

“Beyond the enormous suffering they cause, road traffic crashes can drive a family into poverty as crash survivors and their families struggle to cope with the long term consequences of the event, including the cost of medical care and rehabilitation and all too often funeral expenses and the loss of the family breadwinner.”

– Margaret Chan,
Director-General,
World Health Organization

“The national economy lost US\$175 billion from traffic accidents over the past five years. That is comparable with overall health care expenditures of the same period.”

– Dmitry Medvedev,
President of the Russian Federation,
The New York Times, August 8, 2009

Chapter II. The Epidemic of Road Traffic Injuries

1. The global context

How should exposure to RTI risk be measured? With the growing level of cooperation between the health and transport sectors, deaths—*“fatalities per 100,000 population”* are becoming a widely used measure of exposure to RTI risk (OECD and ECMT, 2006). The use of population as a denominator permits comparisons with other causes of injury or with diseases.

Global road traffic fatalities are growing fast, and most occur in low- and middle-income countries (LMICs). Table 1 on the next page presents World Bank projections for global road fatalities, predicting they will increase by 66 percent between 2000 and 2020 unless road safety interventions are intensified. These fatalities are estimated to increase by 80 percent in LMICs, while declining by close to 30 percent in HICs. Over 90 percent of RTI deaths occur in LMICs, although these countries have only 48 percent of the world’s registered vehicles (WHO 2009a). Road traffic fatality rates in LMICs, at about 20 per 100,000 population, are nearly double the rate in high-income countries (HICs), at 10.3 per 100,000 (WHO 2009a).

The gaps between poor and rich countries are widening. Scaled-up and effective measures are needed to reduce the growing vulnerability of LMICs experiencing

rapid motorization and intensified provision of road infrastructure. This is important when considering the expected negative health impact of RTIs in the world (Plasencia and Borrell 2001; Murray and Lopez 1996).

Road traffic injuries are growing relative to most other diseases worldwide (WHO 2004a). Table 2 on the next page shows that RTIs accounted for about 1.3 million deaths worldwide in 2004, 2.2% of total deaths, expected to rise to 2.1 million and 3.2% of total deaths by 2030. Other sources estimate another 20 to 50 million nonfatal road traffic injuries annually (Murray and others 2001; Peden and others 2004).

RTIs are the leading cause of death for young people aged 10–24 globally (this group accounts for 30 percent of the world’s population), and are forecast by the WHO to become the top cause of disability and premature death for children aged 5–14 in LMICs by 2015. This would cause far more disability-adjusted life years (DALY) lost than malaria, tuberculosis (TB), or acquired immune deficiency syndrome (AIDS).

Pedestrians, cyclists, and motorized two-wheeler riders and passengers are vulnerable road users, at especially high risk of having an RTI and of dying from it. They account for about 46 percent of global road traffic deaths (WHO 2009a).

Table 1: Predicted Road Traffic Fatalities, by World Bank Region

Region	% Change 2000–20
South Asia	144%
East Asia & Pacific	80%
Sub-Saharan Africa	80%
Middle East and North Africa	68%
Latin America and the Caribbean	48%
Europe and Central Asia	18%
Subtotal	83%
High-income countries	-28%
Global Total	66%

Source: Kopits and Cropper (2003).

Road crashes tend to disproportionately affect low-income groups, and their attendant costs can plunge households into poverty due to the loss of breadwinners and the added burden of caring for members disabled by road traffic injuries (Borrell and others 2005; Nantulya and Reich 2003; Roberts and Power 1996, Peden and others 2004). The population groups exposed to highest risks of injury and fatality from traffic crashes in low-income and middle-income countries—pedestrians, passengers of buses and trucks, motorcyclists and bicyclists—are from lower socioeconomic groups because the more affordable modes of transport present higher risks than private cars (Nantulya and Reich 2003, and Mock and others 1997).

2. ECA: A bleak situation and prognosis

Rapid motorization has occurred without adequate infrastructure and regulation. Transition countries that experienced rapid economic growth since the 1990s, such as Kazakhstan and Russia, motorized rapidly but without adequate infrastructure. Nor have effective regulatory controls been put in place—vehicle safety checks, particularly for public transport vehicles; drivers' licensing systems; and enforcement of speed and alcohol limits and seatbelt and helmet use.

ECA countries have experienced rapid growth in the number of passenger cars on the roads over the last two decades. The Commonwealth of Independent States (CIS) went from 64 passenger cars per 1,000 persons in

Table 2: Leading Causes of Death, All Ages, 2004 and 2030

2004			
Disease or Injury	Deaths (millions)	% Total Deaths	
1 Ischemic heart disease	7.2	12.2	
2 Cerebrovascular disease	5.7	9.7	
3 Lower-respiratory infections	4.2	7.1	
4 Chronic obstructive pulmonary disease	3.0	5.1	
5 Diarrheal diseases	2.2	3.7	
6 HIV/AIDS	2.0	3.5	
7 Tuberculosis	1.5	2.5	
8 Trachea, bronchus, lung cancers	1.3	2.3	
9 Road traffic crashes	1.3	2.2	
10 Prematurity and low birth weight	1.2	2.0	
11 Neonatal infections and other	1.1	1.9	
12 Diabetes mellitus	1.1	1.9	
13 Malaria	1.0	1.7	
14 Hypertensive heart disease	0.9	1.5	
15 Birth asphyxia and birth trauma	0.9	1.5	
2030			
Disease or Injury	Deaths (millions)	% Total Deaths	
1 Ischemic heart disease	9.6	14.2	
2 Cerebrovascular disease	8.2	12.1	
3 Chronic obstructive pulmonary disease	5.8	8.6	
4 Lower-respiratory infections	2.8	3.8	
5 Trachea, bronchus, lung cancers	2.3	3.6	
6 Diabetes mellitus	2.2	3.3	
7 Road traffic crashes	2.1	3.2	
8 Hypertensive heart disease	1.5	2.2	
9 Stomach cancer	1.3	1.9	
10 HIV/AIDS	1.2	1.8	
11 Nephritis and nephrosis	1.1	1.6	
12 Self-inflicted injuries	0.98	1.5	
13 Liver cancer	0.95	1.4	
14 Colon and rectum cancer	0.94	1.4	
15 Esophageal cancer	0.88	1.3	

