

Introduction

The previous chapter showed that road traffic injuries are a major global public health and development problem that will worsen in the years ahead if no significant steps are taken to alleviate it. This chapter examines in greater depth the extent of the problem of road traffic injuries. The current global estimates and trends over time are first discussed, with projections and predictions. The sections that follow examine the effects of motorization, the profiles of those affected by road traffic injuries, and the socioeconomic and health impacts of road traffic collisions. Finally, there is a discussion of important issues related to data and the evidence for road traffic injury prevention.

Sources of data

The analysis in this chapter is based on evidence on road traffic injuries derived from four main sources:

- The WHO mortality database and the WHO Global Burden of Disease (GBD), 2002, Version 1 database (see Statistical Annex).
- Recent studies by the World Bank (1) and the United Kingdom's Transport Research Laboratory (now TRL Ltd) (2).
- Databases and web sites of various international and national organizations that compile road transport statistics, including:
 - International Road Traffic and Accident Database (IRTAD);
 - United Nations Economic Commission for Europe (UNECE);
 - Transport Safety Bureau, Australia.
 - Department of Transport, South Africa;
 - Department for Transport, United Kingdom;
 - Fatal Analysis Reporting System, United States;
 - National Highway Traffic Safety Administration (NHTSA), United States;
- A review of available studies on various topics related to road traffic injuries, including road safety issues, in order to secure country and regional level data and evidence. The literature was obtained from libraries, online journals and individuals.

Magnitude of the problem

Mortality is an essential indicator of the scale of any health problem, including injury. It is important, though, that non-fatal outcomes – or injury morbidity – should be measured and included, so as to reflect fully the burden of disease due to road traffic collisions. For each road traffic injury death, there are dozens of survivors who are left with short-term or permanent disabilities that may result in continuing restrictions on their physical functioning, psychosocial consequences or a reduced quality of life. The assessment in this chapter of the magnitude of road traffic injuries, therefore, considers not only on mortality but also injuries and disability.

Global estimates

The road traffic injury problem began before the introduction of the car. However, it was with the car – and subsequently buses, trucks and other vehicles – that the problem escalated rapidly. By various accounts, the first injury crash was supposedly suffered by a cyclist in New York City on 30 May 1896, followed a few months later by the first fatality, a pedestrian in London (3). Despite the early concerns expressed over serious injury and loss of life, road traffic crashes have continued to this day to exact their toll. Though the exact number will never be known, the number of fatalities was conservatively estimated to have reached a cumulative total of 25 million by 1997 (4).

WHO data show that in 2002 nearly 1.2 million people worldwide died as a result of road traffic injuries (see Statistical Annex, Table A.2). This represents an average of 3242 persons dying each day around the world from road traffic injuries. In addition to these deaths, between 20 million and 50 million people globally are estimated to be injured or disabled each year (2, 5, 6).

In the same year, the overall global road traffic injury mortality rate was 19.0 per 100 000 population (see Table 2.1). Low-income and middle-income countries had a rate slightly greater than the global average, while that for high-income countries was considerably lower. The vast majority – 90% – of road traffic deaths were in low-income and middle-income countries. Only 10% of road traffic deaths occurred in high-income countries.

TABLE 2.1

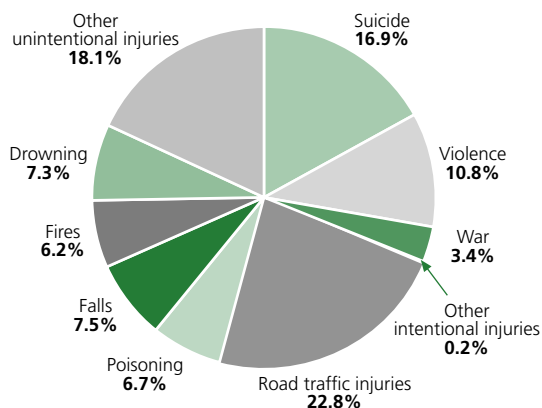
Estimated global road traffic injury-related deaths			
	Number	Rate per 100 000 population	Proportion of total (%)
Low-income and middle-income countries	1 065 988	20.2	90
High-income countries	117 504	12.6	10
Total	1 183 492	19.0	100

Source: WHO Global Burden of Disease project, 2002, Version 1 (see Statistical Annex).

