EPIDEMIOLOGY OF ROAD TRAFFIC ACCIDENTS IN GHANA

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Abstract

In this paper, we shall discuss the morbidity and mortality of road traffic accidents (RTAs) and other epidemiological variables of RTAs in Ghana between 1991 and 2011. The study will show that more than two thousand people died annually during the period. The average incidence of the morbidity and mortality patterns from RTAs in the period were 61.9 and 7.6 per 100 000 population, respectively. The morbidity pattern was similar throughout the same period with a mean of 1.2 per accident and a variance of 0.0093. Mortality rate per 100 accidents between 1991 and 2011, increased from 11.0 to 20.2, during this period, representing an increase of 83.6%. Although the number of accidents increased during the period 1991 to 2011, the number of fatal and injurious accidents per 100 road traffic accidents remained almost constant, with an average of 14.8 and 62.0, respectively. The highest fatalities during the period 1991 to 2011 were in the 26 – 35 year old age group.
Road traffic accidents are responsible for a far higher rate of death among men, by an approximate ratio of 3:1. The highest incidence of road traffic accidents was in the month of November, followed by the month of December. Saturday stood out as the day during which most road traffic accidents occurred. Pedestrians were more likely to be injured or killed in a road traffic accident, than all other road users.

Keywords: Traffic, accident, morbidity and mortality

1. Introduction

The methods developed and adopted in the field of public health for the study and control of epidemic diseases provide a useful framework for the study and control of road traffic accidents. Accidents may be interpreted as resulting from the total forces involved in the competition between man

and his environment (Gordon, 1949), and the epidemiology method thus offers a scientific approach to the prevention of road traffic accidents.

The first study of global patterns of death among people aged between 10 – 24 years of age has found that road traffic accidents, complications during pregnancy and child birth, suicide, violence, HIV/AIDS and tuberculosis (TB) are the major causes of mortality. Many causes of death of young people are preventable and treatable. The study, which was supported by the World Health Organization (WHO) and published in the Lancet Medical Journal, (Lozano, et al. 2012), found that 2.6 million young people are dying each year, with 97% of these deaths taking place in low- and middle-income countries.

In this paper, morbidity and mortality data from road traffic accidents (RTAs) as known in Ghana and other epidemiological variables of RTAs are studied. Since the predominant factors affecting road traffic fatalities in Ghana are population size and the number of registered vehicles, which are subject to rapid changes, the degree and direction of change are likely to determine the magnitude of the effect of RTAs. Thus, the study in this paper, is conducted with the objective of:

> 1. analysing the patterns of road traffic accidents, injuries and fatalities in Ghana;
> 2. determining the magnitude of RTAs in Ghana;
> 3. identifying some current and pertinent factors in the aetiology of RTAs in Ghana.

Based on the above, we make some suggestions and recommendations on how to prevent this serious public health problem.

In a similar study, Odero et al. (1997) reviewed the epidemiological studies of road traffic injury in developing countries and examined the evidence for association with alcohol. The study revealed that, about three-quarters of road traffic deaths in the world occur in developing countries and about 80% of the casualties are men. According to a similar research work conducted by Nilambar et al. (2004), in South India, there were 83% male and 17% female accident victims. Labourers were the highest (29.9%) among the victims. The highest number of accidents took place in the month of January (12.9%) and on Sundays (17.1%). The occupants of the various vehicles constituted the large (45%) group of the victims. Among the motorized vehicles, two wheeler drivers were more (31.1%) involved in accidents. Out of 254 drivers, 14.9% were found to have consumed alcohol. Being knocked down was the commonest mode of accidents.

The data used in this study were obtained from the following sources.

> (a) The data on the number of road traffic fatalities were obtained from the National Road Safety Commission (NRSC) of Ghana.

(b) The Driver and Vehicle Licensing Authority (DVLA) of Ghana provided the data on the number of registered vehicles in Ghana.

(c) The estimated population figures were obtained from Ghana Statistical Service 2010 Population and Housing Census.

2. Population and RTA pattern in Ghana

Table 1, on the next page, shows the magnitude of RTAs over a period of 21 years, (from 1991 to 2011) in Ghana. During the period, 32 004 died in 211 565 road traffic accidents. The average incidence of the morbidity and mortality patterns from RTAs during the period were 61.9 and 7.6 per 100 000 population, respectively. The morbidity pattern was similar throughout the period with a mean of 1.2 per accident and a variance of 0.0093.

