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Traffic Accidents Trends in Developed and Developing Countries: A Case Study for U.S.A. and Jordan

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There is a dramatic increase in the rate of accidents in Jordan with the increase in Jordanian population along with the increase in the numbers of vehicles and the carelessness of drivers and the other road users. However, this is not the case for other developed countries such as the United States of America (U.S.A.), even though the rate of increase in vehicles is higher.

In this study an idea about the frequency of traffic accident statistics in Jordanian and U.S.A. is given. Moreover, comparison is made between the traffic accidents statistics in the two countries. The study concentrates in fatalities, injuries, and property damage statistics during the period of 1991 through 1997. Different accident characteristics are analyzed. Results showed that there is a serious traffic accident problem in Jordan if compared to U.S.A. In fact, despite population growth, accidents deaths from all causes have declined in the U.S.A., however, substantial increase does exist in Jordan.

A new scheme is presented to analyze accident data. It uses time-wise analysis based on day-wise, time-wise, month-wise, and seasonal-wise due to traffic volume fluctuation based on time. Further, stereo-vision mapping is suggested to be used for traffic accidents monitoring, recording and documentation. It has the advantages of accurate measurements for later use and an evidence to be used in the court. A frame-work is proposed to reduce the rate of accidents in Jordan as well as in the developing countries. It includes: consistent applications of traffic legislation and enforcement law, faster and better medical response, greater use of safety belt, educational and public awareness, and application of technological advancement such as Intelligent Transportation Systems (ITS).

Keywords: Traffic Accidents, Fatalities, Injuries, Developed Countries, Developing Countries.

1. INTRODUCTION

High risk factors due to transportation accidents are continuing to prompt all over the world despite their social, economical, medical, and property damage effects. Because of this, transportation safety is considered as one of the top priorities for the governments in developing as well as developed countries. In most of the developed countries, whom they do care more about human being and his life and prosperity, statistics clearly showed that safety in highway transportation modes is improved, however, it is not the case for the developing countries despite the research and educational efforts (Mobility and Access 1997). In fact, the transportation communities as well as the public and the private sectors in the developing countries are suffering from numerous obstacles to improve road safety.

The performance of transportation system's safety is normally assessed by examining the changes or rates of accidents or fatalities over time. The increase or decrease in these rates is considered as an important indicator for safety degradation or improvement. The improvement results is contributed to educational effort done by transportation community, improvement of emergency response, enforcement and regulations, and research innovation.

The main objective of this paper is to present a comparison of traffic accidents rates and statistics between the United States of America (U.S.A.) as a representative country for the developed countries.

and the Hashemite Kingdom of Jordan as a developing country. The study period included the years 1991 through 1995.

2. TRANSPORTATION SAFETY TRENDS IN THE U.S.

As shown in Table 1, transportation accidental deaths from all causes have been declined in the United states as it is viewed in absolute number of fatalities from the year 1970 to 1993. In the year 1970, 2.9 % of the deaths from all causes were transportation accidental deaths. Then, it dropped gradually until it reached 1.9 % by the year 1993 (Mobility and Access 1997). As a percent of all accidental death, the transportation-related accidents were decreased to reach a fairly constant percentage of about 50%.

Table 1: Transportation-Related Fatalities Compared with Total Accidental Fatalities.

Year	Transportation Death (%)
1970	2.9
1980	2.7
1992	1.9
1993	1.9

Well-known causes of accidents in the U.S. include: human error, alcohol, excessive speed, equipment failure, deteriorating infrastructure, and faulty control devices. On highways, about 87 % of accidents are due to vehicle operator causes, 10 % are due to environmental conditions, and 3 % are due to equipment failure.

Table 2 shows the motor vehicle fatalities of rural and urban roads as percentage of all accidental death for the years 1991 through 1995 (National Transportation Statistics 1997).

Table 2: Motor Vehicle Fatalities for Rural and Urban Roads.

Year	Rural (%)	Urban (%)
1991	2.76	1.32
1992	2.57	1.21
1993	2.62	1.20
1994	2.61	1.17
1995	2.57	1.20

Obviously, the motor vehicle fatalities rates in rural and urban roads are decreasing through the period of 1991 through 1995.

One of the interesting measures of safety is to correlate number of accidents to vehicle-miles. Table 3 shows the number of accidents and its percentages to the vehicle-miles for the studied period.

Table 3: Motor Vehicle Accidents as Percentages of Vehicle-Miles.

Year	Accidents (Millions)	Vehicle-Miles (Millions)	Percentage of Accid. to Veh.-Miles (%)
1991	6.1	2172050	0.00028
1992	6.0	2247151	0.00027
1993	6.1	2296700	0.00026
1994	6.5	2357588	0.00027
1995	6.6	2422775	0.00027

The same trend of continuing decrease of number of accidents is clear from this Table, too.

The injury and accident data of passenger car is another important factor to be studied since most of accidents are occurred in this mode of transportation.

