ROAD SAFETY IN THE WEST BANK

by

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ABSTRACT

The paper outlines and analyzes the developments in road traffic safety in the West Bank during the period 1970-1991. A number of parameters presenting general road safety statistics are studied. In addition, the paper looks at some relevant issues regarding traffic safety in the West Bank, including the main components of accidents, as well as the factors which contribute to accidents. The paper compares road safety parameters for the West Bank with those for other countries, indicating that although road fatality rates are relatively high in the West Bank, these rates are decreasing considerably with time. The paper concludes with recommendations of short- and long-term means and strategies in order to improve road safety conditions in the West Bank, including the establishment of bodies concerned with traffic safety, increasing safety education programs and implementing strict traffic enforcement policies.

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Introduction

The West Bank, which had been occupied by Israel since 1967, has a total area of about 5500 square kilometers. The total population of the Palestinians in the West Bank is about 1.11 million, including about 0.15 million living in East Jerusalem. The total length of paved roads in the West Bank reaches about 1870 kilometers. This results in a road density of 1.94 kilometer per 1000 population and 0.33 kilometer per square kilometer, indicating a poor stock of roads infrastructure [1].

The overall relative improvement in the per capita income in the West Bank resulted in a noticeable increase in vehicle ownership rates. The number of registered vehicles in the West Bank (excluding that in East Jerusalem) increased from 4.89 thousands in 1970 to about 76.08 thousands in 1991. The number of registered vehicles per 1000 population increased dramatically from 8 in 1970 to 79 in 1991. Consequently, the associated travel activities increased and so did traffic accidents on the roads of the West Bank.

The paper investigates road traffic safety trends, developments and issues in the West Bank. Road safety is considered as an important national issue, as several hundreds of Palestinian casualties fall each year in road accidents in the West Bank, causing considerable economic loss as well. Road traffic safety in the West Bank has not been thoroughly investigated yet, as there are no known publications in this regard. However, a recent B.S. graduation project presented only a partial description of road safety conditions in the West Bank, with concentration on a local traffic safety case study [3].

The paper considers the analysis period to extend from 1970 to 1991. Although East Jerusalem is an organic part of the West Bank, available statistics prepared by the occupant, the Israelis, consider statistics related to East Jerusalem neither being part of that of the West Bank, nor alone, but together with that of West Jerusalem and Israel. Therefore, traffic safety analysis throughout the paper deals with the West Bank excluding East Jerusalem.

The paper first presents developments of basic road traffic safety statistics for the West Bank, and analyzes some relevant road safety parameters. The paper then discusses a number of important road safety issues in the West Bank, including the main components of accidents, traffic accident severity and causes of accidents. Next, a comparison is made between traffic safety levels in the West Bank with those in a number of selected countries. Finally, the paper suggests a number of strategies, policies and measures to improve road traffic safety conditions in the West Bank.

Road Traffic Accident Statistics

In order to investigate road safety in the West Bank, it is necessary to collect accident statistics for a relatively long

period of time. These will assist in analyzing road safety developments and conditions, road safety levels, and in constructing a descriptive model which describes road safety in the West Bank.

Sources of Data

In the absence of detailed road traffic accident statistics in the West Bank, the main sources of data are the statistical periodicals published by the Israeli Bureau of Statistics and the records of Traffic Police Department. The Israel Bureau of statistics publishes a quarterly, although not on a regular basis, for the West Bank and Gaza Strip statistics. In addition, the bureau publishes the annual Statistical Abstracts of Israel, which includes a special section on the occupied West Bank and Gaza Strip statistics. There is no documented traffic safety statistics for the period 1988-1990 due to the difficulties in attaining the necessary information during the beginning of the Intifadah period, but documentation was resumed in 1991. In addition, some road safety statistics for the West Bank, which appear only in the Statistical Abstracts of Israel, are given since 1971, but did not cover the period 1972-1975.

Another source of information is that of Traffic Police Department files. These, in turn, are not comprehensive, neither easily accessible. These are used only for studying causes of accidents.

No data are available on vehicle-kilometers of travel, which are very important in analyzing traffic safety conditions. However, the number of registered vehicles, can be used as a substitute, as will be explained later.

Trends in Population, Vehicles and Accident Variables

Besides road accident data, two important variables are to be considered in the analysis of road safety conditions for a region, which are the population and the number of registered vehicles. Table 1 lists accident data, in addition to the population and the number of registered vehicles in the West Bank for the period 1970-1991. Accident data are presented for each year, and include the total number of accidents, fatalities and injuries. These data form the basis for producing a number of relevant figures as will follow, where, consequently, these will be utilized in analyzing and examining road safety developments. Figure 1 shows the annual relative growth in the above mentioned variables. In addition, trends in gross domestic product (GDP), are presented in the figure, in order to look at the effect of GDP on road safety.

