total year). Passenger cars were involved in 68.4% of total accidents followed by trucks (20.2) and buses (7.8%).

The casualty profile shows that slight injuries constitute 86% of total casualties, whereas serious injury forms 10% and fatalities form 4% of total casualties. As regards to age group, most casualties (62.8%) were between 15 and 45 years old and females were involved in about 27% of total casualties. This may be attributed to the fact that this age group and males tend to use the road more frequently and are less careful road users. Car drivers represent the highest percentage of casualties (39.8%) followed by passengers (35%) whereas pedestrians represent 26.3% of total casualties.

Weather conditions, road pavement, surface condition and light conditions for the road network in Jordan were found not to have major effect on RTA. This conclusion is made based upon statistical data obtained for road traffic accidents across the entire network for a wide range of conditions entirely covering those of Jordan.

III. Fatality Prediction

Limited work of aggregate nature was carried out on prediction of accidents and resulting casualties in Jordan. Most recently, a model for the prediction of fatalities was

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developed under Jordanian conditions [6]. The model has the following form:

F= - 1114.8 + 0.000243 P – 0.000312 V + .103 L

where:

F is the predicted number of fatalities.

P is the population.

V is the number of registered vehicles.

L is the total length of paved roads (km)

Using the above model, future fatalities were predicted for the next ten years as shown in Table II.

TABLE I. TRENDS AND RATES OF TRAFFIC ACCIDENT (2000-2009)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Accidents	25796	25662	25913	62115	70266	83129	98055	110630	101066	122793
Fatalities	686	783	758	832	818	790	899	992	741	676
Injuries	18842	18832	17381	18368	16727	17579	18019	17969	13913	15662
Fatalities/1000 accidents	12.9	14.8	14.3	13.4	11.6	9.5	9.18	8.9	7.3	5.5
injuries /1000 accidents	356.8	357.6	328.5	295.7	238	211.5	183.7	162.4	137.7	127.5
fatality index	0.035	0.039	0.04	0.043	0.046	0.043	0.047	0.052	0.05	0.041
fatality per 10.000 Vehicles	14.5	15.4	14	14.6	13.4	11.6	11.9	11.8	8.2	6.8
injury per 100.000 vehicle	398.1	369.4	320	321.4	373.2	258.6	238.5	213.4	153.6	157.4
fatality per 100.000 population	13.6	15.1	14.2	15.2	15.3	14.4	16.1	17.3	12.6	11.3
injury per 100.000 population	373.9	363.4	326.2	335.2	312.6	321.2	321.8	314	237.8	261.9
severity Rate	0.37	0.37	0.34	0.31	0.25	0.22	0.19	0.17	0.14	0.13

TABLE II. PREDICTED FATALITIES

Year	Fatality
2013	924
2014	938
2015	957
2016	977
2017	998
2018	1018
2019	1036
2020	1054
2021	1072
2022	1091

IV. ACCIDENT COSTS

Despite the difficulty of attributing monetary values on the losses arising from traffic accidents, an attempt was made to estimate the cost of accidents that occurred in Jordan in 2009 using various sources of information to collect the required data.

The cost analysis considered all cost elements including victim related, property damage and administration costs. The results presented in Table III show the estimated values of all accident cost elements considered in the study with a total cost of 2009 accidents being JOD 336.4 million (equivalent to US $ 475 million).

TABLE III. ESTIMATED ACCIDENT COSTS BY ELEMNT

Accident Cost Elements	**JOD ***
1. Victim Related	
a. loss of Output due to fatalities	36,867,242
b. loss of Output due to injuries	48,204,297
c. Medical cost	12,637,994
d. pain and suffering	17,252,720
Sub-total (1)	114,962,253
2. Property Damage	
a. Vehicle Damage Repair	95,584,830
b. Detention Period	105,532,041
Sub-total (2)	201,116,871
3. Administration Cost:	
a. police investigation or related activities	1,153,302
b. Insurance Administration	19,165,221
Sub- total (3)	20,318,523
Grand total (1+2+3)	336,397,647

*US $ = 0.71 JOD

Using the same method and derived cost for each element together with the predicted number of accidents, the cost of year 2030 predicted accidents were estimated as JOD 558.2 million (equivalent to about US $ 786 million).

V. POTENTIAL COUNTERMEASURES

Earlier work [7] indicated that the introduction and eventual effectiveness of many road safety initiatives often depends on the level of support offered- and likely to be given- by the road using public. Therefore, it is necessary to examine the attitude of road users toward safety remedial measures in order to evaluate their potential acceptability. A preliminary investigation was carried out in order to provide an insight into these issues. A questionnaire was designed for this purpose and distributed to a random sample of road users. The questionnaire aimed at collecting information on what a

representative sample of all types of road users thought about a variety of possible countermeasures. Thirty eight countermeasures were considered in the questionnaire to assess the public attitude in terms of "effectiveness" and "favorability" of these measures.

TABLE IV. HIGHEST AND LOWEST COUNTERMEASURES ON "EFFECTIVE INDEX"

Countermeasure	Effective Index	Rank
Highest		
Provide safe sidewalks for pedestrians free of obstacles	4.65	1
Taking in more projects to improve roads	4.56	2
Increase the support of general public transportation	4.52	3
Improving street lighting	4.47	4
Increase traffic education in schools	4.37	5
Lowest		
Concentrate in the driving test on the written part	2.89	1
Increasing max. speed limits on highways	2.94	2
Retesting drivers every five years	3.03	3
Increase the difficulty level of the driving test	3.04	4
Increase the number of pedestrian crossings	3.21	5

TABLE V. HIGHEST AND LOWEST COUNTERMEASURES ON "FAVORABLE INDEX"

Countermeasure	Effective Index	Rank
Highest		
Provide safe sidewalks for pedestrians free of obstacles	4.83	1
Taking in more projects to improve roads	4.68	2
Increase traffic education in schools	4.67	3
Maintenance of traffic signs and removing the obstacles that obscure vision.	4.67	4
Placing of dangerous crossing signs at high accident locations	4.66	5
Lowest		
Concentrate in the driving test on the written part	2.49	1
Increase the number of pedestrian crossings	2.85	2
Retesting drivers every five years	3.03	4
Increase the penalty for traffic violation	3.16	5

The survey was carried out through distributing 150 questionnaires to collect information on what this representative sample of road users thought of the selected potential countermeasures. The perceived effectiveness and favorability of the studied countermeasures were obtained using indices based on a five point rating scale having verbal labels. The highest and lowest ranked countermeasures for "effectiveness" and "favorability" are listed in Table IV and Table V respectively.

Considering both the effectiveness and the favorability indices, four potential measures were identified as being the most appropriate for implementation. These are:

1) Provide safe sidewalks for pedestrians free of obstacles.

2) Taking in more projects to improve roads.

3) Increase the support of general public transportation.

4) Increase traffic education in schools.

VI. CONCLUSION

The performance of road safety in Jordan falls behind developed countries with the number of fatalities reaching its peak of 992 fatalities in 2007. The continuous growth in vehicle ownership would increase the number to 1091 fatalities in 2022 as predicted by the developed fatality prediction model.

The detailed analysis of 2009 accident costs revealed a total of $475 million expected to reach $786 million in 2030 which put a heavy burden on national economy and calls for the need to implement necessary countermeasures. The driver's perception of the effectiveness and favorability of 38 potential countermeasures was investigated and the most promising measures were identified and recommended for implementation.

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