According to WHO data for 2002, road traffic injuries accounted for 2.1% of all global deaths (see Statistical Annex, Table A.2) and ranked as the 11th leading cause of death (see Statistical Annex, Table A.3). Furthermore, these road traffic deaths accounted for 23% of all injury deaths worldwide (see Figure 2.1).

FIGURE 2.1

Distribution of global injury mortality by cause



Source: WHO Global Burden of Disease project, 2002, Version 1 (see Statistical Annex).

In 2002, road traffic injuries were the ninth leading cause of disability-adjusted life years lost (see Statistical Annex, Table A.3), accounting for over 38 million disability-adjusted life years (DALYs) lost, or 2.6% of the global burden of disease. Low-income and middle-income countries account for 91.8% of the DALYs lost to road traffic injuries worldwide.

These observations illustrate the fact that low-income and middle-income countries carry most of the burden of the world's road traffic injuries.

Regional distribution

There is considerable regional variation, both in the absolute number of road traffic injury deaths and mortality rates (see Statistical Annex, Table A.2). The WHO Western Pacific Region recorded the highest absolute number of deaths in 2002, with just over 300 000, followed by the WHO South-East Asia Region with just under 300 000. These two regions together account for more than half of all road traffic deaths in the world.

As regards death rates, the WHO African Region had the highest mortality rate in 2002, at 28.3 per 100 000 population, followed closely by the low-income and middle-income countries of the WHO Eastern Mediterranean Region, at 26.4 per 100 000 population (see Figure 2.2 and Table 2.2).

TABLE 2.2

Road traffic injury mortality rates (per 100 000 population) in WHO regions, 2002		
WHO region	Low-income and middle-income countries	High-income countries
African Region	28.3	—
Region of the Americas	16.2	14.8
South-East Asia Region	18.6	—
European Region	17.4	11.0
Eastern Mediterranean Region	26.4	19.0
Western Pacific Region	18.5	12.0

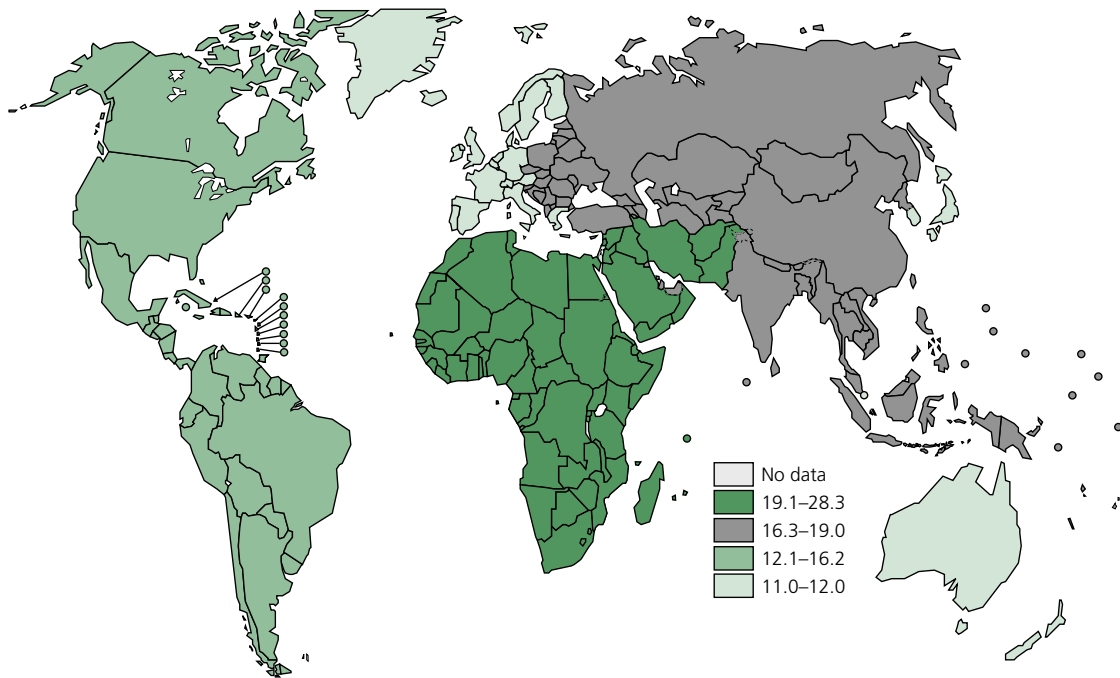
Source: WHO Global Burden of Disease project, 2002, Version 1 (see Statistical Annex).