Data as presented in Table 1 and Figure 1 show that, in general, there is an increasing trend in the total number of accidents and casualties (fatalities and injuries) in the West Bank almost for the whole period of analysis. It in noticed that in 1991, the number of registered vehicles represented about

Table 1. Population, Vehicle Registration and Accident Growth for the Period 1970-1991

Year	Population (thousands)	Registered Vehicles	Accidents	Fatalities	Injuries
1970	602.2	4893	528	71	764
1971	615.2	6233	573	71	866
1972	628.0	7572	626	103	957
1973	624.9	9068	652	98	995
1974	661.0	11162	785	90	1098
1975	672.4	12964	719	108	1142
1976	679.2	14256	795	123	1070
1977	689.5	15946	787	100	1108
1978	701.8	17783	814	105	1129
1979	713.3	20825	765	77	1099
1980	721.4	24257	803	91	1169
1981	728.0	27650	821	98	1339
1982	741.0	32194	681	80	1135
1983	760.5	38609	608	74	1034
1984	782.5	45037	610	98	974
1985	804.4	49316	685	109	1141
1986	826.6	54462	830	113	1304
1987	852.9	59572	903	107	1513
1991	960.3	76076	976	98	2061
Rate of Increase for 1991*	159%	1555%	185%	138%	270%

* Base: 1970=100%

Source of data: Israel Central Bureau of Statistics, Judea, Samaria and Gaza Area Statistics, and Statistical Abstracts of Israel, various editions (1973-1992).

1555% of that in 1970, while the population in 1991 represented only 159% of that in 1970. Therefore, the rate of increase in the number of vehicles is about 10 times that in population. This is a very important indication regarding road safety conditions in the West Bank. The much higher rate of increase in vehicle ownership, refers to a greater potential for traffic accidents, due to increasing travel activities.

It is to be noted here that not all the accidents are usually reported, especially when there is no casualties. Therefore, the reported numbers of accidents are less than the actual numbers. On the other hand, the reported numbers of casualties are considered to represent the actual numbers. However, the study is based on the reported figures.

The number of accidents and casualties dropped slightly in 1979 and more noticeably after 1981 until 1985, where in 1986 the trends continued to follow that before 1982. This decline in the number of accidents and the number of casualties may be attributed to the a number of reasons. One major reason is the relative drop in GDP beginning in 1981 and continuing until 1985, as shown in Figure 1. This is believed to affect the quantity of travel, as may be expressed in vehicle-kilometers of travel, although this did not affect vehicle ownership rates. Another reason for this drop may be attributed to the very intensive safety educational programs initiated during the beginning of the 1980s, which were especially oriented towards school pupils. This is also explained by the drop in pedestrian and limited age casualties as will be presented later. A third reason is related to the strict traffic police enforcement policies during the same period, which reduced the potential of drivers' violations, and consequently, the number of accidents.

The introduction of safety seat belt law and its enforcement in 1975 on inter-urban roads, caused only a very slight decrease in the number of accidents for that year, but following that the trend continued to increase.

Developments in Road Safety Parameters

Based on the figures presented in Table 1, a number of safety-related parameters are calculated. These include the number of accidents, fatalities and injuries with respect to either the population or the number of registered vehicles in the West Bank. Figure 2 illustrates the developments of these parameters for the period 1970-1991. It is to be noted here that in addition to being related to population each of the above mentioned parameters is usually calculated with respect to vehicle-kilometers of travel, not with respect to the number of registered vehicles. But due to the lack of data on total vehicle-kilometers of travel, as in most developing countries, these were related to the total number of registered vehicles, as suggested by a number of researchers [12,14].

Each parameter rate of change for a specific year is calculated with respect to the parameter value for the year 1970.

