Injuries and fatalities in Turkish road traffic accidents

M. Gökdağ, M. D. Kaya, A. Atalay and A. S. Haşiloğlu

This study aims to describe quantitatively the injuries and fatalities from high rates of serious road traffic accidents (RTAs) in Turkey, to identify any trends during the period 1980–2000, to compare the results with those of developed countries and to evaluate the information available on possible causes with a view to identifying the most useful direction for future research. Data were obtained from the Turkish police, State Institute of Statistics, health sources and, for international comparison, from the published literature. Estimates of trends were made using linear regression. The results revealed that during the period 1980–2000, the rates of RTAs per 100 000 population and per 100 000 motor vehicles increased. Deaths in each RTA increased in the short period (1980–1987) and declined during the period 1987–2000. RTA injuries during the period 1980–2000 increased steadily. Between 1980 and 2000 the severity rate (the ratio of fatalities per 1000 RTAs) decreased threefold in Turkey. Turkey's rates were compared to a number of selected countries. Further investigation requiring close collaboration between police and health authorities is therefore essential.

1. INTRODUCTION

The lifestyle of the people of Turkey has changed remarkably during the last 30–35 years. Gross domestic product and per capita incomes have grown rapidly, leading to increases in population, and a greater number of motor vehicles and roadway networks. Between 1980 and 2000, the population of Turkey increased at an annual average growth rate of 2%. Likewise, the number of registered motor vehicles increased at an annual average growth rate of 7.6%.¹ Rising numbers of road traffic accidents (RTAs) and consequent increases in injuries and fatalities accompanied these changes. According to official reports of the State Institute of Statistics Prime Ministry RTA Statistics in Turkey,² the RTA problem is now the second most common cause of death in the country and the leading cause of serious injuries and disabilities among adults.³ In Turkey in 2000, 115 877 people were injured, of whom 3941 (3.4%) died.² The problem therefore constitutes a major concern for public health and the country's economy, and a sizeable burden to Turkey's healthcare and economic resources.

In most developed countries, the problem of RTAs has attracted increasing research and safety interventions, resulting in a

reduction of the size of the problem in many of these countries.^{4–8}

The objective of this paper is to describe quantitatively the injuries and fatalities from RTAs in Turkey, to identify any trends during the period 1980–2000 and to compare these data with the equivalent rates in developed and developing countries. Attempts have also been made to evaluate the possible causes of RTAs in Turkey using routinely collected data from the Turkish police sources. It is likely that this effort will help to establish the baseline facts about the problem of RTAs in Turkey and therefore the most useful direction that future national research and programmes on roadway traffic safety should take.

2. MATERIAL AND METHODS

A retrospective analysis was conducted, based on the data obtained from Turkish official reports on RTAs, RTA injuries and deaths, for people of all ages in Turkey during the period 1980–2000. High estimates for accident reporting are claimed by police authorities and are achieved by insisting that all garages and repair establishments ignore any vehicle involved in an accident unless a police report on the accident is produced, with severe penalties for both drivers and garages that fail to comply with these measures.

According to Turkish police sources, the definition of an RTA includes all traffic-related accidents that result in injury or death to road users (drivers, passengers, pedestrians, cyclists and motorcyclists); the definition of RTA injuries includes all traffic-related, non-fatal injuries; and the definition of RTA fatalities includes all traffic-related deaths that occur within 30 days from the accident. The annual crude rates of RTAs, RTA deaths and injuries (per 100 000 population and per 100 000 registered motor vehicles) were calculated to estimate the lay trends of the RTA problem in Turkey. The severity rates of injury and death per 1000 RTAs (the ratio of injuries and fatalities to accidents) were also calculated to quantify the risk of injury or death in RTAs. Empirical data for the rates of RTAs, RTA injuries and RTA fatalities were obtained from the Ministry of Interior Annual Statistical Report,² R.T. General Directorate of Highways,⁹ State Institute of Statistics of Prime Ministry RTA Statistics,² State Institute of Statistics of Prime Ministry Annual Statistical Reports¹ and the MoH Annual Statistics Report.³ Population denominator data were obtained from Turkey Annual Statistical Abstract.¹⁰ The data for

comparison were obtained from the published literature^{5,6,11} and the WHO Statistics Annual (1985–1996).¹² Trends of RTAs, RTA deaths and injuries for 1980–2000 were estimated using linear regression analysis. The age and gender of road users injured or killed during 1980–2000 were also analysed.