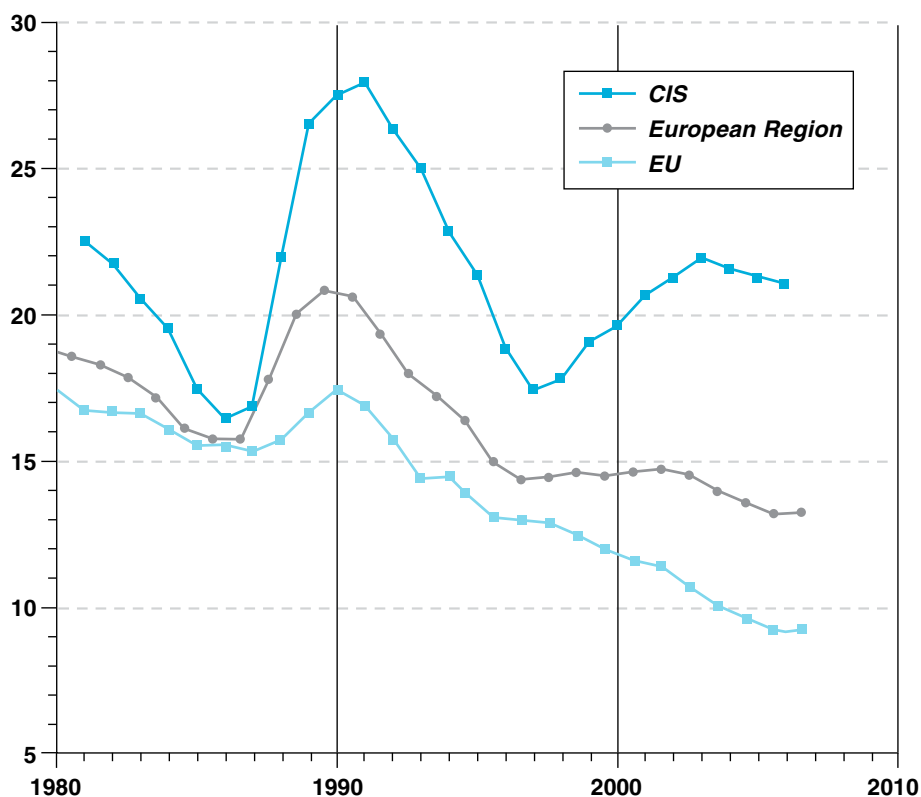
Source: WHO (2008a).

1990 to 141 in 2003, a 120 percent increase (UNECE and WHO EURO 2009). Similar trends are observed in countries in South-Eastern Europe: in Albania the increase was from 18 passenger cars per 1,000 persons in 1994 to 48 in 2002, and in Croatia from 143 to 276. However, the level of cars in some of the ECA countries is still much lower than the typical range of 400 to 600 in Western Europe (UNECE and WHO EURO, 2009). The population in the CIS travel 800 km per capita per year by car, as compared to the population in Western Europe that travels more than 12,000 km per capita by car (passenger cars account for about 80 percent of this total). While still well below Western European levels, increased reliance on private cars for transport in ECA is reflected in the smaller increase in the number of buses (Eurostat 2007).

Vehicles and road infrastructure are generally in poor condition. Vehicles in many ECA countries, particularly in the CIS, tend to be old and have substandard safety features. Cross-border trade in cars considered too unsafe, old, or polluting for Western European countries exacerbates this problem. Kilometers of roads and highways have increased since the 1990s, by 18 percent and 157 percent in the CIS, 21 percent and 75 percent in EU-10 countries⁶, and 46 percent and 144 in South-Eastern Europe, respectively. But in spite of significant investments in road infrastructure since the 1990s, in some CIS countries the road infrastructure suffers from poor maintenance and under-investment.

Changing mortality rates. Road traffic fatalities have steadily declined in Western Europe, reaching levels below 6 fatalities per 100,000 in 2006 in the Netherlands, Sweden, Switzerland, Norway, and the United Kingdom. The annual number of deaths from RTIs declined in the Western European countries by 61 percent over the 1970-2005 period. Central and Eastern

Figure 2: Standardized Mortality Rates from Road Traffic Injuries in the European Region, EU-27 and CIS Countries, per 100,000, 1980–2007



Note: CIS countries are Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, the Republic of Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan. EU-27 countries are Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom.

Source: WHO EURO Health for All Data Base (2009).

European Countries (CEEC)⁷ and the CIS achieved considerable annual reductions in the 1990s but since about 1997 fatality rates have stabilized in the CEEC and have increased in the CIS (Figure 2), in spite of the smaller car fleet and the low number of kilometers travelled per capita by car (OECD and ITF, 2008). While better than in Africa and Asia, ECA residents are three times more likely to die from RTI than people in Western Europe (Sethi and others 2006a; Hyder and Aggarwal 2009). Moreover, fatalities from RTIs are just

⁶ The 10 countries that joined the EU in 2004: Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia.

⁷ Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Serbia, Montenegro, Slovakia, Slovenia, The former Yugoslav Republic of Macedonia.

the tip of the iceberg—for every death, more people are hospitalized and many more have injuries that require medical attention.

Table 3 shows, by ECA country, the rate of increase in deaths from 2006 to 2007 and the number of nonfatal injuries in 2007. Of the estimated 127,000 RTI deaths in the WHO European Region, close to 80,000 deaths or

73 percent of the total deaths occurred in ECA countries, which have only 28 percent of the registered cars in the Region. In contrast, only 27 percent of the deaths occur in non-ECA countries, where 72 percent of the cars are registered (WHO 2009a).