Changes in the index of the Public Health Risk (PHR) of road traffic accidents however give cause for concern. Since 1997, there has generally been a gradual upward trend, as shown in   Table 1. Although, the 8.8 fatalities/100 000 in 2011 population is relatively low by international standards, it still points to the fact that more and more people as a proportion of the population are being killed through road traffic accidents. It means that, the public health significance of road traffic accidents is growing, and that should serve as a trigger for early action to forestall a serious national health problem.

Between 1991 and 2011, mortality rate per 100 accidents increased from 11.0 to 20.2. This represents an increase of 83.6% during the period. The risk indicator, which measures the chance of one death in a RTA, has increased by more than 80% during the 21-year period. Improved trauma care interventions would help save some lives from RTAs. For the year 2011, for instance, one person was killed in every five road traffic accidents that occurred.

Table 1: Population and RTA pattern in Ghana during the period 1991 to 2011

Year	Population $\times 10^3$	No. of RTAs	No. injured from RTAs	Mortality from RTAs	Injury accidents	Fatal Accidents	No. injured per 100 000 population	No. of persons injured per accident	Death rate per 100 000 population	Death rate per 100 accidents	No. of injurious accidents per 100 RTAs	No of fatal accidents per 100 RTAs
1991	14821	8370	8773	920	4866	724	59.2	1.0	6.2	11.0	58.1	8.6
1992	15222	6922	9116	914	4515	717	59.9	1.3	6.0	13.2	65.2	10.4
1993	15634	6467	7677	901	4119	704	49.1	1.2	5.8	13.9	63.7	10.9
1994	16056	6584	7664	824	4088	632	47.7	1.2	5.1	12.5	62.1	9.6
1995	16491	8313	9106	1026	4897	813	55.2	1.1	6.2	12.3	58.9	9.8
1996	16937	8488	9903	1049	4964	830	58.5	1.2	6.2	12.4	58.5	9.8

1997	17395	9918	10433	1015	5638	864	60.0	1.1	5.8	10.2	56.8	8.7
1998	17865	10996	11786	1419	6370	1127	66.0	1.1	7.9	12.9	57.9	10.2
1999	18349	8763	10202	1237	5303	979	55.6	1.2	6.7	14.1	60.5	11.2
2000	18845	11087	12310	1437	6429	1092	65.3	1.1	7.6	13.0	58.0	9.8
2001	19328	11293	13178	1660	6831	1257	68.2	1.2	8.6	14.7	60.5	11.1
2002	19811	10715	13412	1665	6593	1245	67.7	1.3	8.4	15.5	61.5	11.6
2003	20508	10542	14469	1716	6849	1327	70.6	1.4	8.4	16.3	65.0	12.6
2004	21093	12175	16259	2186	7852	1600	77.1	1.3	10.4	18.0	64.5	13.1
2005	21694	11320	14034	1776	7025	1388	64.7	1.2	8.2	15.7	62.1	12.3
2006	22294	11668	14492	1856	7137	1419	65.0	1.2	8.3	15.9	61.2	12.2
2007	22911	12038	14373	2043	7533	1622	62.7	1.2	8.9	17.0	62.6	13.5
2008	23544	11214	14531	1938	7309	1647	61.7	1.3	8.2	17.3	65.2	14.7
2009	24196	12299	16259	2237	8188	1790	67.2	1.3	9.2	18.2	66.6	14.6
2010	24223	11506	14918	1986	7629	1686	61.6	1.3	8.2	17.3	66.3	14.7
2011	25099	10887	14020	2199	7320	1738	55.9	1.3	8.8	20.2	67.2	16.0
Total	**412316**	**211565**	**256915**	**32004**	**131455**	**25201**	**1298.9**	**25.5**	**159.1**	**311.6**	**1302.4**	
Mean	**19634.1**	**10074.5**	**12234.0**	**1524.0**	**6259.8**	**1200.0**	**61.9**	**1.2**	**7.6**	**14.8**	**62.0**	

Athough the number of accidents increased during the the period 1991 to 2011, the number of fatal and injurious accidents per 100 road traffic accidents remained almost constant during the period, with an average of 14.8 and 62.0, respectively. Thus, about 15 of every 100 road traffic accidents during the period were fatal, whilst 62 out of every 100 RTAs resulted in an injury. These figures showed that RTAs still pose a major public health problem, threatening the quality of life in Ghana.