The high-income countries in Europe have the lowest road traffic fatality rate (11.0 per 100 000 population) followed by those of the WHO Western Pacific Region (12.0 per 100 000 population). In general, the regional averages for low-income and middle-income are much higher than corresponding rates for high-income countries.

Significant variations also arise between countries; some features specific to individual countries are discussed below.

FIGURE 2.2

Road traffic injury mortality rates (per 100 000 population) in WHO regions, 2002



Source: WHO Global Burden of Disease project, 2002, Version 1 (see Statistical Annex).

Country estimates

Only 75 countries report vital registration data, including road traffic injury data, to WHO that are sufficient for analysis here (see Statistical Annex, Table A.4). The regional estimates, presented in the section above, are based on these data, as well as on incomplete data from a further 35 countries and various epidemiological sources. These estimates indicate that African countries have some of the highest road traffic injury mortality rates. However, when examining data from the individual 75 countries that report sufficient data to WHO, a different picture emerges. The highest country rates are found in some Latin American countries (41.7 per 100 000 population in El Salvador, 41.0 per 100 000 in the Dominican Republic and 25.6 per 100 000 in Brazil), as well as some countries in Europe (22.7 per 100 000 in Latvia, 19.4 per 100 000 in the Russian Federation and 19.3 per 100 000 in Lithuania), and Asia (21.9 per 100 000 in the Republic of Korea, 21.0 per 100 000 in Thailand and 19.0 per 100 000 in China).

Many Member countries of the Organisation for Economic Co-operation and Development (OECD) report road traffic fatality rates of less than 10 per 100 000 population (see Table 2.3). The Netherlands, Sweden and Great Britain have the lowest rates per 100 000 population.

TABLE 2.3

Road traffic fatality rates in selected countries or areas, 2000

Country or area	Per 100 000 inhabitants
Australia	9.5
European Union ^a	11.0
Great Britain	5.9
Japan	8.2
Netherlands	6.8
Sweden	6.7
United States of America	15.2

^a Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and the United Kingdom.

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Trends in road traffic injuries

Global and regional trends

According to WHO data, road traffic deaths have risen from approximately 999 000 in 1990 (8) to just over 1.1 million in 2002 (see Statistical Annex, Table A.2) – an increase of around 10%. Low-income and middle-income countries account for the majority of this increase.

Although the number of road traffic injuries has continued to rise in the world as a whole, time series analysis reveals that road traffic fatalities and mortality rates show clear differences in the pattern of growth between high-income countries, on the one hand, and low-income and middle-income countries on the other (2, 9–11). In general, since the 1960s and 1970s, there has been a decrease in the numbers and rates of fatalities in high-income countries such as Australia, Canada, Germany, the Netherlands, Sweden, the United Kingdom and the United States of America. At the same time, there has been a pronounced rise in numbers and rates in many low-income and middle-income countries.