Nonfatal injuries in ECA neared 820,000 in 2007, contributing importantly to disabilities (WHO 2009a).

For example, a study in Turkey found that of approximately 95,000 people injured in road traffic crashes in 2005, 13 percent had a subsequent disability (Esiyok and others 2005). In Auckland, New Zealand, evidence on the burden of disability after motor vehicle crashes in a population-based study shows that 43 percent of crash drivers admitted to the hospital and 20 percent of those not admitted reported that their overall health at an 18-month follow-up was worse than before the crash (Ameratunga and others 2006). The drivers who reported worsened health reported both worsened physical and mental health.

The burden of RTIs can be measured by disability-adjusted life years (DALYs). Supplementing mortality data, the DALY is an indicator that captures the full burden of disease or injury. It is calculated by summing the years of life lost due to premature death (defined as the difference between the actual age of death and the life expectancy at that age in a low-mortality population) and the years of fully productive life or full functionality lost because of a disability (Murray 1993; Murray and Lopez 1993). For example, each year lived with a disability that leaves a person able to perform only half the normal functions of their life would be counted as one-half of a DALY lost. DALYs capture both the fatal and non-fatal effects of RTIs. Recent estimates indicate that in ECA countries RTIs account for 3.1 percent of total DALYs lost, as compared with 2.4 percent in EU-15 countries (WHO accessed October 20, 2009). Overall, RTIs are the sixth-leading cause of DALY losses in ECA compared to ninth among EU-15 countries (WHO 2005a).

RTI data underestimate and underreport the situation. As explained in Box 1 on the next page, ECA countries still differ substantially in the

Table 3: Road Traffic Deaths and Nonfatal Injuries in ECA, by Country

Country	Deaths 2006	Deaths 2007	% Change 2006–2007	Nonfatal Injuries, 2007
Albania	277	384	38.6	1,344
Armenia	332	371	11.7	2,720
Azerbaijan	1,027	1,107	7.8	3,432
Belarus	n.a.	1,517	n.a.	7,991
Bosnia and Herzegovina	n.a.	428	n.a.	11,647
Bulgaria	n.a.	1,006	n.a.	9,827
Croatia	n.a.	619	n.a.	25,092
Czech Republic	n.a.	1,222	n.a.	23,060
Estonia	n.a.	196	n.a.	3,270
Georgia	675	737	9.2	7,349
Hungary	n.a.	1,232	n.a.	27,452
Kazakhstan	n.a.	4,365	n.a.	32,988
Kyrgyzstan	1,051	1,252	19.1	6,223
Latvia	n.a.	407	n.a.	5,404
Lithuania	n.a.	759	n.a.	8,254
Moldova	n.a.	589	n.a.	2,985
Montenegro	n.a.	122	n.a.	2,796
Poland	n.a.	5,583	n.a.	63,224
Romania	n.a.	2,712	n.a.	29,832
Russian Federation	32,724	33,308	1.8	292,206
Serbia	n.a.	962	6.8	
Slovakia	n.a.	627	n.a.	11,310
Slovenia	n.a.	293	n.a.	16,449
Tajikistan	n.a.	464	n.a.	2,048
The Former Yugoslav Republic of Macedonia	140	173	23.6	6,133
Turkey	4,633	5,004	8.0	169,080
Turkmenistan		650		1,606
Ukraine	7,592	9,921	30.7	40,887
Uzbekistan	n.a.	2,034	n.a.	n.a.

n.a.= Not available.

Sources: ITF (2008); WHO (2009a).

availability, quality, and completeness of data on mortality and injuries related to road traffic crashes. Underestimation and underreporting of RTI data is one of the key institutional building challenges that need to be tackled, as argued in Chapter VII of this report.

3. Country variability

The average mortality rate due to RTIs in CIS countries (21.8 per 100,000 population) is nearly three times that of EU-15 and other Western European countries (7.9 per 100,000) (data from WHO 2009a, shown in Figure 3 on the next page). Kazakhstan has by far the highest mortality rate in ECA (30.6 per 100,000), followed by Russia (25.2 per 100,000) and Kyrgyzstan (22.8 per 100,000). With 33,308 victims in 2007, Russia had the most RTIs deaths in ECA. As crashes tend to increase with traffic density, urban driving tends to claim more lives per vehicle-mile than rural driving, although rural crashes tend to be more severe because they occur at higher speeds (Janke 1991, BTS 1997). Recent data for several ECA countries indicate that cities, especially major ones with the largest concentrations of population and cars, and inadequate road infrastructure, face huge challenges with RTIs. In 2008, for example, 21 percent of Armenia's road deaths and 35 percent of injuries were in Yerevan; 47 percent of Azerbaijan's road deaths and 47 percent of its injuries occurred in Baku; and in Georgia, 48 percent of road deaths and 68 percent of injuries were in urban centers (Camos-Daurella and Silcock 2009).

4. Fatal road traffic injuries by ECA road user type

The proportion of deaths among different road users varies from country to country, reflecting differences in exposure and safety. Table 4 on page 13 presents the esti-

Box 1: Sources and Quality of the Statistics and Indicators on Road Traffic Deaths and Injuries in Europe

In most European countries, the road police, the health sector, the agency responsible for death certificates and insurance companies are the main actors responsible for collecting statistics about road traffic deaths and injuries. States that are members of the European Union, the European Council of Ministers of Transport (ECMT), the Organization for Economic Co-operation and Development (OECD), the United Nations Economic Commission for Europe (UNECE), and the World Health Organization (WHO) also report their national data, according to internationally agreed questionnaires, to these international bodies, which run databases (such as the WHO Health for All Database, statistics on road traffic crashes from the UNECE, the International Road Traffic and Accident Database [IRTAD], and the Community Road Accident Database [CARE]), and publish reports, such as the statistical reports on road crashes of the ECMT, which allow some international comparisons and analyses of trends across the Region.