Prior to 1990, Turkish police used to publish summary reports containing few details of RTA causal factors. Subsequent improvements in these reports, especially the reporting of RTA causal factors, permitted attempts to be made to determine the specific causal factors of RTAs. These factors include speeding, careless driving, personal factors (e.g. fatigue, driving under the effect of medical drugs, alcohol, etc.), environmental and vehicle conditions.^{13–15} Hence, the data for 1990–2000 were analysed to describe the possible factors. All data variables were processed and analysed using the statistical programmed SPSS 10. Tables and graphs were prepared using Microsoft Excel 98.

3. RESULTS

Motor vehicle traffic fatalities are an important public health problem in both developed and developing countries. When Turkey's fatality rates from RTAs for the period 1985–1995 were compared with the equivalent rates in a number of developed and developing countries including Portugal, Norway, USA, Australia and Kuwait,¹⁶ it could be seen that RTAs clearly presented a grave public health, social and economic problem in Turkey (Fig. 1). For the rate based on the population, the UK and Norway were the lowest of those countries; Turkey's rate was higher than those of the UK and Norway. However, the number of deaths in RTAs per 100 000 persons seems to be low. When compared with the UK,

Norway, and some Eastern European countries that have witnessed a similar pattern of swift transition to market economies at the end of the 1980s, Turkey still had higher rates. For the rate based on motor vehicles for the year 1991, Turkey's rate was by far the highest and was six times higher than the mean rate of the comparison group of countries (Fig. 2).

Between 1980 and 2000 the size of the Turkish population increased at an average rate of 2.2% per year. Likewise, the number of registered motor vehicles increased at a rate of 7.6%, averaging 7.1% per year between 1980 and 1985 and 8.0% between 1986 and 2000. This rising trend was accompanied by an increase in the numbers of RTA injuries, but a decrease in the numbers of RTA fatalities (see Table 1).

The trend analysis of these data, using linear regression, revealed the following respective trend components: +46.47 ($P < 0.001$; $R^2 = 0.93$) for RTA injuries and -17.7 ($P > 0.05$; $R^2 = 0.01$) for RTA fatalities. The action taken by traffic police as well as imposed speed limits reduced the number of deaths in traffic accidents, but because of the low level of seat-belt usage in Turkey and the number of the accidents not decreasing, the number of injuries increased.¹

These increases were accompanied by increases in the rate of RTAs and RTA injuries but a decline in the number of RTA fatalities during the same period (see Table 2 and Figs 3–5). The trend analysis of these rates, calculated on the basis of resident population and number of registered motor vehicles, revealed rising and declining trend components per 100 000 population of

Fig. 1. Fatality from road traffic accidents for Turkey and some selected countries (1985–1995)

Fig. 2. Fatality rates per 100 000 motor vehicles in Turkey and some selected countries (1991)

- +2.98 ($P < 0.001$; $R^2 = 0.65$) for RTAs
- -0.21 ($P = 0.03$; $R^2 = 0.37$) for RTA fatalities
- +5.70 ($P < 0.001$; $R^2 = 0.79$) for RTA injuries.

Per 100 000 registered motor vehicles, the trend components were

- -38.17 ($P < 0.005$; $R^2 = 0.34$) for RTAs
- -16.06 ($P < 0.001$; $R^2 = 0.91$) for RTA fatalities
- -45.37 ($P = 0.025$; $R^2 = 0.24$) for RTA injuries.

Paradoxically however, except for a short period (1980–1987), these increases were accompanied by a persistent decrease in the severity of injury and the rate of death per RTA (Table 2, Figs 6 and 7). Since 1988 the severity of injury per 1000 RTAs has increased; but since 1980 the rate of death per 1000 RTAs

in Turkey has been reduced threefold, and the trend components of these rates has decreased.