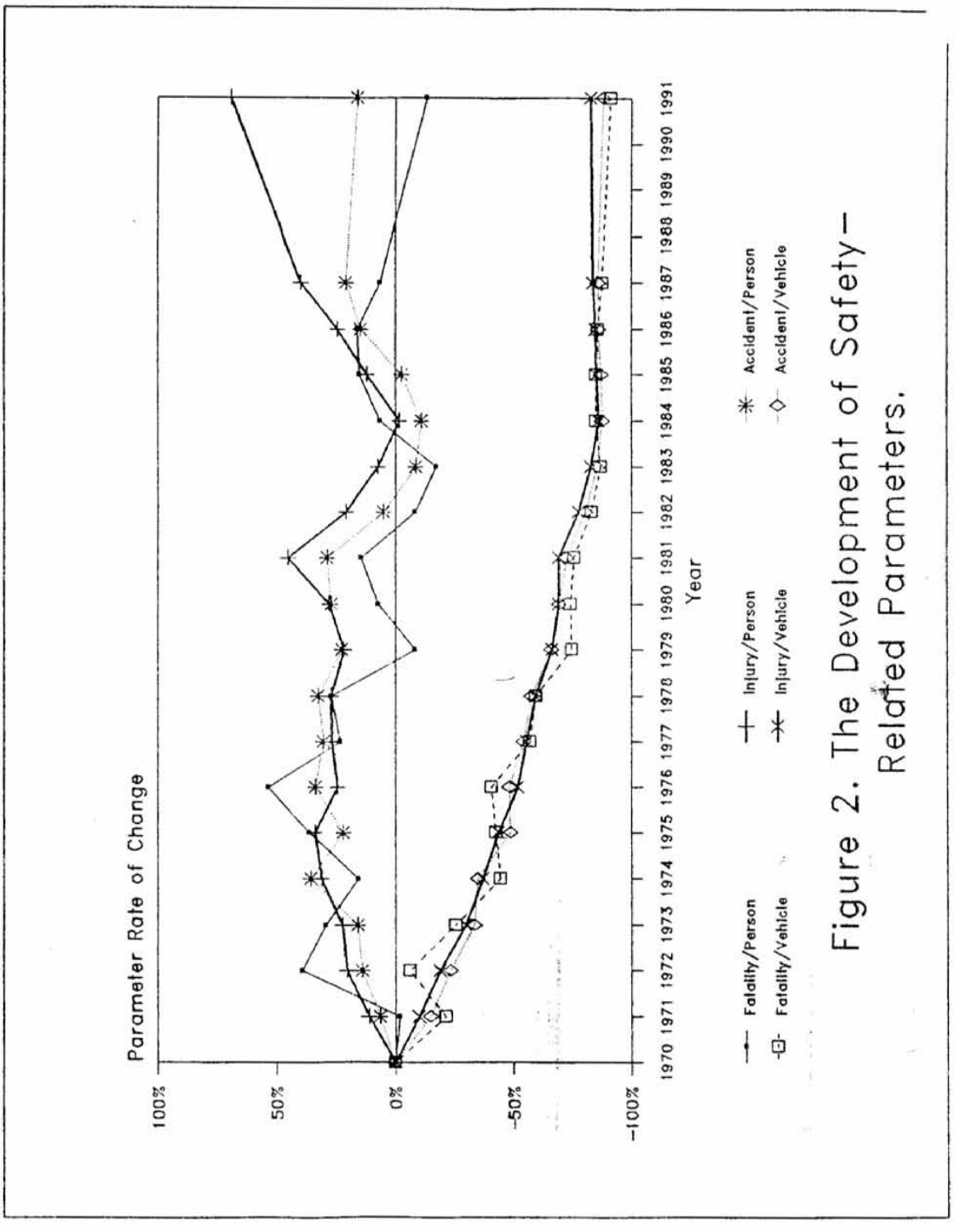

Figure 2. The Development of Safety-Related Parameters.

In general, it is noticed that when each of the accident variables is considered with respect to population, the resulting parameter exhibits an increasing trend for most of the period. On the other hand, when each of these variables is related to the total number of registered vehicles, the resulting parameter exhibits a decreasing trend over time in general. This was also noticed by a number of researchers who investigated traffic safety in developing countries such as Smeed [14], Jacobs and Hards [11] and Gharaybeh [4]. This is attributed to the much higher rate of increase in the number of registered vehicles with respect to that in population, or in other words, attributed to the high rate in motorization level. The latter is defined as the population divided by the number of registered vehicles.

The resulting decreasing trend of safety parameters, which are defined with respect to the number of registered vehicles, over time, does not mean that road safety in the West Bank has reached an acceptable level. Safety parameters considered here are calculated with respect to the number of registered vehicles, not to the vehicle-kilometers of travel. This is due to the lack of data on vehicle-kilometers of travel, and because motorization level is not considered here.

In order to overcome this, the motorization level is utilized in further analysis of road traffic safety trends, as will be presented later in the paper.

Main Components of Road Accidents

A number of main components of road accidents in the West Bank are presented. These include the vehicles involved in accidents, casualty road-user categories and casualty age groups.

Vehicles Involved in Traffic Accidents

The development of the percentages of vehicles involved in traffic accidents in the West Bank for the period 1971-1991 is presented in Figure 3. Vehicle types considered are based on the classification of the Israel Bureau of Statistics and include private and small commercial vehicles, taxis, buses, trucks, bicycles and others.

It is noticed that for almost all vehicle types, the percentage of vehicles involved in traffic accidents were either stable or slightly decreasing with time, except for the private passenger and commercial vehicles category, where the percentages of vehicles in this category exhibit an increasing trend with time. This may be explained by the relative increase in the vehicles, belonging to this category over time, with respect to other vehicle types. In 1991, private passenger and commercial vehicles formed about 60.7% of all vehicles involved in road accidents in the West Bank. Taxis and buses represent 3.0% and 2.1%, respectively, of all vehicles involved in accidents.

Trucks are overrepresented in being involved in traffic accidents when compared to their presence in the population