The statistics on road safety in the European Region are relatively good compared with other regions. Nevertheless, countries still differ substantially in the availability, quality, and completeness of data on mortality and injuries related to road traffic crashes, which makes international comparisons difficult. At the international level, the IRTAD and CARE adjust the data to the internationally agreed definition. Data on injuries differ even more, since there is ample room for discretion in interpreting the definition of “slightly” versus “seriously” injured. Data on mortality are comparatively more reliable and complete than data on nonfatal injuries. The reasons include differences in methods and the quality of data collected, differences in definitions used by bodies involved in monitoring crash outcomes, and difficulty in reconciling data from different sources.

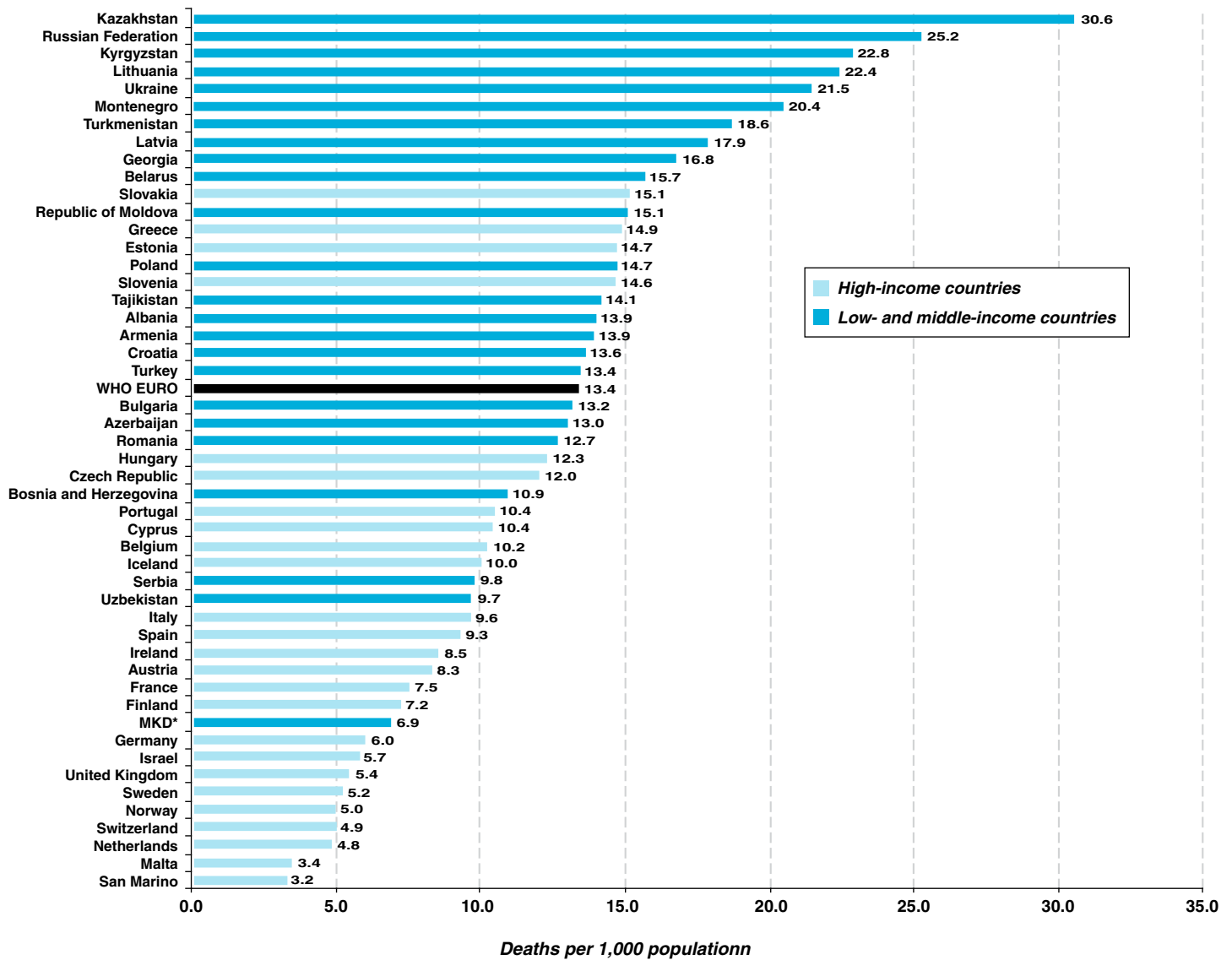
Related to this is the important problem of underestimating the real burden of road traffic injury because data are underreported. The reasons for underreporting include the public failing to report injuries; the police not recording cases reported to them; hospitals not reporting cases presenting to them; and certain institutions such as the military being exempt from reporting directly to the police. Underreporting is not exclusive to low- and medium-income countries. Within countries, the numbers of reported fatalities and injuries differ between road police records and those of public health institutions, such as first aid stations and hospitals. Finally, data collected by insurance companies are often published in the form of representative surveys, to protect information considered commercially sensitive.

Source: Adapted from Racioppi and others (2004).

mated distribution of fatal injuries by road user category in ECA countries. It shows that the majority of road traffic fatalities in ECA occur among motorized four-wheeler occupants—typically 40 to 75 percent.

However, in several ECA countries pedestrian fatalities are also very high, accounting for 40 percent or more

Figure 3: RTI Death Rates in WHO-EURO Member Countries, per 100,000 Populations, 2007



Note: MKD is the international standardized abbreviation for the Former Yugoslav Republic of Macedonia.