During the period 1980–2000 there were a total of 119 380 RTA deaths in Turkey (Table 3). Of these deaths, 19.7% were female and 80.3% were male. Children aged 0–5 years accounted for 10.0% of the total RTA deaths and those aged 6–14 years accounted for 7.4%. Adults aged 15–44 years accounted for a proportion of 50.6%, which was similar to the proportion of the population in this age range (46.7%). Of all RTA casualties during that period, motor vehicle occupants (drivers, passengers and motorcyclists) accounted for an average of 82% while pedestrians and cyclists accounted for 18%. The rate of pedestrian and cyclist casualties declined slowly from 34% in 1990 to 19% in 1997 since bicycle use is not so common in Turkey. However, this rate increased slightly in 1997–1998 but decreased to 18% in 2001 (Fig. 8). Non-Turkish citizens (expatriate workers and their families) accounted for an average of 3.0% and Turkish citizens accounted for an average of 97% of total RTA deaths.

The analysis of the pattern of alleged causal factors revealed some changes during the period 1990–2000 (Table 4). Careless driving was found to be the largest contributing factor for RTA deaths in Turkey over these years followed by vehicles exceeding speed limits and other factors. The percentage contribution of careless driving among other factors increased from 40.3% in 1990 to 49.5% in 1993. However, the effect of this factor decreased to 39.5% in 1994 before rising again thereafter. The contribution of speeding—the second most common cause of RTA deaths in Turkey—declined from 30.6% in 1990 to 26% in 1994 and again to 22% in 2000. The contribution of personal factors—the third most common cause of RTA deaths—declined, decreasing from 19.1% in 1990 to 12.5% in 1996 before increasing slightly to around 19.8% in

Years	Resident population	Number of registered vehicles	Number of RTAs	Number of RTA deaths	Number of RTA injuries
1980	44 737 000	1 344 254	18 500	4199	24 608
1981	45 540 000	1 420 688	20 293	4441	29 744
1982	46 688 000	1 502 370	22 560	4884	35 976
1983	47 864 000	1 610 681	27 225	5201	44 769
1984	49 070 000	1 751 834	29 813	5731	50 521
1985	50 664 000	1 888 767	32 000	5680	52 586
1986	51 433 000	2 075 408	44 925	7315	71 264
1987	52 561 000	2 258 500	54 001	7530	80 321
1988	53 715 000	2 456 688	53 600	6846	79 174
1989	54 840 000	2 659 778	50 900	6332	80 013
1990	56 470 000	2 981 222	55 770	6286	87 693
1991	57 291 000	3 307 324	56 536	6231	90 520
1992	58 379 000	3 756 137	58 304	6214	94 824
1993	59 478 000	4 380 060	63 289	6457	104 330
1994	60 587 000	4 711 208	62 584	5942	104 717
1995	61 706 000	4 975 331	66 029	6004	114 319
1996	62 841 000	5 317 565	62 696	5428	104 599
1997	63 989 000	5 810 081	63 259	5181	106 146
1998	65 145 000	6 264 084	65 245	4935	114 552
1999	66 304 000	6 62 6885	63 515	4596	109 899
2000	67 853 000	7 161 379	64 590	3941	115 877

Table 1. Numbers of road traffic accidents, RTA deaths and injuries in Turkey (1980–2000)

