AN ANALYSIS OF FACTORS AFFECTING ROAD SAFETY: THE GREEK EXPERIENCE

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Abstract

This paper presents an analysis of factors affecting road safety in Greece. Disaggregate data about the road user, the road environment and the vehicle are considered in an effort to reveal the critical characteristics of each factor. Specific road user groups together with specific road network types and traffic characteristics are identified as requiring special treatment. The comparison of road accident indices among Greece, the EU member states, USA and Japan reveals that the road safety level in Greece is relatively low. This is mainly explained by the inappropriate road infrastructure, the lack of persistent implementation of the road safety measures and the behavioural particularities of the Greek driver. In concluding, this paper proposes a number of priority recommendations for Greece.

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1. INTRODUCTION

Over the last twenty years, the number of persons killed in road accidents in Greece has almost doubled. In 1994, a total of 1,909 road users were killed, and 30,297 injured in 22.222 road accidents involving injury in Greece. The persons killed and injured as well as the material damages of the road accidents consist a major problem for the Greek economy as well as for the Greek society[1].

The analysis of road accident causes consists a fundamental tool for the improvement of safety in a road network[2]. This paper presents an analysis of factors affecting road safety in Greece in an attempt to clarify some reasons for which the Greek road network is less safe than those of the other EU countries. More specifically, some European comparisons of basic accident statistics are initially presented; then the road user, the road environment and the vehicle are considered as these are the main factors affecting road safety in Greece[3]. The conclusions of the analysis lead to a number of recommendations for the improvement of the road safety level.

It is noted that for the purposes of this paper the national and international road accident data bases of the Department of Transportation Planning and Engineering of the National Technical University of Athens (NTUA) were used. More specifically, national data have been retrieved from the national disaggregate data files. International data were retrieved from a data base formed in the NTUA as a synthesis of data from various publications of international organizations[4, 5, 6, 7, 8].

2. INTERNATIONAL COMPARISONS

When killed persons per vehicle are considered, Greece has the highest index (788 killed persons per million vehicles) as compared to the EU average one (251 killed persons per million vehicles). It is worth mentioning that, with the exception of Portugal, all other EU countries have road accident indices less than half of the Greek one. Similar comparison of another road accident index, namely the number of killed persons per million inhabitants shows also equivalent trends[9].

In absolute figures, for the period 1975 - 1995, the number of killed persons in road accidents in Greece increased by 142%, whereas on average in the other European Union countries it has decreased by 34%. This phenomenon is partly explained by the fact that the vehicle fleet in Greece increased by 384% while in the EU countries showed an average increase of 98%. Thus, the twenty-year trend (95/75) of the number of killed persons per million vehicles for Greece shows a decrease of 53% which is not far from relevant EU average decrease of 65%.

The corresponding changes in USA and Japan during the above period, as presented in Table 1, were 5% and 12% decrease respectively in the number of killed persons in road accidents, 44% and 118% increase respectively in the number of vehicles, and 35% and 60% decrease respectively in the number of killed persons per million vehicles.

*** Insert Table 1. here ***

It is worth mentioning that for the comparison of absolute numbers of killed persons, the common definition of killed person in a road accident has been used, which comprises all persons that died within 30 days from the day of the accident[10]. In the case of Greece, the numbers provided by the National Statistical Service refer only to deaths on the spot. The number of killed persons according to the above definition can be found by multiplying this figure by a correction coefficient 1,3[11].

It should be added that in most European Union countries important long-term road safety programs were launched supported by substantial budgets, which contributed to an important decrease in the number of road accidents and of their casualties[12]. Lack of such a coherent road safety program in Greece is one of the reasons for the low level of road safety in this country. The lately developed European Union policy in the field of road safety (legislative decisions and directives for drivers and vehicles together with support of promotion actions)[13] has started to affect the way road safety decisions are taken in Greece but has not produced yet any spectacular results.

3. THE ROAD USER

Table 2 presents an overview of the distribution of the number of persons killed by age group, sex and road user type. Even though the distribution of killed persons among men and women is 77% and 23% respectively, further breakdown of these percentages by road user type shows that 96% of killed drivers are men, whereas the corresponding percentages for killed passengers and pedestrians are 53% and 62% respectively.

It is interesting to note that out of the total number of killed persons 52% are drivers, 24% are passengers and 24% are pedestrians. Variation within these three road user types is less important for passengers but presents important peaks in different age groups for the drivers (15 - 35) and the pedestrians (55+). It should be stressed that although these percentages give a broad overview, they do not take into account exposure, and as a consequence no valid conclusions can be extracted through cross comparisons about the behaviour of each of the above groups.

Further observation of the age group distribution of killed persons revealed some interesting facts such as:

(i) Age group distribution among pedestrians shows that 52% of the total number of pedestrians killed are more than 64 years old, whereas killed pedestrians aged up to 44 years present very low percentages.
(ii) For each cross combination of age group and road user type the nembers of persons killed are always higher for men than for women except for women passengers of more than 35 years old.
(iii) Distribution of killed men drivers among age groups presents the peak percentage at the age group 15-24 while the peak percentage for killed women drivers is found at the age group of 25-34.