Source: WHO EURO (2009).

of total road fatalities in Albania, Belarus, Kyrgyzstan, Tajikistan, and Ukraine. Road infrastructure in these countries lacks features to make roads safer for pedestrians (for example, crossings, walkways, and guardrails), and the speed limits are too high in urban areas. In most ECA countries urban speed limits are 60 kilometers per hour (km/h), whereas good practice advocates 50 km/h in urban area and 30 km/h in residential areas (Racioppi and others 2004; UNECE and WHO EURO 2009). The high limits are also poorly enforced. Speeding vehicles are particularly dangerous for pedestrians: the probability of a pedestrian being killed increases eight-

fold as the speed of impact with a car increases from 30 km/h to 50 km/h.

Pedestrians, cyclists, and motorcyclists usually suffer the most severe RTIs and report more continuing health problems that require more assistance. Among pedestrians, children and older people tend to be more affected. Risk analysis for the EU shows that the fatality risk for people using motorized two-wheeled vehicles is the highest of all modes of transport—on average, 20 times that of car occupants. Fatality for cyclists and pedestrians is seven to nine times that of people in cars (Racioppi and

others 2004; Sethi, Racioppi, and Bertollini 2007).

The impact of RTIs among pedestrians must be stressed since most safety interventions historically have focused on protecting vehicle occupants rather than pedestrians. Walking and cycling are more likely to be chosen if people feel their safety is assured. In addition to the RTI gains from safer walking and cycling, getting people to use these healthier modes of transport and exercising as part of everyday life would achieve important health gains by reducing obesity and other non-communicable conditions such as cardiovascular diseases and diabetes.

Drunk driving is an important risk factor for all road users, and young drivers and riders aged 18–25 are particularly at risk of crashing (Sethi, Racioppi, and Bertollini 2007). As blood alcohol concentration (BAC) increases, so does the likelihood of crashing, particularly above a BAC of 0.04 grams per deciliter (g/dl). Increases in alcohol consumption in many ECA countries are strongly associated with the region's unprecedented rise in mortality due to RTIs. Russia, Ukraine and some Eastern European countries have the highest overall alcohol consumption—11.9 liters of pure alcohol (100 percent ethanol) per adult per year compared to the worldwide average of 6.2 liters per adult per year (Rehm and others 2009). Other areas of Europe also have high overall alcohol consumption.

The data reported by national sources to WHO (Table 5) show that alcohol consumption was estimated to be responsible for more than 30 percent of all reported road

Table 4: Percentage of Fatal Road Traffic Injuries by Road User Type, 2007

Country	Pedestrians	Bicyclists	Motorcyclists	Motorized Four-wheelers	
				Drivers	Passengers
Albania	40	6	9	24	22
Armenia	39	1	n.a.	34	26
Azerbaijan	38	1	1	28	31
Belarus	40	9	4	24	23
Bosnia and Herzegovina	24	6	5	38	23
Bulgaria	26	4	n.a.	65 (drivers and passengers)	
Croatia	20	5	19	29	21
Czech Republic	19	10	11	41	18
Estonia	19	9	6	39	27
Georgia	28	1	Unspecified	Unspecified	Unspecified
Hungary	23	12	10	34	21
Kazakhstan	37	1	n.a.	23	32
Kyrgyzstan	43	1	4	43	n.a.
Latvia	37	8	4	31	19
Lithuania	32	7	5	28	26
Moldova	34	2	4	25	33
Montenegro	20		4	48	27
Poland	35	9	5	30	21
Romania	11	7	8	52	23
Russian Federation	36		2	34	28
Slovakia	34	8	8	32	17
Slovenia	11	6	18	22	43
Serbia	25	9	6	37	22
Tajikistan	44	6	1	18	30
The Former Yugoslav Republic of Macedonia	34	4	11	29	12
Turkey	19	2	8	24	31
Turkmenistan	29	5		n.a.	n.a.
Ukraine	43	9	8	35	n.a.
Uzbekistan	n.a.	n.a.	n.a.	n.a.	n.a.

n.a. = Not available.

Source: National sources as reported WHO (2009a).

traffic deaths in Estonia, Georgia, Latvia, and Slovenia in 2008, and at least 10 percent in Russia and several other countries. These figures are influenced by legislative testing practices and it has been suggested that the actual figures are much higher in ECA countries as a result of their extremely high alcohol consumption.

Table 5: Road Traffic Deaths Involving Alcohol in ECA, 2007

Country	% of Road Traffic Deaths	Country	% of Road Traffic Deaths
Albania	5	Latvia	21
Armenia	6	Moldova	17
Azerbaijan	3	Poland	14
Belarus	13	Romania	2
Bosnia and Herzegovina	7	Slovakia	4
Bulgaria	5	Slovenia	38
Croatia	30	Russian Federation	10
Czech Republic	3	Serbia	6
Estonia	48	Tajikistan	5
Georgia	37	Turkey	2
Hungary	12	Turkmenistan	7
Kazakhstan	3	The Former Yugoslav Republic of Macedonia	5