Year	RTA fatality rates				RTA injury rates			
	RTA fatalities	Per 100 000 resident population	Per 100 000 resident motor vehicles	Per 1000 road traffic accidents	RTA injuries	Per 100 000 resident population	Per 100 000 resident motor vehicles	Per 1000 RTAs
1980	4199	9.4	312	236	24 608	55	1831	1333
1981	4441	9.8	313	225	29 744	65	2093	1416
1982	4884	10.5	325	217	35 976	77	2395	1499
1983	5201	10.9	323	189	44 769	94	2778	1646
1984	5731	11.7	327	192	50 521	103	2885	1695
1985	5680	11.2	301	178	51 586	102	2731	1617
1986	7315	14.2	352	163	71 264	138	3434	1587
1987	7530	14.3	333	139	80 231	153	3552	1487
1988	6846	12.7	279	127	79 174	147	3222	1477
1989	6332	11.5	238	124	80 013	146	3011	1572
1990	6286	11.1	211	112	87 693	155	2942	1574
1991	6231	10.9	188	110	90 520	158	2737	1602
1992	6214	10.6	165	106	94 824	162	2525	1626
1993	6457	11.0	147	102	104 330	175	2382	1648
1994	5942	9.8	126	95	104 717	173	2223	1675
1995	6004	9.7	121	91	114 319	185	2298	1732
1996	5428	8.6	102	87	104 599	166	1967	1668
1997	5181	8.0	89	82	106 146	166	1827	1677
1998	4935	8.0	79	77	114 552	175	1828	1757
1999	4596	6.9	69	72	109 889	165	1658	1731
2000	3941	5.8	55	61	115 887	171	1618	1794

Table 2. Rates of road traffic accident fatalities and injuries in Turkey (1980–2000)

2000. Environmental and vehicle conditions appeared to be relatively less important, as both showed persistent declines. Alcohol consumption was never very high, and there was a notable percentage decrease in its contribution.

4. DISCUSSION

When Turkey's fatality rates from RTAs were compared with equivalent rates in other developed and developing countries, RTAs appeared to present a grave public health, social and

economic problem in Turkey. For the rate based on motor vehicles for the year 1991, Turkey exceeded all other countries in the list. Except for the period 1980–1987, however, the rates of RTA fatalities showed progressive declines. These declines were most probably attributable to improvements in roadway traffic engineering and design, roadway traffic controls and the provision of other safety measures on the roads. Most of the roads in Turkey are now double-lane roads, fully illuminated at night and well equipped with traffic signs in general. Moreover, from the early 1990s, many safety interventions

were made to curb RTAs including the enforcement of speed limits with speed radar systems, steel guard-rails along road edges, and so on.⁹ From 1980 the risk of death from RTAs in Turkey has progressively declined; that is, death rates per 1000 RTAs have decreased by more than threefold between 1980 and 2000. From 1989, however, the risk of injury per RTA has seen a gradual and progressive increase; that is, the severity injury rates per 1000 RTAs has increased gradually between 1989 and 2000. These patterns suggest that, whereas improvements in traffic management and roadway design have reduced the number of RTA deaths per fixed population, the number of RTA injuries per fixed population were actually increasing.

While the precise reason(s) for the increasing RTA severity in Turkey still remain unclear (due to the limitations of this study), a number of underlying factors might have contributed to it. In particular, the low level of seat-belt usage in Turkey and a failure of casualty management could be to blame.

First, despite mandatory seat-belt usage,¹⁷ the rates reported in 2000 for seat-belt use in Turkey were below 6%. Second, smaller vehicles on the roads have replaced the older, heavier, passenger car models in Turkey.⁹ It is established that smaller vehicles have higher occupant injury rates because of the smaller interior space in which occupants can decelerate. The wheelbase—the distance from the front to rear axle of the vehicle—is the best predictor of differences in fatality rates due to different vehicle sizes.⁸ Third, the increasing difficulty in the management of serious injury following RTAs could be to blame.¹⁸

In Turkey there is a very low level of first-aid knowledge in the community. Until recently there was a general fear of blame being attached to those who attempted to help at an accident scene. While there are well-equipped ambulances in Turkey, they are not radio dispatched and are rarely staffed with personnel knowledgeable in casualty handling or first aid. It seems reasonable to suppose that, as RTAs become increasingly complex, progressively greater skill in first aid will be needed to manage the victims of these disasters. Road engineering and hospital services have reached a high standard in Turkey but there is an important service gap still to be filled in pre-hospital care. Finally, it is suggested that the factors so far discussed may not be sufficient to account for the increased severity of RTAs found in this study.

The three categories of RTA causal factors with persistently high percentages (careless driving, speeding and personal factors) were most probably attributable to lack of competence and judgement on the part of the driver; but the precise underlying reasons require further investigation. The low percentage of accidents linked with alcohol is presumably reflecting its cultural disapproval, but since the rate of alcohol consumption is increasing continuously there is an accompanying increase in accidents. The contribution of drugs cannot yet be defined in the absence of a roadside test.