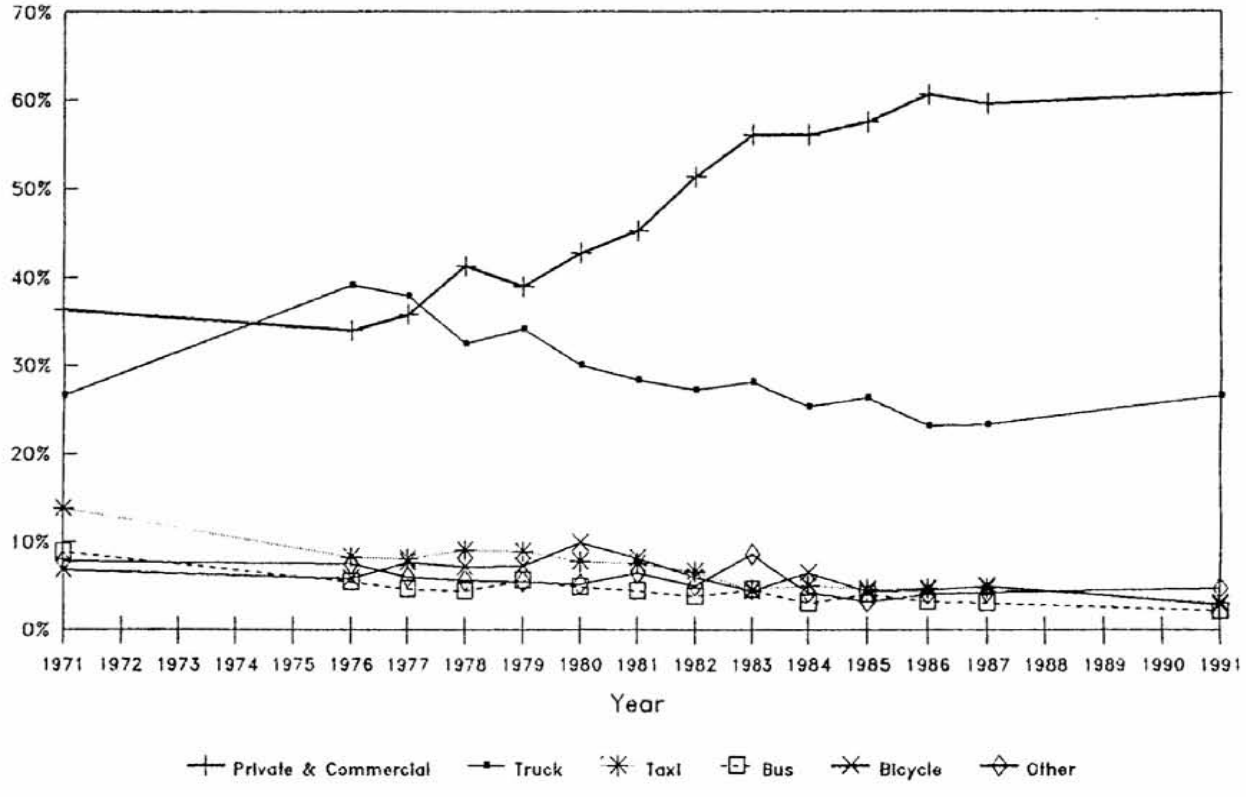

Figure 3. Vehicles Involved in Accidents According to their Type (in percent).

of registered vehicles. In 1991, trucks involved in traffic accidents represent 26.6% of all vehicles involved in accidents, while trucks form less than 22.0% of the total number of registered vehicles in the West Bank. During the same year, 2.1% of all registered trucks were involved in traffic accidents, while 1.7% and 3.8% of all registered private vehicles and taxis, respectively, were involved in traffic accidents.

Private vehicles were estimated to be involved in 86.5% of all road accidents in the West Bank during 1991. Trucks were estimated to be involved in 37.9% of all road accidents. This high rate of truck involvement in road accidents may be attributed to the fact that most of the trucks are owned and operated by the private sector, where there is high competition, leading to driving at high speeds. In addition, many of the drivers of these trucks are not their owners and are in general under-educated. A similar conclusion is made for truck high involvement rates in Jordan [4]. There is also no police nforcement regarding truck weight and dimensions limits.

Accident Casualties According to Road-User Category

Figure 4 shows the number of casualties for different road-user categories for the period 1971-1991. Sources of data in this regard do not breakdown the numbers of casualties into killed, slightly or heavily injured for each road-user category. In general, the number of passenger casualties is greater than the number of casualties for any other road-user category. Passenger casualties formed a share of 50.6 % of total casualties in 1991. Driver casualties increased over time, and represent about 26.8 % of total casualties in 1991. Pedestrian casualties' share is relatively stable over time and formed about 20.5 % of total casualties in 1991. A drop in pedestrian casualties during the beginning of the 1980s is noticed, and is attributed mainly to the intensive safety educational programs during the same period, especially those oriented towards schools pupils. Limited numbers of casualties are noticed for bicycle riders and other road-users.

Accident Casualties According to Age Group

Figure 5 shows how the number of casualties vary with age. Available statistics classify casualties into 3 age groups: children (0-14 years), adults (15-64 years), and old people (65+ years), in addition to a casualty class defined as "not known". The number of casualties in the adults group always accounted for about 50% of the total casualties. On the other hand, the number of casualties in the children group represents, in general, about 20%-30% of the total number of casualties for the period 1970-1991, though children form about 48% of the total population. This can be attributed to the children overall lesser involvement in travel activities, although they are considerably exposed to pedestrian accidents.