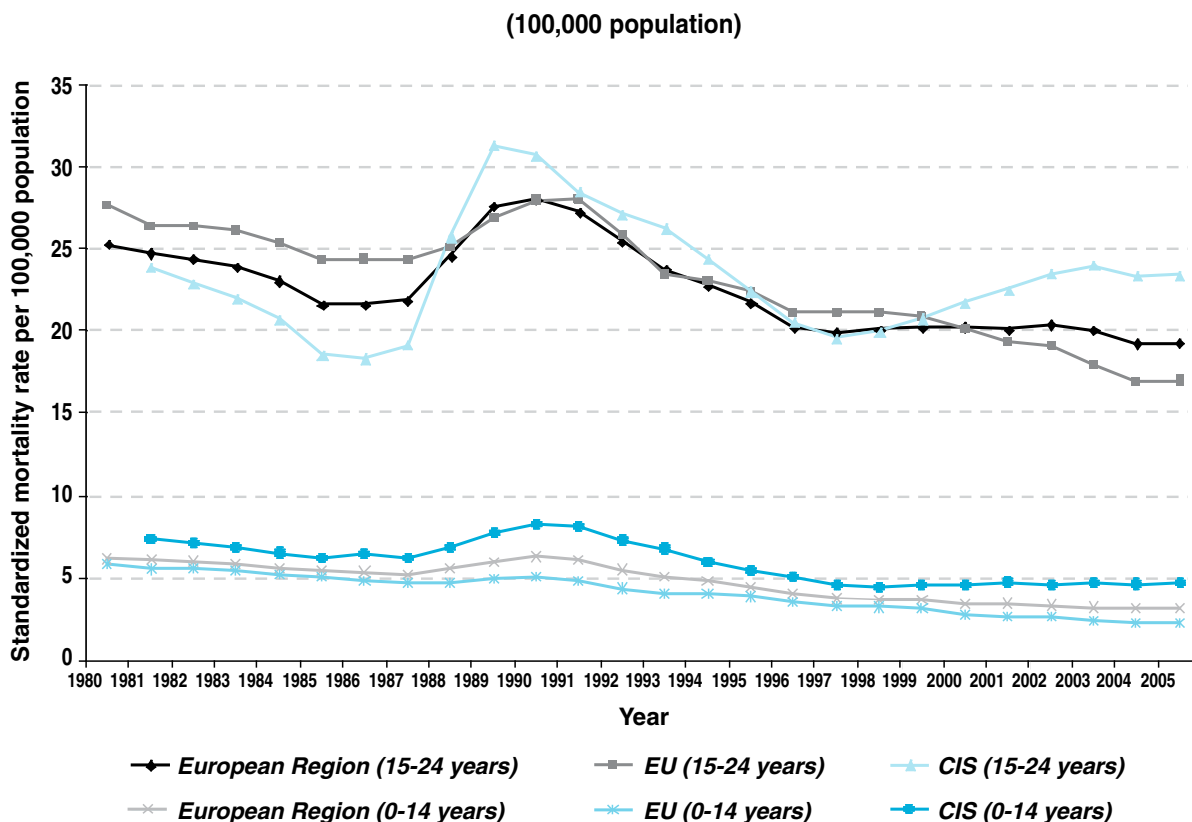
No data available for Kyrgyzstan, Montenegro, Ukraine and Uzbekistan.

Source: National sources as reported in WHO (2009a).

Reflecting this high drinking pattern, the European region, particularly the countries of the former Soviet Union, had the highest proportion of alcohol-attributable net deaths in the world in 2004, with more than one in every ten deaths in European men attributed to alcohol. A recent study in Russia (Zaridze and others 2009) documenting the impact of alcohol on the high and fluctuating adult mortality rates found that among men, RTIs are one of the three leading causes accounting for alcohol-related deaths, particularly among young adults.

Medicines can also cause road-traffic injuries. Many commonly used medicines act on the central nervous system and impair cognitive function (for example, they can result in slow reaction time, somnolence, and dizziness). There are many examples but the most consumed medicines that can produce these effects

Figure 4: Trends in Age-standardized Mortality Rates from RTIs among People Aged 0–14 and 15–24 in the European Region, the EU, and CIS Countries, 1980–2005



Source: WHO EURO (2009).

are antidepressant drugs, anti-anxiety drugs and hypnotics, and classical antihistamines used for allergies. Mixing such medication and alcohol potentiates the cognitive and motor impairment effects; some research has found a positive association between road injuries and consumption of antidepressants (Hours and others 2008).

5. RTIs among population groups

Children and young adults are highly impacted.

Although RTIs affect all age groups, their impact is most striking among the young, whose daily lives tend to carry them from one area to another for school, home, and leisure. Mortality rates for RTIs among children are highest in Latvia, Moldova, Romania, and the Russian Federation (UNECE 2003). Young drivers, particularly males, have especially high road traffic fatality rates, associated with high-risk behaviours. CIS road traffic death rates are about four times greater among those aged 15–24 than among children aged 0–14. Figure 4 on the previous page highlights these striking differences. For both age groups, the average rates for CIS countries are higher than for the EU. Except for a peak in 1989–91, recent death rates from transport injuries in the two age groups have declined in the EU but have increased in CIS countries since 1997. RTIs are the leading cause of death among people aged 15–29, and this age group accounts for one-third of total victims (WHO 2002).

The distribution of road deaths by type of road user varies with age. For children aged 0–14 in the ECA Region, nearly half of the deaths were pedestrians (48 percent), followed by car occupants (32 percent), cyclists (9 percent), and motorcyclists (6 percent) (UNECE and WHO EURO 2009; Sethi, Racioppi, and Mitis 2007). Adolescents aged 15–17 are more likely to die in car crashes (40 percent) or on motorized two-wheelers (31 percent) and less likely to die as pedestrians (21 percent) and cyclists (5 percent). This reflects different risk exposures, with older children using cars and motorcycles more than walking and cycling.

The elderly are particularly vulnerable. People over age 60 are more vulnerable to road traffic injuries due to fragility and reduced ability to cope with traffic. Although injuries in those aged 15–29 are a bigger public health problem, older people—frequently as pedestrians and often more frail—have a higher fatality rate if injured since their injuries tend to be more severe. For example, older people account for nearly half of all

fatalities in pedestrians in the European member states of the Organization for Economic Co-operation and Development (OECD). As population aging accelerates in ECA, identifying new strategies that address their mobility, sensory impairment and safety needs are essential.

Working-age population. RTIs are among the main causes contributing to premature mortality and disability among working-age males, particularly in ECA. This is clearly illustrated by the situation in Russia and Ukraine, where adult male mortality levels are as high as in low-income countries (Box 2 on the next page, World Bank 2005a, 2009a).