3. Distribution of road traffic fatalities by age group and gender

Table 2 gives the annual distribution of road traffic fatalities by age group. It can be seen that, unlike many fatal diseases, road traffic accidents kill people from all age groups. A cumulative total of 27 582 fatalities were recorded during the 21-year period. The highest fatalities during the period, were in the 26 – 35 year old age group. The table also shows that the active age group, 16 – 45 years, were the most vulnerable in road traffic fatalities, representing more than 60% of the total fatalities in the 21-year period.

Table 2: Annual Distribution of Fatalities in RTAs by Age Group

Year	Age Group								Total
	0 – 5	6 – 15	16 – 25	26 – 35	36 – 45	46 – 55	56 – 65	Over 65	
1991	65	136	109	138	102	54	34	23	**661**
1992	50	112	89	172	91	58	55	27	**654**
1993	49	121	101	134	83	64	44	22	**618**
1994	50	113	98	124	90	45	42	24	**586**
1995	60	139	128	152	112	61	48	38	**738**
1996	67	139	134	160	109	61	70	30	**770**
1997	44	134	137	188	112	70	47	42	**774**
1998	58	153	175	224	146	95	61	47	**959**
1999	63	161	160	203	170	85	77	50	**969**
2000	72	188	233	301	196	117	62	49	**1218**

Year								
2001	80	179	259	298	282	137	105	65	**1405**
2002	85	200	230	337	237	149	96	76	**1410**
2003	113	203	264	359	241	422	99	61	**1762**
2004	116	272	357	444	280	191	132	83	**1875**
2005	120	184	276	375	273	138	101	82	**1549**
2006	124	201	260	363	266	146	108	69	**1537**
2007	109	214	369	579	379	191	120	81	**2042**
2008	136	218	310	528	329	177	138	102	**1938**
2009	130	250	388	609	383	222	141	109	**2232**
2010	136	217	269	577	379	184	129	95	**1986**
2011	126	212	365	658	400	209	126	103	**2199**
Total	**1853**	**3746**	**4711**	**6923**	**4660**	**2578**	**1835**	**1278**	**27582**
%	**6.8**	**14.2**	**17.4**	**24.3**	**16.6**	**9.3**	**6.8**	**4.6**	**100.0**

Table 3, on the next page, gives the annual distribution of male/female ratio of road traffic fatalities. It can be seen that, during the 21-year period, road traffic accidents are responsible for a far higher rate of death among males, by an approximate ratio of 3:1. Similar proportions apply to all the years. In the 21-year period, 73.7% of the road traffic fatalities were males while 26.3% were females.

Table 3: Annual distribution of road traffic fatalities by gender

Year	Fatalities		Male/female ratio
	Male	Female	
1991	642	273	2.4
1992	647	253	2.6
1993	662	210	3.2
1994	616	196	3.1
1995	708	290	2.4
1996	744	280	2.7
1997	728	273	2.7
1998	1013	381	2.7
1999	887	315	2.8
2000	1091	441	2.5
2001	1193	441	2.7
2002	1175	480	2.4
2003	1280	437	2.9
2004	1568	587	2.7
2005	1292	463	2.8
2006	1348	492	2.7
2007	1554	489	3.2
2008	1448	490	3.0
2009	1655	582	2.8
2010	1511	475	3.2
2011	1695	504	3.4
Total	**21762**	**7848**	**2.8**
Percentage (%)	**73.7**	**26.3**	

Male dominant in road traffic fatalities in Ghana may be due to the fact that men spend substantially more time in moving vehicles than women. Men are also more likely to be employed as drivers and mechanics of cars and trucks, including drivers of long haul vehicles which may mean spending several days and nights in the vehicle. Males, therefore, have a higher exposure to the risk of road traffic injuries.

4. The distribution of months and days during which persons were killed or injured in RTAs

Table 4 shows the monthly distribution of road traffic injuries and fatalities in Ghana, in 2010 and 2011. In 2011, the highest incidence of 260 road traffic fatalities was recorded in the month of November. This represents 11.8% of the road traffic fatalities that year. In 2010, the highest incidence of 11.9% was recorded in the month of October. In 2011, February and June have the lowest incidence of 6.5% and 6.7% of road traffic fatalities, respectively.