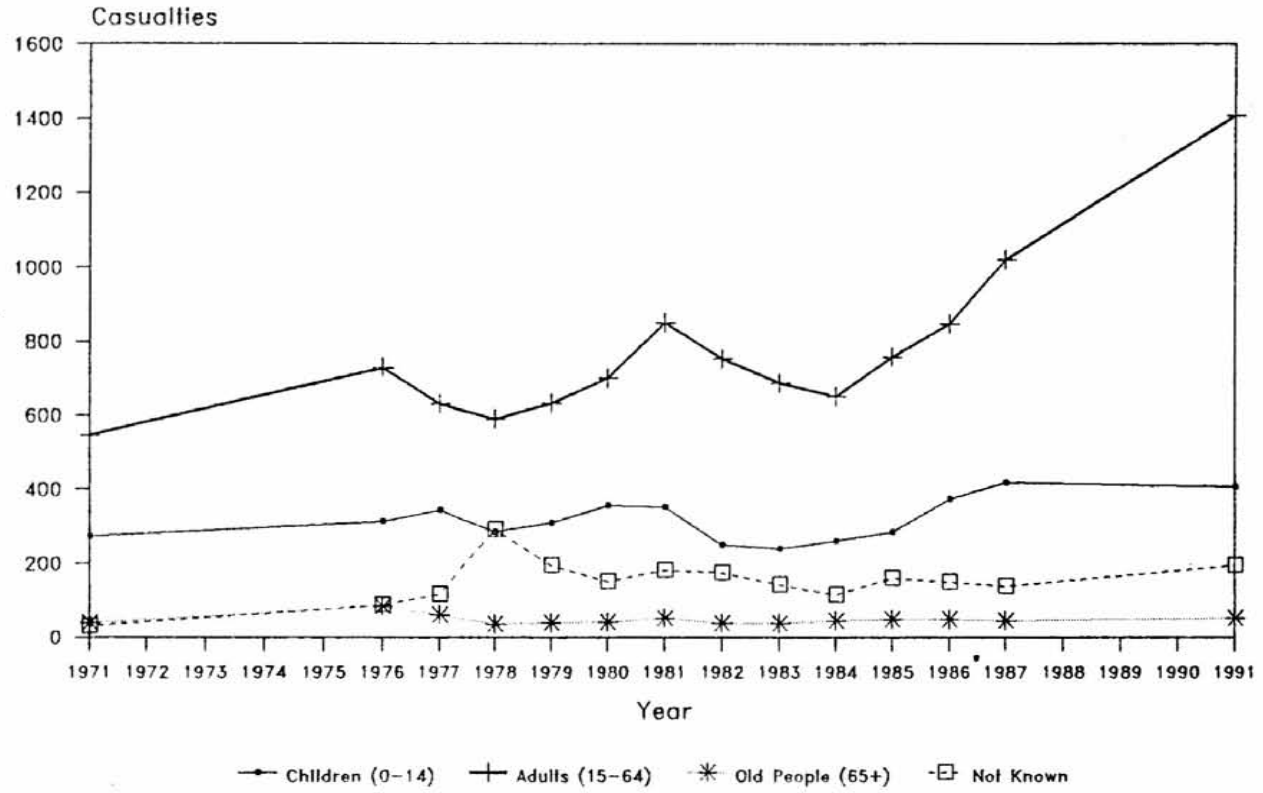

Figure 5. Accident Casualties According to Age of Casualty

In general, the figure shows that there is a drop in the number of casualties of almost all age groups during the late 1970s and the beginning of the 1980s, which can be attributed to the same reasons explaining the drop as presented earlier.

Types and Causes of Accidents

Road traffic accidents are affected by human, vehicle and roadway characteristics. Human errors, mainly driver errors, vehicle conditions and roadway and environmental conditions are considered to be the major causes of traffic accidents.

Figure 6 shows the development of the type of accidents over time as classified based on their end results into: collision with moving vehicle, other collisions, running over pedestrian and others. It is noticed that there was a drop in running over pedestrian accidents during the period 1982-1985, due to the safety educational activities during that period, which were especially oriented towards school pupils, as presented above. In 1991, accidents classified as running over pedestrian represented 40.7% of all road accidents, followed by accidents between moving vehicles, which accounted for 35.1% of all accidents.

In order to study the causes of road accidents, access to detailed accident information was only possible for the district of Ramallah for the first eleven months of 1992 [3]. Because of the lack of any other data regarding the causes of accidents in the West Bank, Ramallah data are assumed to be representative of the causes of accidents in the West Bank. Table 2 presents a detailed list of accident causes as reported during the period from January to November of 1992 in Ramallah District.

According to the statistics illustrated by Table 2, driver errors are directly or indirectly associated with about 84% of all accidents. The most significant single cause of accident is driving above speed limit, causing 24.5% of accidents, followed by the inability to maintain driving on the right side of the road, which caused 17.6% of the accidents. Other driver-related errors include illegal behavior and driving, which accounted for 12.2% of accidents, and close following and illegal passing, where each represented 7.4% of total accidents. Pedestrian errors form about 9.0% of all traffic accidents. Vehicle mechanical failure caused only 1.1% of all the accidents. Roadway, traffic control and environmental conditions are not considered to be relevant in causing traffic accidents according to the information provided by traffic police.

The above analysis reveal that human errors, including driver and pedestrian errors and the failure to follow driving rules, are considered as the prime factor causing the vast majority of traffic accidents in the area studied.

Accident Severity

The development of accident severity in the West Bank is

Table 2. Causes of Traffic Accidents in Ramallah District for the Period (January-November 1992).

Accident Cause	Number	Percent of Total
Failure to maintain driving on the right	33	17.6
Close following	14	7.4
Illegal passing	14	7.4
Above speed limit	46	24.5
Illegal behavior and driving	23	12.2
Vehicle skidding	4	2.1
Vehicle skidding due to snow	2	1.1
Failure to give right of way	8	4.3
Pedestrian improper behavior	17	9.0
Vehicle mechanical failure	2	1.1
Lack of driver's attention	17	9.1
Bicycle rider error	1	0.5
Stressed driver	1	0.5
Unknown	6	3.2

Source of Data: Ba'ba', M., Road Safety in the West Bank (Ramallah: A Case Study), Unpublished B. S. Graduation Project, Birzeit University, 1993.

investigated for the period of study. Severity index is widely defined to express the relative accident severity, but through a number of various methods. Each of these define severity index as the number of fatalities or injuries occurred with respect to a specific safety related variable, which can be the total number of casualties or accidents. One of the widely used definitions of severity index is that expressing, in percent, the number of fatalities to the total number of casualties, which includes the total number of fatalities and injuries. This definition has been used by many researchers such as Jacobs and Hards [11] and Qatamin and Siyam [13].

Figure 7 illustrates the development of severity index over time. It is noticed that the severity index fluctuates in general and ranges from 4.8% to 10.8%. A drop in severity index in noticed between 1979 and 1982 due to the reduction in the number of fatalities during the same period, as indicated above. The apparent reduction in severity index after 1987 does not necessarily reflect an improvement in safety conditions. This reduction is mainly due to the limited travel activities during the Intifadah period, especially that related to inter-urban traffic, despite the slight increase in the number of accidents during the same period.

Development of Fatality Rate Model

The number of fatalities (F) in road accidents in a country have been studied in relation with many variables. Fatality rates were found to be influenced by two main variables, specifically, country's population (P) and the vehicle-kilometers of travel. However, in cases where data on vehicle-kilometers traveled are not available, as in the case of the West Bank, the number of registered vehicles (V) can be used as a substitute [12,14].