Table 4 shows the car fatalities, accidents, and vehicle-miles in the United States for the period of 1991 through 1995 (National Transportation Statistics 1997). The number of accidents is correlated with vehicle-miles. The rates of accidents per 100 million vehicle-miles are: 338, 315, 326, 360, and 358 for the years 1990 through 1995, respectively. However, the rates of fatalities per 100 million vehicle-miles are: 1.5, 1.3, 1.4, 1.5, and 1.5 for the same years.

Table 4: Passenger Vehicle Accidents.

Year	Accidents (Millions)	Vehicle-Miles (Millions)	Fatalities (Thousand)
1991	5.2	1533552	22385
1992	5.1	1600839	21387
1993	5.1	1547366	21566
1994	5.4	1501402	21997
1995	5.5	1541458	22358

A clear look to the previously mentioned numbers of accidents and fatalities showed an improvement in transportation safety in the study period. As stated by mobility and access (1997) this improvement may be explained by research, development, and use of innovative practices and technologies such as the Intelligent Transportation Systems (ITS). Some of the development and improvement include: safer designs for highways, alcohol countermeasures, medical intervention capabilities and training and education programs.

The year 1995 is taken as a representative year to study the distribution of transportation fatalities. The total number of fatalities at that year was 44394. About 50 % of the fatalities was passenger car occupants, 21 % for light-trucks, 13 % for pedestrian struck by motor vehicles, 5 % for motorcyclists, and any other category was less than

2 % of the fatalities. The percentage of pedestrian struck by motor vehicles is relatively low if compared with other countries. This is an indicator for well-behavioral responses of pedestrians while performing roadway crossing.

Other major cause of accidents in the U.S. is alcohol. Much progress has been made in discouraging drivers from drinking. For example, in 1982, 57 % of fatalities involving motor vehicle arose from alcohol-related crashes, however, it decreased to about 41 % in 1995 due to enforcement, education, and traffic regulations.

Excessive speed is another major factor in motor vehicle crashes which contributed about 31 % of all fatal crashes involving motor vehicle.

Concerning the safety belt, 60 % of those who killed in 1990 crashes were unrestrained. In fact, studies showed that lap/shoulder safety belt can reduce the risk of fatal injury to about 45 % for front seat passenger car (USDOT NHTSA 1996).

3. TRANSPORTATION SAFETY TRENDS IN JORDAN

As other developing countries, traffic accidents and fatalities rates are dramatically increased in Jordan despite the efforts which have been made by the public and private sectors. Officials justify this increase due to the natural increase in number of registered vehicles and the increase in population which is of course not convincing (Jordanian Public Security Directorate Statistics 1997).

Table 5 shows the motor vehicle fatalities accidental death, injuries, and number of motor accidents in Jordan for the years 1991 through 1997 (Jordanian Public Security Directorate Statistics 1997). The percentages of increase in traffic accidents is shown in Fig. 1. The statistical data shows clearly the yearly dramatic increase in traffic accidents in Jordan which ranged between 8 % to about 18 % and the average increase was about 12.5 %. This increase in traffic accidents is almost three times of the annual population growth which is about 4 %. Thus, the reasons mentioned by officials concerning the increase of accidents is unjustified and it is not due to population growth only. Of course, there are other factors contributing to the problem which make traffic accidents really a serious problem in Jordan. Some of the factors which can contribute to this problem include: exceeding the speed limit, not giving traffic priority, using the wrong lane, psychological problems of drivers, alcohol, and behavioral issues from some of the drivers.

Table 5: Motor Vehicle Accidents, Fatalities, and Injuries in Jordan

Year	Number of Accidents	Number of Fatalities	Number of Injuries
1991	18756	379	10126
1992	20970	388	10676
1993	24799	440	11754
1994	26837	443	12516
1995	28970	469	13184
1996	33784	552	15375
1997	39005	577	16259

The fact of contributing most of the increase of traffic accidents to drivers behavioral response can be supported if a study is made for the causes of accidents. For example, the major mistakes and problems for the last five years were contributed due to drivers behaviors. In fact, about 70 to 85 % of traffic accidents in Jordan was due to drivers mistakes. Major problems of drivers involved in traffic accidents included: near-following, using the wrong lane, yielding problems for traffic and pedestrians, wrong passing, sudden stop, etc.

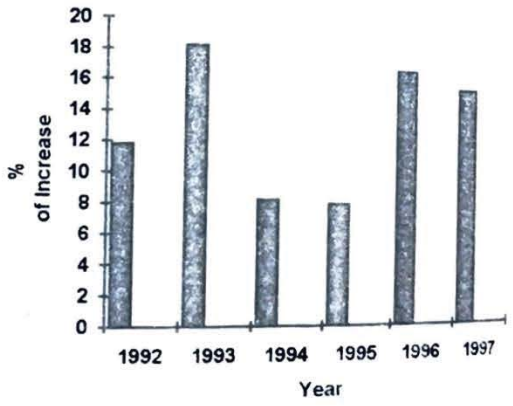

Fig. 1: Accident Percentage Increase in Jordan

Table 6 shows other interesting numbers about traffic accidents involvement in Jordan for private, public, and rent a car passengers vehicles for the years 1996 and 1997.