Gender differences. Males are more adversely affected than females by RTIs in ECA. A recent study documented that in 2004, the male predominance of deaths among young people aged 10–24 years for all causes in ECA was largely due to more than a seven-fold rise in injury deaths, particularly RTI fatalities, between adolescence and young adulthood (from 24 to 179 per 100,000, which accounted for 65 percent of male deaths and 48 percent of all deaths (Patton and others 2009). In 2007, males in all age groups accounted for 74 to 83 percent of all road traffic fatalities in ECA countries (WHO 2009a). In the course of their life, women and men play different roles in society, which affect their risk-taking behavior, exposure to risks and health-seeking behavior (WHO EURO, 2006). Although exposure data are not available, males travel much more in most of these countries, so the relative risk between males and females may be much less imbalanced than indicated by the absolute number of deaths. Heightened alcohol misuse among young males has been linked to high road fatalities and other injuries in ECA (McKee and Shkolnikov, 2001, Bye 2008). Alcohol-attributable mortality rates in ECA are four times higher among men than among women (Rehm and others 2009). In ECA, extremely high mortality levels among working age men shortens the average man's life expectancy by 10–12 years.

6. Inequality dimension of RTIs

Across and within countries, lower incomes are associated with high death rates from injuries. People in low- to middle-income ECA countries are three to six times more likely to die from injuries than people in EU-15 countries (Sethi and others 2006, Mohan 2002a, 2002b). Even EU-15 and other Western European coun-

Box 2: RTIs Contribute to High Mortality Rates among Working-age Males in Russia and Ukraine

Road traffic injuries (RTIs) play a major role in reducing life expectancy among males in Russia and Ukraine. The probability of men surviving to old age in Russia and Ukraine is low compared not only with European Union (EU) countries but with Central European countries. The probability is especially low among working-age males, whose death rates are similar to those of men in countries with less than one fifth the Gross National Product per capita.

Russia

At 25.2 per 100,000 population, Russian road traffic mortality rate is five or six times higher than in several Western European countries such as Sweden, the Netherlands, Norway, and the United Kingdom, about double that in the United States, and higher than in other Eastern European countries such as Poland and Hungary (OECD/EMCT 2008). This difference is even more remarkable considering that Russia has fewer automobiles than Western Europe, the United States, or Canada. Russia's traffic mortality rate is also higher than in other former Soviet states. In 2007, more than 30,000 people in Russia—mostly working-age males—died in crashes. Driver factors are the major causes: intoxication, lack of discipline, and aggressive driving. In addition, nearly half of all these deaths victimize pedestrians, not drivers or passengers.

By a second, more meaningful measure, fatalities per 10,000 vehicles, Russia's rate of 12.2 is exceptionally high—50 percent higher than the second highest (the Republic of Korea at 8.2) among reporting countries. The severity of road crashes is often measured by the proportion of fatalities to serious injuries. For this measure, Russia is similar to the other transition countries, with an index of 0.12; that is, 12 percent of people injured in road crashes die. Russia's index for the severity of RTIs is 5 to 10 times higher than that in most developed countries (which may result partly from poor registration of road crashes not leading to deaths or injuries). However the problem is measured, Russia clearly has a serious problem of road fatalities and injuries.

Ukraine

Mortality due to road injuries began to decline in Ukraine in 1992 but started to rise again in 1999. Four years later, it was twice the EU average. In 2007, transport injuries caused 21.5 deaths per 100,000 population (compared to 13 per 100,000 in 1999), representing 14 percent of all external causes of death. Again, this rate is even more remarkable considering that there are fewer automobiles per capita in Ukraine than in Western Europe. Alcohol consumption plays an important role in RTIs and other injuries, as well as causing increased risk of cirrhosis of the liver, high blood pressure, heart disease, and cancers.

Source: World Bank (2005a, 2009a).

tries have steep social class gradients in pedestrian injury rates, and it is well established that child pedestrians in lower socioeconomic groups and ethnic minorities suffer more injuries.

7. What are the economic and social consequences of RTIs?

Impact on health systems. RTIs are a major burden on health systems worldwide, placing heavy demands on already overburdened facilities, and straining limited budgets. The results from a comprehensive review of epidemiological studies show that traffic-related injuries accounted for 30 to 86 percent of all trauma admissions in hospitals, with an overall mean length of stay of 20 days. Patients who sustained spinal or head injuries or compound fractures were hospitalized for longest—more 60 days in 25% of cases in one study (Odero, Garner, and Zwi 1997). This review also found that patients with traffic injuries represented 13 to 31 percent of all injury-related visits to medical facilities, 48 percent of bed occupancy in surgical wards, and were the most frequent users of operating theaters and intensive care units.

Similar data for Russia indicate that road traffic victims are seven times more likely to need hospitalization compared with victims of other types of trauma; RTIs account for 75 percent of all types of injury, with victims of road traffic crashes representing more than 60 percent of the total number of severe trauma cases (for example, patients with sustained spinal or head injury or severe and multiple fractures). The provision of medical services for traffic injuries and other external causes absorbed approximately 0.27 percent of Russia's gross domestic product (GDP) in 2003, or about US\$1.2 billion (World Bank 2005a). This is about 10 percent of total health care expenditures in Russia.

The economic cost of RTIs. Globally, RTIs have a significant negative impact on society which occur through many channels (Peden and others 2004; Mohan 2002a, 2002b; Jacobs, Aeron-Thomas and Astrop 2000) and disproportionately affect the most economically productive age groups. Motor vehicle crashes and injuries cause direct and indirect costs to individuals and to society as a whole, arising

from the decline in the general health status of those injured in motor vehicle crashes (Blincoe and others 2002). In estimating the total economic cost of RTIs, the value of the decreased production and consumption of injured individuals is included, as are the resources consumed as a result of any injury or crash that might otherwise have been used for increasing societal well-being.

Direct costs include emergency treatment, initial medical costs, rehabilitation costs, long-term care and treatment, insurance administration expenses, legal costs, and employer/workplace costs. Indirect costs include productivity costs in the workplace due to temporary and permanent disability and decreases in household productivity emanating from these disabilities. Property damage and travel delay and crash costs are estimated for injury and non-injury crashes (Blincoe and others 2002).

The method used to calculate the economic cost of RTIs does not include costs associated with loss of emotional well-being unless it requires medical attention or there are permanent losses in functional capacity or earning capacity.