A well-known relationship was developed by Smeed to relate road accident fatality rate to motorization level [15]. Road fatality rate was expressed in terms of fatalities divided by the number of registered vehicles (i.e., F/V). Motorization level was expressed as the number of registered vehicles divided by the population (V/P). He developed the following negative exponential model

$$F/V = a\ (V/P)^{-b}$$

In the model, a and b are regression coefficients, where b can be interpreted as the elasticity of fatality rate with respect to motorization level and represents the percent decrease in F/V for 1 percent increase in V/P.

Although the above model had been initially formulated to model cross-sectional data for a number of countries [15], it was later utilized to model time series data for a specific country [2,4]. This model can efficiently explain how traffic safety levels are changing with time (i.e., whether improving or not), and can be used as a basis for comparison of safety levels with

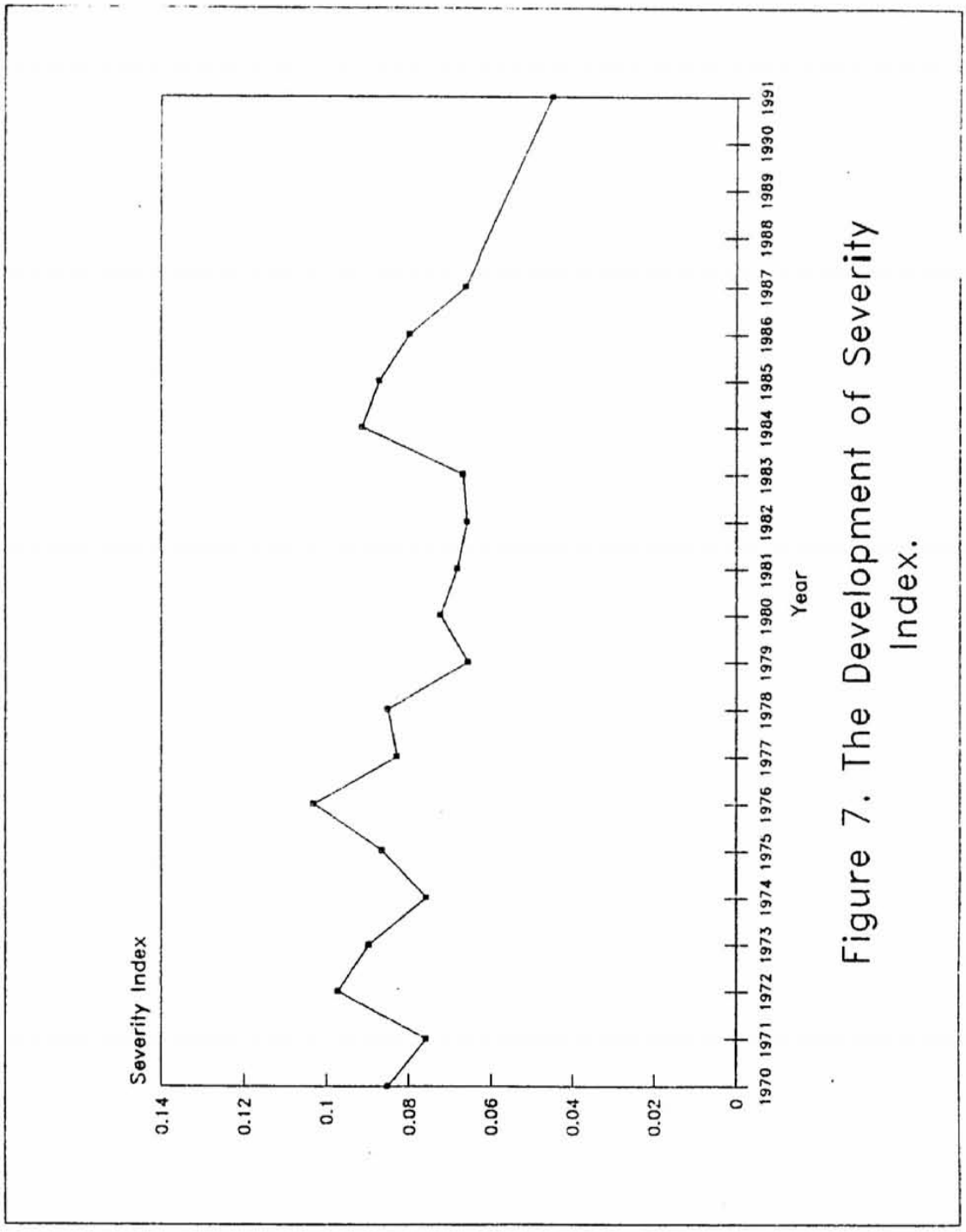

Figure 7. The Development of Severity Index.

other countries.

The time series data for P,V, and F, as presented in Table 1, were used to develop the fatality rate model for the West Bank. The resulting model can be used to express the development of fatality rate over time.