The analysis of the gender, age structure and road user groups of RTA casualties during 1980–2000 showed that the proportion of RTA deaths among adults from the 15–44 years age group (50.6%) was similar to their proportion of the population (46.7%) during 1980–2000. Children aged 0–14

Age group	Males	Females	Citizens	Non-citizens	Total	%
0–5	8 520	3 475	11 690	305	11 995	10.0
6–14	6 697	2 087	8 560	224	8 784	7.4
15–44	51 415	9 041	59 345	1 111	60 456	50.6
45–49	17 351	4 863	21 507	707	22 214	18.6
>60	10 014	4 007	13 810	210	14 020	11.8
Unspecified	1 910	—	700	1 210	1 910	1.6
Total	95 907	23 473	115 613	3 767	119 380	100.0

Table 3. Distribution of road traffic accident fatalities in Turkey to age, sex and nationality (1980–2000)

Fig. 8. Casualties per 100 000 population according to road-user groups (1990–2001)

years accounted for 17.0% of all RTA deaths, a result that implies that children involved in RTAs in Turkey are more likely to be killed. The rate of pedestrian and cyclist casualties (per 100 000 population) declined slowly from 34% in 1990 to 18% in 2001, which reflects the effect of the recent safety improvements of roadway design in Turkey on this user group. These improvements included the extension of median barriers, steel guard-rails along road edges, and provision of passageways at pedestrian crossings on most Turkish roads.⁹

5. CONCLUSION

The study confirmed the status of RTAs as a major and increasing cause of social, health and economic problems in

Turkey. Despite huge investment in roadway traffic infrastructure, the increase in RTAs can clearly be demonstrated. There is obviously a need to elucidate more precisely the underlying factors, and a key area to investigate is the effectiveness of traffic safety measures that have been introduced over the previous years, including enforcing speed limits on highways.¹⁹ For example, frequent police reports in Turkey suggest that the use of fixed positions for speed radar on highways and the possibility of widespread use of radar detectors that warn speeding drivers of the presence of mobile radar cameras, might have reduced the likelihood of spotting violating drivers, thereby leading to the persistent increase in the severity of RTAs.

An immediate step to control the problem would be to increase police surveillance on the roads in order to enforce traffic safety regulations (e.g. seat-belt laws and speed limits)²⁰ and to conduct effective education campaigns on safe driving, roadway risk factors and safety precautions. These activities should be accompanied by legislation imposing severe penalties on careless driving and speeding. Another key area for reducing fatality on the roads would be the prompt and appropriate management of casualties at the roadside and during transportation to hospital and the training of traffic policemen and ambulance personnel in first aid. Finally, a computer-based surveillance system for RTA injuries is essential to support prevention strategies and to promote safety on the roads. Such a system would integrate police and hospital data to facilitate the identification of risk factors that cause RTA injuries.

Years	Careless driving: %	Excessive speed: %	Personal factors: %	Alcohol: %	Vehicle condition: %	Environmental factors: %	Unspecified conditions: %	Total: %
1990	40.3	30.6	19.1	5.3	2.1	—	2.6	100
1991	37.9	29.5	17.2	5.1	2.0	0.9	7.5	100
1992	40.2	27.4	14.3	4.8	1.7	1.0	10.6	100
1993	49.5	28.3	13.2	3.8	1.5	0.5	3.2	100
1994	39.5	26.3	19.7	4.6	1.4	0.9	9.5	100
1995	48.1	28.5	14.1	4.8	1.5	0.5	2.5	100
1996	46.3	29.5	12.5	5.0	1.3	0.4	4.0	100
1997	43.7	28.0	18.0	3.8	1.2	1.0	4.5	100
1998	44.5	25.2	21.4	3.0	1.2	0.8	3.9	100
1999	49.0	23.3	20.0	3.3	1.4	—	3.0	100
2000	45.5	22.3	19.8	3.5	2.7	0.9	5.3	100

Table 4. Percentage distribution of road traffic accident fatalities in Turkey according to casual factors (1990–2000)