Table 4: Months during which persons were killed or injured in RTAs, in 2010 and 2011

Month	2010				2011			
	Fatalities		Persons injured		Fatalities		Persons injured	
	Number	%	Number	%	Number	%	Number	%
January	124	6.2	1316	8.8	176	8.0	1103	7.9
February	139	7.0	975	8.5	142	6.5	934	6.7
March	112	5.6	1211	8.1	187	8.5	1138	8.1
April	181	9.1	1120	7.5	178	8.1	1192	8.5
May	167	8.4	1405	9.4	190	8.6	1212	8.6
June	143	7.2	1091	7.3	148	6.7	1055	7.5
July	170	8.6	1008	6.8	177	8.0	1069	7.6
August	129	6.5	1170	7.8	174	7.9	1173	8.4
September	163	8.2	1413	9.5	199	9.0	1296	9.2
October	237	11.9	1430	9.6	160	7.3	1143	8.2
November	188	9.5	1336	9.0	260	11.8	1376	9.8
December	233	11.7	1443	9.7	208	9.5	1329	9.5
Total	1986	100	14918	100	2199	100	14020	100

The trend where the Christmas season and activities preceding it were associated with many fatal RTAs, seemed to have marginally disappeared, since, in 2011, November happened to be the worst month, as shown in Table 4.

Table 5, on the next page, shows the occurrences of road traffic accidents, in 2010 and 2011. It can be seen that, between January 2010 and December 2011, there was significant variation in the number of road traffic fatalities and the number of persons injured per day. Saturday stood out as the "problem day", during which most road traffic fatalities occurred. This

may be due to the fact that, in Ghana, most funerals, all-night parties and other social activities are on Saturdays. Many people return from these activities intoxicated with alcohol. The role of alcohol intoxication in the causation of RTAs should therefore not be underestimated.

Table 5: Day of occurrence of road traffic accidents, from January 2010 to December 2011

	2010				2011			
	Fatalities		**Persons injured**		**Fatalities**		**Persons injured**	
Day	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Monday	258	13.0	2061	13.8	323	14.7	1794	12.8
Tuesday	249	12.5	1901	12.7	282	12.8	1750	12.5
Wednesday	218	11.0	1866	12.5	267	12.1	1966	14.0
Thursday	245	12.3	1930	12.9	318	14.5	1778	12.7
Friday	297	15.0	2300	15.3	312	14.2	2218	15.8
Saturday	403	20.3	2583	17.3	398	18.1	2503	17.9
Sunday	316	15.9	2300	15.4	299	13.6	2011	14.3
Total	**1986**	**100**	**14918**	**100**	**2199**	**100**	**14020**	**100**

In the year 2011, the highest number of road traffic fatalities (398; 18.1%) occurred on Saturdays and in the year 2011, the lowest number of road traffic fatalities occurred on Wednesdays. Surprisingly, in the year 2011, Mondays (14.7%) and Thursdays (14.5%) recorded more fatalities than Fridays (14.2%) and Sundays (13.6%), which, according to NRSC of Ghana, are known to be associated with high fatalities. This will have to be studied for at least two more years before any conclusion can be drawn.

5. Road user class involved in deaths and injuries

Table 6, on the next page, shows the various descriptions of road users at risk from January 1991 to December 2011, as far as the effects of road traffic accidents are concerned. It can be seen that, during the 21-year period, pedestrians were more likely to be injured or killed in RTAs than other road users. This may be due to the fact that, in Ghana, separating cars and pedestrians on the road by providing pavements, is very often not done. Speed limits of 30 km/h in shared-space residential areas are commonly not implemented. Car and bus fronts, as generally designed, do not provide protection for pedestrians against injury at collision speeds of 30 km/h or greater. During the 21-year period, more than 40% of those who were killed through road traffic accidents were pedestrians, followed by bus passengers (20.7%), car occupants (11.8%) and Heavy Goods Vehicles (10.4%) in that order.