A regression analysis was made on the data for the period 1970-1991 for the West Bank. A linear transformation of the model into a logarithmic form resulted in

$$\log (F/V) = \log a - b \log (V/P)$$

where log (F/V) was regressed on log (V/P). The fatality rate model is estimated by least squares method. The results of regression analysis indicate that the value of a coefficient equals 0.000095 and the value of b coefficient equals 1.091, resulting in the final form of the model as

$$F/V = 0.000095 \ (V/P)^{-1.091}$$

The b coefficient estimate of 1.091 with a standard error of 0.055 indicate that the motorization level is a very strong predictor of the actual fatality rate. Overall, the high coefficient of determination, R^2, for the model of 0.959 indicates that the model very well explains the developments of fatality rate over time. Figure 8 illustrates a plot of the fatality rate with motorization level according to the above model compared with actual data. The figure shows the strong explanation power of the model. Figure 9 shows the development of the fatality rate over time based on the calculations utilizing the above model for a given motorization level for each year, as compared with the actual fatality rate for the same year. Again, the figure shows a close representation of the fatality rates as found through the model with that of actual data.

The figures indicate that the fatalities per 10,000 vehicles dropped significantly from 145 in 1970 to about 13 in 1991. Therefore, the rate of decrease in fatality rate over time is high, and therefore, there is a remarkable decrease in fatality rate with time and with the increase in motorization level. The elasticity as resulted from the above estimated fatality rate model suggests that the percentage decrease in fatality rate is 1.091% for each 1% increase in motorization level, thus resulting in an appreciable decrease in fatality rates due to the abnormal increase in motorization level in the West Bank.

International Comparisons

In order to examine the conditions of traffic safety in the West Bank in relation with those in other countries, international comparisons of road accident fatalities and road fatality rates are essential. International comparisons usually do not utilize accident or casualty rates, as the reporting of these varies widely from country to another, but utilizes fatality rates, which are generally reported with more

reliability. The number of fatalities with respect to the population and the number of vehicles, in addition to the motorization level, are given in Tables 3 and 4, for ten selected countries from allover the world for the period 1977-1987. In Table 3, the 1987 figures are presented, while in Table 4, the percent change in the parameters for the same countries are presented. The year 1987 was considered as the reference year because it is the latest year with statistics not reflecting the impacts of the Intifadah on traffic safety in the West Bank.

It can be shown that although the motorization level for the West Bank reached 699 vehicles per 10000 population in 1987, which indicates a high motorization level as compared with other developing countries, the fatality rates were 1.3 per 10000 population and 18.0 per 10000 vehicles. The fatality rate with respect to the number of vehicles is considered to be relatively high. On the other hand, the fatality rate with respect to the population is considered as moderate in general, but high when compared with those for other developing countries. Developing countries usually with limited vehicle ownership have small rates of fatalities per overall population, but considerably high levels of fatalities with respect to the number of registered vehicles, when compared with the respective rates for developed countries.

The percent change in vehicle ownership in the West Bank for the period 1977-1987 is 202.6%. The percent change in the number of fatalities per 10000 vehicle reached -71.3%, while it reached -10.4% when considering the number of fatalities per 10000 population. The reduction in the fatality rate with respect to the number of registered vehicles is considered very encouraging, when compared with other countries. This indicates an improvement in road safety level in the West Bank, though the resulting level is not up to an acceptable level. This apparent improvement may be attributed to the very high rate of increase in vehicle ownership. The rate of change in the number of fatalities with respect to population is considered to be moderate when compared with other countries.

Road safety level in the West Bank is very similar to that in Jordan. In 1987, road fatalities per 10000 vehicles reached 18.0 in the West Bank, compared with 17.7 in Jordan, while road fatalities per 10000 population reached 1.3 in the West Bank, compared with 1.4 in Jordan. Motorization level in the West Bank, which reached 699 vehicles per 10000 population in 1987, is close to that in Jordan, which reached 771 vehicles per 10000 population. However, the rate of change in fatalities per 10000 population for 1987 with respect to that in 1977 varies greatly, where it showed a slight improvement of -10.4% in the West Bank, the respective rate reached -18.1% in Jordan. Meanwhile, motorization level increased in the West Bank in a remarkable rate of 202.6%, compared with 124.0% in Jordan.

Table 3. Vehicle Ownership and Fatality Rates in Selected Countries for the Year 1987.

Country	Vehicles per 10000 Population	Fatalities per 10000 Vehicles	Fatalities per 10000 Population
United States	7322	2.6	1.9
F.R. of Germany	4855	2.7	1.3
Japan	4078	1.9	0.8
G. Britain	3701	2.5	0.9
Kuwait	3014	4.8	1.5
Israel	2018	5.6	1.1
Jordan	771	17.7	1.4
West Bank	**699**	**18.0**	**1.3**
Niger	278	13.0	0.4
Thailand	50	46.7	0.2
Pakistan	40	121.4	0.5

Source of Data: International Road Federation, World Road Statistics.

Table 4. Percent Change in Vehicle Ownership and Fatality Rates in Selected Countries (1977-1987).

Country	Vehicles per 10000 Population	Fatalities per 10000 Vehicles	Fatalities per 10000 Population
United States	+10.2	-23.5	-15.8
F.R. of Germany	+35.8	-60.8	-46.8
Japan	+45.6	-32.9	-2.3
G. Britain	+26.3	-39.8	-23.9
Kuwait	-9.5	-53.4	-55.9
Israel	+65.4	-60.3	-34.5
Jordan	+124.0	-63.4	-18.1
West Bank	**+202.6**	**-71.3**	**-10.4**
Niger	+7.3	-24.9	-19.3
Thailand	+74.5	-64.1	-37.4
Pakistan	+86.2	-43.2	+6.1

Source of Data: International Road Federation, World Road Statistics, various editions (1978-1990).