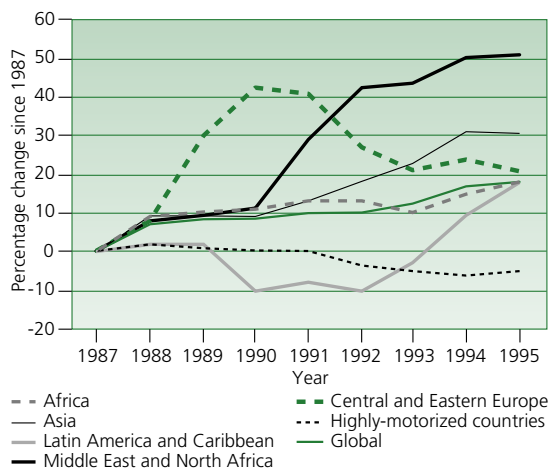
The percentage change in road traffic fatalities in different regions of the world for the period 1987–1995 is shown in Figure 2.3. The trends are based on a limited number of countries for which data were available throughout the period and they are therefore influenced by the largest countries in the regional samples. Such regional trends could mask national trends and the data should not be extrapolated to the national level. The regional classifications employed are similar to, but not exactly the same as those defined by WHO. It is clear from the figure that there has been an overall downward trend in road traffic deaths in high-income countries, whereas many of the low-income and middle-income countries have shown an increase since the late 1980s. There are, however, some marked regional differences; Central and Eastern Europe witnessed a rapid increase in road traffic deaths during the late 1980s, the rate of increase of which has since declined. The onset of rapid increases in road traffic fatalities occurred later in Latin America and the Caribbean, from 1992 onwards. In contrast, numbers of road traffic deaths have risen steadily

since the late 1980s in the Middle East and North Africa and in Asia, particularly in the former.

The reductions in road traffic fatalities in high-income countries are attributed largely to the implementation of a wide range of road safety measures, including seat-belt use, vehicle crash protection, traffic-calming interventions and traffic law enforcement (2, 12). However, the reduction in the reported statistics for road traffic injury does not necessarily mean an improvement in road safety for everyone. According to the International Road Traffic and Accident Database (IRTAD), pedestrian and bicyclist fatalities have decreased more rapidly than have fatalities among vehicle occupants. In fact, between 1970 and 1999, the proportion of pedestrian and bicyclist fatalities fell from 37% to 25% of all traffic fatalities, when averaged across 28 countries that report their data to IRTAD (13). These reductions could, however, be due, at least in part, to a decrease in exposure rather than an improvement in safety (14).

FIGURE 2.3

Global and regional road fatality trends, 1987–1995^a



^a Data are displayed according to the regional classifications of TRL Ltd, United Kingdom.

Source: reproduced from reference 2 with the permission of the author.

Trends in selected countries

As already mentioned, the regional trends do not necessarily reflect those of individual countries.

Table 2.4 and Figures 2.4 and 2.5 show how road traffic mortality rates have changed with time in some countries. It can be seen from Figures 2.4 and 2.5 that some individual countries' trends in mortality rates do indeed reflect the general trend in the number of road traffic deaths. Thus in Australia, the mortality rate increased – with some annual fluctuations – to peak at about 30 deaths per 100 000 population in 1970, after which there was a steady decline. Trends in the United Kingdom and the United States followed a similar pattern. The rates in Brazil, on the other hand, appear to have reached a peak in 1981 and may now be declining very slowly. In contrast, India, with relatively high rates of population growth, increasing mobility and growing numbers of vehicles, is still

TABLE 2.4

Changes in road traffic fatality rates (deaths per 10 000 population), 1975–1998

Country or area	Change (%)
Canada	-63.4
China	
Hong Kong SAR	-61.7
Province of Taiwan	-32.0
Sweden	-58.3
Israel	-49.7
France	-42.6
New Zealand	-33.2
United States of America	-27.2
Japan	-24.5
Malaysia	44.3
India	79.3 ^a
Sri Lanka	84.5
Lesotho	192.8
Colombia	237.1
China	243.0
Botswana	383.8 ^b

SAR: Special Administrative Region.