Estimates indicate that in HICs, 80 percent of the cost of RTIs is attributable to nonfatal events, with 2 percent of nonfatal crashes accounting for 44 percent of lifetime medical costs (NHTSA 1987; Miller, Luchter, and Brinkman 1989, as reported in Ameratunga, Higar, and Norton 2006).

The economic cost of road deaths and injuries globally is estimated at US\$518 billion—1 percent of GNP in low-income countries, 1.5 percent in middle-income countries, and 2 percent in high-income countries (Peden and others 2004; Jacobs, Aaron-Thomas, and Astrop 2000).

The cost in ECA. One estimate from Russia suggested that the loss from RTIs was as high as 3 percent of GDP (ECMT 2006). Using the conservative estimate of the economic costs of road crashes in ECA as being approximately 1.5 percent GDP, Table 6 presents the results for ECA countries. Of course, human life has no price tag, and the results are presented only for economic comparison purposes. The highest costs are in the large economies that also have sizeable populations: Russia (US\$34 billion per year), Turkey (US\$14 billion), Poland (US\$10 billion), and Ukraine (US\$5 billion).

Table 6: Socioeconomic Cost Estimates for Road Injuries in ECA (2008 prices)

Country/Economy	GDP (US\$b) ^a	GDP Per Capita (US\$)	Number of Fatalities ^b	Number of Fatalities per Million Inhabitants	Estimated Economic Costs (US\$b) ^c	Estimated Unit Economic Cost per Fatality) (US\$) ^d
Russia	2,285	16,161	34,506	246	34.3	1,131,270
Turkey	937	13,447	4,496	59	14.1	941,290
Poland	669	17,560	5,583	145	10.0	1,229,200
Ukraine	350	7,634	6,966	152	5.3	534,380
Romania	273	12,698	2,794	126	4.1	888,860
Czech Republic	266	25,755	1,221	120	4.0	1,802,850
Hungary	199	19,830	1,232	124	3.0	1,388,100
Kazakhstan	180	11,563	3,136	204	2.7	809,140
Belarus	118	12,344	1,688	175	1.8	864,080
Slovakia	120	22,242	627	115	1.8	1,556,940
Bulgaria	94	12,372	1,006	140	1.4	866,040
Azerbaijan	78	8,958	1,027	125	1.2	627,060
Serbia	81	10,911	897	88	1.2	763,770
Croatia	73	16,474	614	137	1.1	1,153,180
Uzbekistan	71	2,606	2,075	75	1.1	182,420

(Continued on next page)

Table 6: Socioeconomic Cost Estimates for Road Injuries in ECA (2008 prices)*(continued)*

Country/Economy	GDP (US\$b) ^a	GDP Per Capita (US\$)	Number of Fatalities ^b	Number of Fatalities per Million Inhabitants	Estimated Economic Costs (US\$b) ^c	Estimated Unit Economic Cost per Fatality) (US\$) ^d
<i>Lithuania</i>	64	18,855	739	208	1.0	1,319,850
<i>Slovenia</i>	58	28,894	292	146	0.9	2,022,580
<i>Latvia</i>	40	17,801	419	188	0.6	1,246,070
<i>Turkmenistan</i>	30	5,765	533	109	0.5	403,550
<i>Bosnia and Herzegovina</i>	30	7,618	436	95	0.5	533,260
<i>Estonia</i>	28	20,754	196	151	0.4	1,452,780
<i>Armenia</i>	19	5,437	259	87	0.3	380,590
<i>Georgia</i>	22	5,001	637	138	0.3	350,070
<i>Albania</i>	22	6,797	277	76	0.3	475,790
<i>The Former Yugoslav Republic of Macedonia</i>	19	9,128	143	69	0.3	638,960
<i>Moldova</i>	11	3,154	391	90	0.2	220,780
<i>Kyrgyz Republic</i>	12	2,174	892	164	0.2	152,180
<i>Tajikistan</i>	13	1,984	483	66	0.2	138,880
<i>Montenegro</i>	7	10,414	122	181	0.1	728,980
<i>Kosovo</i>	5	2,300	152	84	0.1	161,000

^a IMF World Economic Outlook Database, October 2008.

^b Fatalities data: Latest available from WHO, UNECE, EuroStat databases, and World Bank. The statistics used are the average number of fatalities during 2003–05.

^c Economic costs estimated at 1.5 percent of country GDP at 2008 prices.

^d To quantify the savings due to lower deaths, a cost to human life has to be approximated. This is referred to as the value of a statistical life (VSL). The literature presents two main approaches: the willingness-to-pay approach and the human capital or lost output approach. In the willingness-to-pay approach, as the name implies, an estimate is made of the value that individuals in a society attach to road safety in terms of the amount of money that they are willing to pay to avoid the risk of loss of life. Either stated preference or revealed preference techniques can be used in this method. In the human capital approach, the main part of the estimate is the discount to present value of a victim's foregone future output or income due to the death resulting from a road crash. Both approaches have a clear linkage to the level of income (GDP per capita). The willingness-to-pay approach is discussed in the literature as being more robust but presents the weakness of requiring intensive and sophisticated surveys. One approach has been devised to estimate the statistical value of a life based on available studies from both approaches; and linking simply to the GDP per capita of the country (McMahon and Dahdah, 2008). The estimate of VSL at 70 times GDP per capita has been found to fit most data samples from different countries' estimations of VSL depending on the datasets used. This research is supported by earlier work (European Road Safety Observatory, 2006). In that study, there were wide variations in VSL in the official valuations of road safety fatalities in 23 different countries. However, all the countries with good road safety records were using an official valuation in the range of 60 to 80 times GDP per capita, and confirm the estimation at 70 times GDP per capita recommended in McMahon & Dahdah (2008).

Sources: IMF, WHO, UNECE, EuroStat, World Bank; and McMahon and Dahdah (2008).