Suggested Road Safety Measures and Strategies

After more than quarter a century of Israeli occupation of the Palestinian territories, including the West Bank, with the associated negative impacts on almost all aspects of life, Palestinians should be able to suggest and implement short-term measures and long-term strategies in order to improve road traffic safety in the West Bank. The existing Israeli controlled Road Traffic Department in the West Bank, which has responsibilities in road safety and traffic regulations and control, has only one engineer, and has no remarkable impact in improving road safety conditions in the West Bank.

It is recommended to establish a Palestinian Road Safety Division, within a Palestinian Road Authority or Department of Transportation, which has the responsibility of developing short- and long-term actions and plans to improve road traffic safety in the occupied Palestinian territory. This division should be formed of highly qualified and experienced individuals. In addition, the establishment of unofficial societies, especially oriented towards the prevention of road accidents or the improvement of road traffic safety, is encouraged.

Despite the conclusion reached earlier in the paper, indicating that road traffic safety is improving over time in the West Bank, there is much to be done to improve road safety conditions. A number of short- and long-term actions and policies are suggested below.

The recommended short-term actions are suggested to include:

1. The implementation of traffic engineering studies which aim at improving traffic safety and relieving traffic congestion in general. In addition, it is recommended to provide the proper devices as warranted on urban and inter-urban roads, including guardrails, crash attenuators, signs, markings and traffic signals.

2. The initiation of well designed safety educational programs for the public in general, and for children (school pupils), at specific.

3. Tightening the driver licensing and vehicle registration procedures. It is essential to ensure that only qualified drivers who understand well traffic laws and regulations are granted driving licenses. Applicants for driving licenses should attend a specified number of classroom lectures, in addition to the required written exam and practical training and exam. In addition, deficient vehicles should not be allowed to be registered or to operate on roads.

4. Developing a computerized accident data filing system immediately to record and store all relevant data regarding any traffic accident. This will also assist in studying the various aspects of road traffic safety.

5. Strict enforcement of traffic laws, by increasing road surveillance, and taking the required measures to punish the violators. Special attention should be given to monitor speeds, truck weight limits, as well as the use of safety seat belts.

The recommended long-term actions are suggested to include:

1. Developing and implementing a comprehensive master transportation plan for the occupied Palestinian territory with objectives to meet future transportation needs and to provide for safer transportation facilities.

2. The introduction of the proper geometric design standards and traffic control features for the newly planned highways and roads in the West Bank.

3. Allocation of proper budgets for long-term road and traffic safety improvement plans that will consider all existing roads and highways.

4. Support road safety research and allocation of the required budgets.

Conclusions

An overview of road safety in the West Bank is presented in this paper. Although road accident fatality rates are still considered to be high in the West Bank, it has been illustrated that road safety conditions are improving remarkably over time. Human errors and improper behavior are responsible for most of traffic accidents.

The paper finally suggests the establishment of official and unofficial bodies concerned with road traffic safety in the West Bank. A number of short-term actions and long-term strategies are suggested to improve traffic safety conditions.

References

1. Abu-Eisheh, S. A., et al., Future Transportation Infrastructure Needs for the Palestinian People in the West Bank and Gaza Strip, Report submitted to the United Nations Centre for Human Settlements (HABITAT), The Center for Engineering and Planning, Ramallah, 1989.

2. Al-Suleiman, T. I. and H. R. Al-Masaeid, "Descriptive Model for Fatality Rates of Traffic Accidents in Jordan", ITE Journal, Institute of Transportation Engineers, April 1992, pp 37-39.

3. Ba'ba', M., Road Safety in the West Bank (Ramallah: A Case Study), Unpublished B. S. Graduation Project, Birzeit University, 1993.

4. Gharaybeh, F. A., "Development of traffic Safety in Jordan", Proceeding of the Jordanian Conference on Civil Engineering, Vol. 2, University of Jordan, 1992, pp. 721-738.

5. Hakkart, A. S., "Road Safety in Israel", Technion, Vol. XXVIII, Summer 1990, pp. 22-27.

6. Horn, B. E., "Cultivating Traffic Safety: Experiences and New Approaches", 1989 Compendium of Technical Papers, Institute of Transportation Engineers, 1989, pp. 384-387.

7. International Road Federation, World Road Statistics, various editions, 1978-1990.

8. Ismail, I., "An Overview of Traffic Safety in Jordan", ITE Journal, Institute of Transportation Engineers, Nov. 1988, pp. 43-46.

9. Israel Central Bureau of Statistics, Statistical Abstracts of Israel, various editions, 1979-1992.

10. Israel Central Bureau of Statistics, Judia, Samaria and Gaza Area Statistics, various editions, 1973-1987.

11. Jacobs, G. D. and W. A. Hards, "Further Research on Road Accident Rates in Developing Countries" (Sec. Report), TRRL Report SR 434, Transport and Road Research Laboratory, 1978.

12. Mekky, A., "Road Traffic Accidents in Rich Developing Countries: the Case of Libya", Accident Analysis and Prevention, Vol. 16, 1984, pp. 263-277.

13. Qatamin, N. M. and Y. M. Siyam, "The Effect of Gulf Crisis on Road Accident in Jordan", Proceeding of the Jordanian Conference on Civil Engineering, Vol. 2, University of Jordan, 1992, pp. 699-720.

14. Smeed, R. J., "Variations in the Pattern of Accident Rates in Different Countries and their Causes", Traffic Engineering and Control, Vol. 10, 1968, pp. 364-371.

15. Smeed, R. J. and G. O. Geffcoate, "Effects of Changes in Motorisation in Various Countries on the Number of Road Fatalities", Traffic Engineering and Control, Vol. 12, 1970, pp. 150-151.