Table 6:   Road user class involved in deaths and injuries

	Road User Class and Vehicle type in accidents																							
	Pedestrian		Car			Heavy Goods Vehicles (HGVs)			Bus/Mini Bus			Motor cycle			Pick-up			Bicycle			Other		
Year	No. Killed	No. Injured	No. Killed	No. Injured	No. of Vehicles	No. Killed	No. Injured	No. of Vehicles	No. Killed	No. Injured	No. of Vehicles	No. Killed	No. Injured	No. of Vehicles	No. Killed	No. Injured	No. of Vehicles	No. Killed	No. Injured	No. of Vehicles	No. Killed	No. Injured	No. of Vehicles
1991	423	2250	85	1852	6544	106	759	1283	177	2529	288	16	242	311	45	638	795	28	258	442	17	72	134
1992	388	1971	126	1883	4921	83	613	1081	215	3339	2381	18	211	258	23	625	731	43	267	402	12	42	113
1993	404	1806	93	1625	4721	118	494	976	186	2736	2356	11	228	279	29	372	637	35	248	359	18	44	114
1994	367	1826	81	1602	4728	91	488	1116	180	2733	2585	18	203	260	41	431	708	22	227	305	17	61	115
1995	488	2266	95	1733	6410	87	671	1440	232	3325	3145	21	221	288	34	454	929	40	263	359	19	45	123
1996	461	2408	115	1711	6485	130	872	1418	197	2661	3419	15	262	337	47	540	1004	44	254	358	32	84	157
1997	491	2569	107	1912	7258	111	608	1741	181	3982	4291	28	310	435	48	566	1154	30	298	388	10	72	152
1998	630	2777	137	2001	8011	150	743	1772	328	4597	4839	29	376	470	55	787	1335	63	331	491	24	74	178
1999	528	2165	142	1798	6146	111	738	1522	281	4263	3708	35	343	436	50	492	1046	60	281	426	10	63	165
2000	662	2965	207	2679	9270	189	932	1853	314	4886	4705	42	414	539	72	682	1208	62	332	498	13	62	225

2001	757	2899	182	2783	8852	146	959	1740	399	5089	4607	44	402	518	41	512	1175	59	357	470	31	131	262
2002	681	2757	202	2783	8314	171	1079	2089	421	5577	4312	48	380	469	57	454	1082	69	334	478	16	46	114
2003	724	2784	218	2874	7696	228	1335	2193	341	6144	4326	53	496	616	47	454	986	91	360	562	16	82	154
2004	869	3166	246	3153	8904	235	1427	2598	556	6749	4849	100	685	792	53	519	1172	100	421	613	14	79	163
2005	733	2890	242	2679	8277	200	1111	2283	317	5809	4410	109	595	860	76	527	1181	92	363	562	13	57	153
2006	770	3117	206	2643	8391	270	1315	2636	382	5790	4696	94	619	828	34	484	1137	84	384	559	16	141	403
2007	880	3059	212	2913	8809	213	1074	2610	414	5575	4777	182	805	1063	36	531	1267	85	339	487	16	59	128
2008	855	2779	274	2988	7932	184	1587	2648	282	5269	4305	170	965	1210	45	561	1145	111	305	449	13	54	239
2009	938	3118	283	3616	9145	193	1247	2662	466	6290	4772	192	1055	1345	53	615	1334	92	252	373	20	50	232
2010	853	2854	271	3359	8680	159	1210	2508	325	5452	4192	210	1135	1377	55	640	1270	91	208	322	22	60	235
2011	898	2448	251	3271	8172	168	1036	2491	427	5167	3692	313	1260	1641	46	577	1160	80	200	288	16	61	253
Total	13800	54854	3775	51858	157666	3343	20298	40660	6621	97962	80655	1748	11207	14332	987	11461	22456	13381	6282	9191	3665	1439	3812
%	43.1	21.5	11.8	20.3	48.0	10.4	7.9	12.4	20.7	38.4	24.5	5.5	4.4	4.4	3.1	4.5	6.8	4.3	2.5	2.8	1.1	0.6	1.2

Buses, in particular, have high number of occupants and are therefore always likely to produce casualties (fatalities) far more than the number of registered buses when they get involved in accidents. The number of Heavy Goods Vehicles (HGVs) occupants killed in road traffic accidents, is unacceptable, considering the fact that they are not required to carry passengers.