REFERENCES

1. STATE INSTITUTE OF STATISTICS. *Annual Statistical Reports*. SIOS, Prime Ministry Republic of Turkey, Ankara. Annual report 1980–2000.
2. STATE INSTITUTE OF STATISTICS. *RTA Statistics*. SIOS, Prime Ministry Republic of Turkey, Ankara. Annual report 1980–2000.
3. MINISTRY OF HEALTH. *Annual Statistical Reports of the Turkey Ministry of Health*. MoH, Ankara. Annual report 1980–2000.
4. LAWRENCE J., BLINCOE J. and BARBARA M. F. The economic cost of motor vehicle crashes. *Department of Transport Health Statistics*, 1992, 807, I.1–I.14.
5. ELVIK R. Analysis of official economic valuations of traffic accidents fatalities in 20 motorized countries. *Accident Analysis and Prevention*, 1995, 27, No. 2, 237–247.
6. WYATT J. P., BEARD D., GRAY A., BUSUTILL A. and ROBERTSON C. E. Rates, causes and prevention of deaths from injuries in South-East Scotland. *Injury*, 1996, 27, No. 5, 337–340.
7. DIGUISEPPI C., ROBERTS I. and LI L. Influence of changing travel patterns on child death rates from injury: trend analysis. *British Medical Journal*, 1997, 314, No. 7082, 710–713.
8. ROBERTSON L. S. Reducing deaths on the road: the effects of minimum safety standards, publicized crash tests, seat belts and alcohol. *American Journal of Public Health*, 1996, 86, No. 1, 31–34.
9. GENERAL DIRECTORATE OF HIGHWAYS. *Annual Statistics of Turkish Highways Reports of the Turkey Republic*. GDOH, Ankara. Annual report 1980–2000.
10. STATE INSTITUTE OF STATISTICS. *The Turkey Annual Statistical Abstracts (TURKEY-ASA)*. SIOS, Prime Ministry Republic of Turkey, Ankara. 1980–2000.
11. LAMA A. Road traffic safety information system in Latvia. *Proceedings of the Joint Scientific Latvian–Swedish Injury Prevention Research Conference*, Tukums and Riga, 1999. (in Swedish), KI Report 1999, p. 27.
12. WORLD HEALTH ORGANISATION. *Statistics Annual (1985–1996)*. WHO, Geneva, 1996.
13. ABERG L. Drinking and driving: intentions, attitudes, and social norms of Swedish male drivers. *Accident Analysis and Prevention*, 1993, 25, No. 3, 289–296.
14. LITTLE R. and CLONTZ K. Young, drunk, dangerous and driving: underage drinking and driving research findings. *Journal of Studies on Alcohol*, 1994, 50, No. 3, 320–330.
15. MILLER R. T. and BLINCAE J. L. Incidence and cost of alcohol-involved crashes in the United States. *Accident Analysis and Prevention*, 1994, 26, No. 5, 583–592.
16. JADAAN K. S. and BENER A. Pedestrian accidents in rich developing countries. *Journal of Traffic Medicine*, 1993, 21, 157–163.
17. EVANS W. N. and GRAHAM J. D. Risk reduction or risk compensation? The case of mandatory safety belt use laws. *Journal of Risk and Uncertainty*, 1991, 4, No. 1, 61–73.
18. BENER A., BREGER A. S. and AL-FALASI A. S. Risk taking behavior in RTAs. *Journal of Traffic Medicine*, 1994, 22, 67–70.
19. TRANSPORTATION RESEARCH BOARD. *Designing Safer Roads: Practices for Resurfacing, Restoration, and Rehabilitation*. Special Report 214, National Research Council, Washington D.C., 1987.
20. MCCARTHY P. S. Public policy and highway safety: a city-wide perspective. *Regional Science and Urban Economics*, 1999, 29, No. 2, 231–244.

Please email, fax or post your discussion contributions to the secretary by 1 May 2005: email: mary.henderson@ice.org.uk; fax: +44 (0)20 665 2294; or post to Mary Henderson, Journals Department, Institution of Civil Engineers, 1–7 Great George Street, London SW1P 3AA.