*** Insert Table 2. here ***

The distribution of the number of killed persons per month, day of the week and hour of the day was also considered. It was found that the months with the highest rates are the summer months July (12% of the total) and August (11%), probably due to the increased concentration of traffic at specific touristic routes and areas. On the contrary, the lowest numbers occur in January (6%) and February (5%) when weather conditions do not favour high numbers of vehicle-kilometers.

The hourly variation shows that a significant number of fatal accidents occur during the evening hours (between 6 p.m. and midnight a 30% of the total number of accidents was recorded). This can attributed to the specific night life habits concerning entertainment in Greece.

4. THE ROAD ENVIRONMENT

The consideration of road accidents and related killed persons inside and outside built up areas in Greece reveals that accidents in the interurban network (national and regional roads) are, as expected, more serious, probably due to higher travel speeds. It is worth mentioning that injury accidents occur at a percentage of 73% inside built up areas, while only 45% of the total number of killed persons are killed in these accidents. Furthermore, the accident severity inside built up areas increases when these areas are crossed by roads of the regional or national network (Table 3). Only 9% of the total number of accidents occur in national or regional roads crossing a built up area, but the respective percentage for killed persons is 24%.

Typical views of some of the road types which can be found in Greece are presented in Figures 1 and 2.

*** Insert Table 3. here ***

The severity of accidents by accident type was also considered. Table 4 shows clearly that the most serious accident types in Greece, for both urban and rural areas, are collisions to fixed object or vehicle, pedestrian accidents and coming off the road. On the contrary, lateral, at angle and rear-end collisions present less important severity. Accident severity varies considerably inside and outside built up areas and presents, as expected, its peak value for pedestrian accidents outside built up areas (32 killed per 100 injured persons). It is worth mentioning that, in contrast to the existing belief, head-on collisions are not the cause for the most serious accidents. This conclusion applies not only for accidents inside built-up areas where such a fact would be rather expected, probably due to low speeds, but also outside built-up areas, where: head-on collisions lead to serious accidents, but other accident types lead to more fatalities per 100 persons injured.

*** Insert Table 4. here ***

*** Insert Figures 1 and 2 ***

5. THE VEHICLE

Lack of traffic data (vehicle- kilometres, passenger-kilometres) makes the analysis of the role of vehicle type on road accidents a very difficult task. The fact that in 85% of the road accidents a passenger car (79%) or a taxi (7%) was involved provides only general utility information as no information about the exposure to road accident risk exists. Furthermore, information such as, e.g. 26% of persons were killed in accidents where a two-wheel motor vehicle was involved (37% inside and 17% outside urban areas) or, 34% of persons were killed in accidents where a lorry was involved (25% inside and 40% outside urban areas) leads rather to conclusions about traffic characteristics than about safety behaviour.

The use of the severity index: number of persons killed per 100 persons injured, gives some useful safety conclusions. Table 5 reveals that the highest accident severity is found in accidents where heavy trucks (> 3.5 ton) or high power motorcycles (> 750 cc) were involved in the accident, with respective severity indices 12 and 10. These two vehicle types are those with the highest accident severity inside urban areas (9 and 8 killed persons per 100 injured respectively). Outside urban areas, increased severity is also observed in accidents where bicycles (14 killed per 100 injured), motorcycles with capacity between 250 and 750 cc (12) and buses (11) were involved.

*** Insert Table 5. here ***

6. CONCLUSIONS AND RECOMMENDATIONS

The analysis of disaggregate data affecting road safety is obviously a very useful tool for designing the national road safety policy[14]. On the basis of such an analysis for Greece, specific road user groups together with specific road network types and traffic characteristics were identified as requiring special treatment.

Legislation as well as information campaigns should be designed to meet in the most appropriate way the particularities of each case. Attention should be focused to the specific road user groups presenting problems as far as safety is concerned. These groups include children and elderly pedestrians, pedestrians outside built-up areas, young drivers, heavy truck (> 3,5 ton) drivers, high power motorcycle (> 250 cc) drivers and bicycle drivers outside built-up areas.

Furthermore, road infrastructure improvements for particular types of road network and for particular road elements as well as measures for specific traffic conditions are necessary. These refer to: the national road network crossing built-up areas, the municipal road network outside built-up areas, pedestrian crossings, collisions with fixed objects, increase of traffic during July and August and traffic conditions after 6 p.m.

It can be argued that the low level of road safety in Greece is mainly due to the inappropriate road infrastructure and the lack of persistent implementation of road safety measures, together with the behavioural particularities of the Greek driver[15]. All main accident factors (road user, road environment, vehicle) require thorough and continuous investigations concerning their effects on road accidents followed by the implementation of an efficient and long-term program for road safety improvements. Even though a number of road safety measures [e.g. wearing of seat belts (cars) and helmets (motorcyclists), intensification of alco-tests, sporadic upgrading of design elements in the road network, periodical technical tests of all vehicles, updates of the Road Traffic Code][16] have been introduced in Greece during the last decade, their enforcement was neither systematic nor persistent. Consequently, no serious impact of these measures towards the improvement of road safety in Greece has been identified.