Table 6: Percentages of Vehicles Involvement in Traffic Accidents

Year	Private Vehicles	Public Vehicles	Rent-A-Car
1996	14.4%	45.1%	63.0%
1997	17.0%	56.6%	56.5%

From Table 6, it is clear that above 50% of public vehicles are involved in traffic accidents, while low

percentage of private vehicles is involved in accidents. The tourist vehicles (Rent-A-Car) traffic accidents involvement reach about 60 % which is considered as a high percentage because of illegal driving of some of teen-agers drivers.

Fig. 2 shows the percentage of accidents occurred due to exceeding the speed limit. This percentage is increased due to the fact that young drivers don't obey traffic signs and speed limits despite of increasing traffic citations of about 50 % to 55 % during the years 1995 and 1996 (Al-Shagrawi 1997 and Saleem 1997).

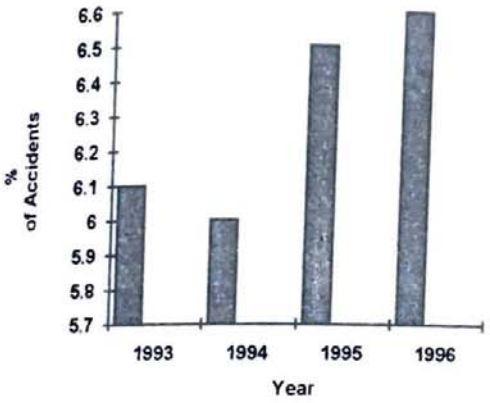

Fig. 2: Percentages of Accidents Due to Exceeding of Speed Limits.

Accidents are mainly occurred in urban areas. For example, about 61 % of the accidents occurred in the capital Amman. That was due to high percentage of car ownership and the percentage of Amman's population with respect to other cities.

Obviously, there is a high percentage of traffic accidents in Jordan if compared with the U.S.A. This is an indicator of giving a warning signal to authorized people to take care of this major problem due to economical, social, and other factors. Anyhow, listing the statistics of traffic by it self does not mean any thing unless we use it as indicator to find solutions and regulations to this problem.

4. NEW SCHEME FOR TRAFFIC ACCIDENTS DATA ANALYSIS

The frequency of accidents as well as the location and time of occurrence are very important to understand the characteristics of traffic accidents. Therefore, seasonal characteristics and variations of traffic movement have to be studied thoroughly in order to understand the effect of traffic volume and weather conditions on traffic accidents frequency (Chand 1998).

Thus, the distribution of traffic accidents according to time-wise analysis should be studied. The distribution of month-wise, day-wise, and time-wise are expected to influence traffic accidents frequency as well as geographical distribution. Therefore, a time-based data-base could be built. This data-base could give the geographical distribution of accidents as well as their associated attributes such as type of vehicle, time of accident, day of accident, driver's characteristics, accident victim's characteristics, accidents victim's sex, age of driver and victims, fatalities and injuries characteristics, etc. Thus, a digital map which displays accidents could be implemented by the mean of Geographic Information Systems (GIS) applications. These maps could be used for accident data analysis, queries, map display, visualization, animation, prediction and history of traffic accidents in particular locations, etc. This means that temporal as well as spatial traffic accident data analysis are quit possible.

Stereo-vision mapping could be used for traffic accidents monitoring, recording and documentation. It has the advantages of accurate measurements for later use and an evidence to be used in the court.

5. SOLUTIONS FOR TRAFFIC ACCIDENT PROBLEMS IN DEVELOPING COUNTRIES

There is an increase of traffic accidents and fatalities rates in developing countries as seen from the Jordanian case. Therefore solutions should be given to enhance roadway safety. The followings are broad solutions to this problem:

1. Enforcement and traffic regulation application: the application of tough pointing system which leads gradually to withdraw the drivers license in case of repetitive traffic violations.
2. Traffic control: visible, hidden, movable, and stationary control.
3. Training and education of drivers: police departments, universities, and traffic institutes could take the lead in this case.
4. Engineering criteria and design: enhance roadway geometric design, intersections, etc.
5. Application of innovative technology for drivers as well as vehicles, using intelligent systems such as ITS.

It has to be noted here that, the application of these solutions should be applied fairly and effectively, otherwise the road accidents rates will keep increasing dramatically.

6. CONCLUSIONS

In this paper, a comparison between traffic accidents rates in Jordan as a developing country and the U.S. as a developed country has been presented. Traffic accidents data showed a significant differences between the accident rates of the two countries. While traffic accidents is increasing in Jordan, it is decreasing in the U.S. That was due to many reasons including: research, development, education, and use of innovative practices and technologies. Except the usage of innovative technologies, the developing countries use the same methods to improve roadway safety, however, higher accident rates still exist. Therefore, this problem should be concentrated on and proper solutions should be fairly used to enhance the image of road safety in developing countries. Understanding the problem of course is part of solving it, therefore, using time-wise analysis through GIS can give a better understanding of roadway traffic accidents.

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