In terms of strategy, isolating buses and HGVs for road safety interventions, would be consistent with the recommendation by the National Road Safety Commission, since most bus and HGV fatalities are recorded on the trunk roads. Ensuring the use of seat-belts in cars and buses will significantly save lives of some cars and bus occupants. Again, the inappropriate use of HGVs to ferry passengers should be stopped. Cutting down the overall pedestrian fatalities would require active speed management on all categories of road users. A comprehensive traffic calming programme and speed controls may also be imperative. This may buttress the need to rationalize the National Highway System so as to bypass major settlements. This will be in keeping with the mobility functional requirements of the National Highways. Given the continuing high casualties among public transport buses and HGVs, it is rather urgent that, in addition to providing speed management measures on trunk roads passing through settlements, these categories of vehicles should be subjected to operational speed restrictions in the interest of the travelling public. These recommendations are in line with that of the National Road Safety Commission road safety report for 2011. The very direct link between speed at the time of collision and injury outcomes does not need to be over-emphasized.

Also of significance to note is the type of vehicles involved in fatal accidents. Cars constituted about 48% of vehicles involved in accidents (see Table 6). The involvement of buses, HGVs and pick-up utility vehicles also still trail car-involvement in that order. Of all the vehicle types, it is the HGVs and buses that are over-represented in their crash involvement relative to their proportion in the overall national vehicle mix. But even more worrying is that these classes of vehicle, accounted for higher proportions of involvement in fatal accidents.

The magnitude of road traffic accidents (RTAs) in Ghana over the past two decades is borne out by the fact that, averagely, about 72 persons out of every 100 000 population, suffered from grievous bodily injury and close to 8 persons of the same population died from RTAs. More than 60% of road traffic fatalities occur in children and young persons under 35 years of age. Many of these victims are likely to be pedestrians and young adults who were either drivers or passengers. About 75% of road traffic accident

victims were males since more males than females own and drive vehicles in Ghana.

6. Conclusion

This study has shown that, during the period 1991 to 2011, males were more at risk than females in being injured in road traffic accidents. The preponderance of males may be attributed to their greater exposure to traffic and other associated factors. Mondal et al. (2011) and Odero et al. (1997) gave similar conclusions which are well documented. Male dominance in road traffic fatalities in Ghana may be due to the fact that men spend substantially more time in moving vehicles than women.

The findings that the active age group, 16 – 45 years, was the most vulnerable in road traffic fatalities, representing more than 60% of the total fatalities in the 21-year period, is well documented in this paper. This has important economic impacts as these are people in their most economically productive years.

This paper has given sufficient evidence of relatively high incidence of road traffic casualties on Saturdays. This may be due to the fact that, in Ghana, most funerals, all-night parties and other social activities are held on Saturdays. Most of the people return from these activities intoxicated with alcohol.

Road traffic accidents in Ghana have not received the attention warranted, considering the magnitude of the problem. There is the need to view road traffic accidents as an issue that needs urgent attention aimed at reducing the health, social and economic impacts.

References:
Gordon, J. E. (1949). The epidemiology of accidents. Amer. J. Public Health, 39 (**4**) 504 – 515.
Lozano, R., Naghavi, M., Foreman, K., Lim, S., Aboyans, V., and others (2012). Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010**.** Lancet medical journal, 380 (**9859**)   2095 – 2128.
Mondal, P., Abhishek, K., Bhangale, U., and Dinesh, T. (2011). A silent tsunami on Indian road: A comprehensive analysis of epidemiological aspects of road traffic accidents. British Journal of Medicine & Medical Research, 1(**1**), 14 – 23.
National Road Safety Commission of Ghana (2011). Building and Road Research Institute (BRRI), *Road Traffic Crashes in Ghana*, Statistics.
Nilambar, J., Srinivasa, D., Gautam, R., and Jagdish, S. (2004). Epidemiological study of road traffic accident cases: a study from South India. Indian Journal of Community Medicine, 29 (**1**), 20 – 24.

Odero, W., Garner, P., and Zwi, A. (1997). Road Traffic Injuries in Developing Countries: A comprehensive Review of Epidemiological Studies. Tropical Medicine and International Health, 2(**5**), 445–460.

Patton, G. C., Coffey, C., Sawyer, S. M., Viner, R. M., Haller, D. M., Bose, K., Vos, T., Ferguson, J., and Mathers, C. D. (2009). Global patterns of mortality in young people. Lancet, 374 (**9693**), 881 – 892.

Peden, M., Scurfield, R., Sleet, D., Mohan, D., Jyder, A., Jarawan, E., and Mathers, C. (2004). World Report on Road Traffic Injury Prevention. Geneva: World Health Organization.