On the basis of the above analysis concerning road safety in Greece and the relevant experience[17, 18, 19, 20], a number of steps are recommended for the improvement of the existing situation. These recommendations are summarised to the following points:

(1) There is need for the formation of a national road safety policy aiming at the progressive decrease of road accidents and their victims. The formation of this policy together with its implementation should be co-ordinated by a National road safety body[21].
(2) Road safety should be continuously monitored both in aggregate and disaggregate level allowing reliable and effective analysis. Decisions for improvements should be taken after appropriate studies, while the evaluation of the implemented measures should be ensured by "before" and "after" studies.
(3) There is need for speeding up the interventions for improving the infrastructure in both the interurban and urban road network. These interventions should concern among others, geometric characteristics, pavements, signs, etc. The newly introduced concept of road infrastructure management should be enhanced with the determination of satisfactory road safety standards.
(4) Information and education campaigns should be carried out periodically, focusing on critical road safety issues such as drinking and driving, speed excess, use of seat belts, young drivers, etc.
(5) The enforcement of a safer traffic behaviour should focus more on the re-training of road users and less on their punishment. The use of advanced technologies can contribute significantly to a more efficient enforcement of various measures for safer driving.
(6) The procedure for acquiring a driving licence should be upgraded towards forming a driver behaviour of increased responsibility.
(7) The implementation of an effective road safety policy requires important resources including human work-effort, money and time. A higher level of road safety can be achieved only by continuous and systematic effort.

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Table 1. Trends in the number of killed persons, vehicles and killed persons per million vehicles

	KILLED (within 30 days)				VEHICLES				KILLED PER MILLION VEHICLES			
	1975	1985	1995*	% 95/75	1975 x 1000	1985 x 1000	1995* x 1000	% 95/75	1975	1985	1995*	% 95/75
GR	1.060	1.908	2.560	142%	650	1.882	3.147	384%	1.631	1.014	813	-50%
EUR 15	67.844	50.804	44.941	-34%	92.619	131.703	183.410	98%	733	386	245	-67%
USA	43.635	43.825	41.244	-5%	132.962	171.653	193.299	45%	328	255	213	-35%
JAPAN	14.030	12.039	12.285	-12%	28.934	48.268	62.962	118%	485	249	195	-60%

Source: European Commission, ECMT, IRTAD **1995: estimation*

Table 2. Number of killed persons by age group, sex and road user type (1987-1993).

	Drivers		Passengers		Pedestrians		Drivers	Passengers	Pedestrians			Total	%
Age	M	F	M	F	M	F				M	F		
0-4	0	0	30	20	44	18	0	50	62	74	38	112	1%
5-14	51	3	106	63	80	65	54	169	145	237	131	368	3%
15-24	1.655	67	587	374	108	51	1.722	961	159	2.350	492	2.842	24%
25-34	1.415	77	289	222	120	45	1.492	511	165	1.824	344	2.168	18%
35-44	858	46	151	195	96	40	904	346	136	1.105	281	1.386	12%
45-54	747	31	142	168	136	85	778	310	221	1.025	284	1.309	11%
55-64	736	13	143	179	268	179	749	322	447	1.147	371	1.518	13%
65+	438	5	125	158	891	573	443	283	1.464	1.454	736	2.190	18%
Total	5.900	242	1.573	1.379	1.743	1.056	6.142	2.952	2799	9.216	2.677	11.893	100%
%	96%	4%	53%	47%	62%	38%	52%	25%	24%	77%	23%		

Table 4. Deaths per 100 Injured persons by road type and accident type.

Accident type	Inside Built up area	Outside Built up area	Total
Head-on collision	3	12	8
At angle collision	2	9	4
Lateral collision	2	4	2
Rear-end collision	4	5	4
Fixed object/vehicle collision	9	12	10
Pedestrian accident	7	32	10
Came off the road	8	10	10
Total	**4**	**11**	**6**

Table 3. Deaths per 100 injured persons by road type.

	Inside Built up areas	Outside Built up areas	Total
National	10	14	13
Regional	7	9	9
Municipal	4	12	4
Total	4	11	6

Table 5. Deaths per 100 Injured persons by vehicle type (1985 -1993)

Vehicle type	Inside urban area	Outside urban area	Total
Passenger Car	2	8	4
Taxi	2	8	3
Lorry < 3,5 tn	3	8	6
Lorry > 3,5 tn	9	14	12
Lorry total	**5**	**10**	**7**
Bus	4	11	6
Bicycle	3	14	5
Two-wheel < 50 cc	2	7	3
Two-wheel 50 - 125 cc	2	8	3
Two-wheel 125 - 250 cc	3	9	4
Two-wheel 250 - 750 cc	5	12	7
Two-wheel > 750 cc	8	17	10
Two-wheel total	**3**	**9**	**4**
Total	**4**	**11**	**6**

Figure 1. Typical view of four-lane, two-way road of the national network, with median (outside built-up areas)

Figure 2. Typical view of two-lane, two-way road of the regional network (outside built-up areas)