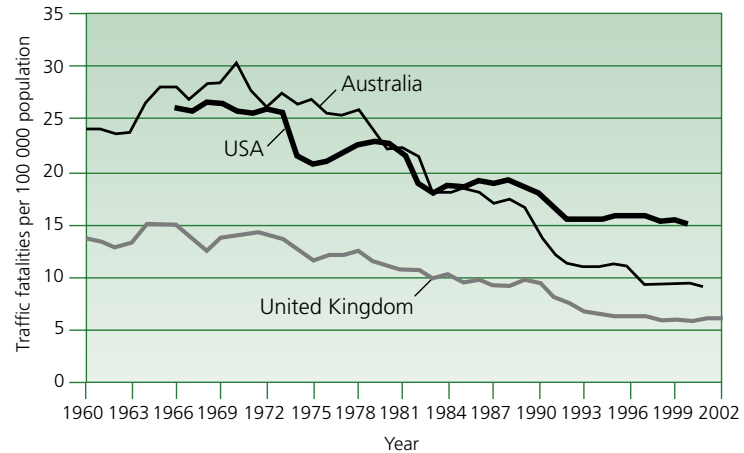
^a Refers to the period 1980–1998.

^b Refers to the period 1976–1998.

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FIGURE 2.4

Road traffic fatality trends in three high-income countries (Australia, United Kingdom, United States of America)



Sources: Transport Safety Bureau, Australia; Department of Transport; United Kingdom; Fatality Analysis Reporting System, United States of America.

showing a rising trend in mortality rates.

There are many factors contributing to these trends and the differences between countries and regions. At the macro level, these trends have been successfully modelled and used for predicting future developments.

Projections and predictions

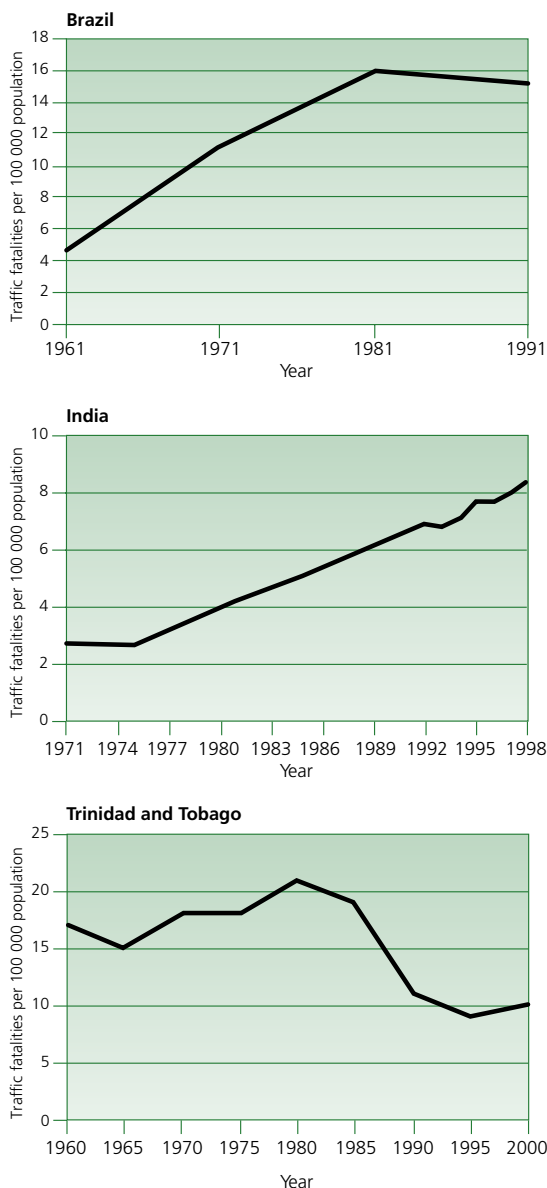
While a decrease in deaths has been recorded in high-income countries, current and projected trends in low-income and middle-income countries foreshadow a large escalation in global road traffic mortality over the next 20 years and possibly beyond. Currently, there are two main models for predicting future trends in road traffic fatalities. These two models are:

- the WHO Global Burden of Disease (GBD) project (8), using health data;
- the World Bank's Traffic Fatalities and Economic Growth (TFEC) project (1), using transport, population and economic data.

Both predict a substantial increase in road traffic deaths if present policies and actions in road safety continue and no additional road safety counter-measures are put into place. The GBD model predicts the following scenario for 2020 compared with 1990 (8):

FIGURE 2.5

Road traffic fatality trends in three low-income and middle-income countries



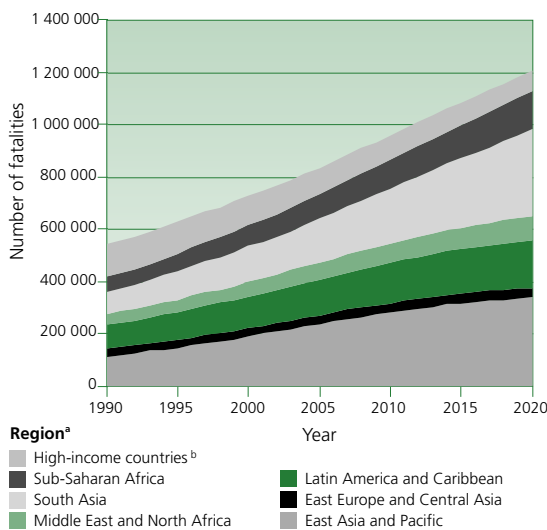
Sources: Denatran, Brazil; Ministry of Surface Transport, India; Police statistics, Highway Patrol Unit, Trinidad and Tobago Police Service.

- Road traffic injuries will rise in rank to sixth place as a major cause of death worldwide.
- Road traffic injuries will rise to become the third leading cause of DALYs lost.

- Road traffic injuries will become the second leading cause of DALYs lost for low-income and middle-income countries.
- Road traffic deaths will increase worldwide, from 0.99 million to 2.34 million (representing 3.4% of all deaths).
- Road traffic deaths will increase on average by over 80% in low-income and middle-income countries and decline by almost 30% in high-income countries.
- DALYs lost will increase worldwide from 34.3 million to 71.2 million (representing 5.1% of the global burden of disease).

FIGURE 2.6

Road traffic fatalities, adjusted for underreporting, 1990–2020



^a Data are displayed according to the regional classifications of the World Bank.

^b 28 countries with a Human Development Index of 0.8 or more. Source: reproduced from reference 1, with the permission of the authors.

According to the TFEC model predictions (Table 2.5 and Figure 2.6), between 2000 and 2020, South Asia will record the largest growth in road traffic deaths, with a dramatic increase of 144%. If the low-income and middle-income countries follow the general trend of the high-income countries, their fatality rates will begin to decline in the future, but not before costing many lives. The

TABLE 2.5

Predicted road traffic fatalities by region (in thousands), adjusted for underreporting, 1990–2020

Region ^a	Number of countries	1990	2000	2010	2020	Change (%) 2000–2020	Fatality rate (deaths/ 100 000 persons)	
							2000	2020
East Asia and Pacific	15	112	188	278	337	79	10.9	16.8
East Europe and Central Asia	9	30	32	36	38	19	19.0	21.2
Latin America and Caribbean	31	90	122	154	180	48	26.1	31.0
Middle East and North Africa	13	41	56	73	94	68	19.2	22.3
South Asia	7	87	135	212	330	144	10.2	18.9
Sub-Saharan Africa	46	59	80	109	144	80	12.3	14.9
Sub-total	121	419	613	862	1 124	83	13.3	19.0
High-income countries	35	123	110	95	80	-27	11.8	7.8
Total	156	542	723	957	1 204	67	13.0	17.4

^a Data are displayed according to the regional classifications of the World Bank.

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model anticipates that India's rate will not decline until 2042. Other low-income and middle-income country rates may begin to decline earlier, but their fatality rates will still be higher than those experienced by high-income countries.

The predicted percentage decrease in deaths from 2000 to 2020 for high-income countries of 27% and the global increase of 67% in the TFEC model are similar to those of the GBD model. However, the models differ on the total number of deaths each predicts for 2020. The TFEC model suggests that there will be 1.2 million deaths, as against 2.4 million for the GBD model. To some extent, this difference is explained by a much higher starting estimate for 1990 in the GBD model, which is based on data from health facilities.

The predictions need to be interpreted in context. The international data presented in this report show that at each income level, there are significant differences among countries in the number of vehicles per capita and in fatalities per capita. This implies that it is possible for people to live with fewer vehicles per capita and fewer fatalities per capita than the average rates seen at present. Projected trends are based on the averages of past trends. While existing scientific knowledge has not always been easily accessible for most countries, efforts are now being made to collate and disseminate this information so that it can be fed into predictive models. It is feasible, therefore, that low-

income and middle-income countries will not follow the trends of the past and even that they could improve upon them. As a result, the projections of the World Bank and WHO may prove too high and low-income and middle-income countries may see much lower death rates in the future.

Both models have made a large number of assumptions about the future and are based on scarce and imperfect data. Moreover, models cannot be expected to predict future reality precisely, as unforeseen factors will almost inevitably emerge. Nevertheless, the underlying message from the projections is clear: should current trends continue and no intensified and new interventions be implemented, then many more deaths and injuries will be experienced from road traffic crashes in the future. Helping low-income and middle-income countries tackle the problem of road traffic injuries must be a priority, as these are the countries where the greatest increases will occur in the next 20 years.

Motorization, development and road traffic injury

The earlier discussion on estimates and trends has shown that the road traffic injury problem is a complex one and represents the unfolding of many changes and events, both economic and social. The intricate relationship between road traffic injuries, motor vehicle numbers and a country's stage of development has been explored in a number of studies.

This section describes factors affecting trends in road traffic mortality rates, and, in particular, empirical findings on the links between road traffic fatalities, the growth in the number of motor vehicles and development.

The growth in the number of motor vehicles in various parts of the world is central, not only to road safety, but also to other issues such as pollution, the quality of life in urban and rural areas, the depletion of natural resources, and social justice (15–20).

As regards the number of fatalities, many high-income countries in the first half of the 20th century experienced a rapid growth in deaths from road crashes, alongside economic growth and an increase in the number of vehicles. During the second half of the century, though, many of these countries saw reductions in fatality rates, despite a continued rise in the number of motor vehicles and in mobility. It does not follow, therefore, that a growth in mobility and motorization will necessarily lead to higher rates of fatalities.

The first significant attempt to model the relationship between fatality rates and motorization was carried out by Smeed (21), who used data from 1938 for 20 industrialized countries. Smeed came to the conclusion that fatalities per motor vehicle decreased with an increasing number of vehicles per head of population. A similar relationship was later established for 32 developing countries, based on 1968 data (22). This research led to a basic belief that the road traffic injury death rate per registered vehicle is expected to decrease as the number of vehicles per head of population increases. However, this model was derived from a cross-section of countries and not from a time series of data for one or more countries. It is therefore dangerous to apply this model to changes over time in a single country. Furthermore, the use of the variable “fatalities per vehicle” has been criticized as an indicator for road traffic safety. It tends to ignore, for example, non-motorized forms of transport (23). Nor does it take into account other relevant road and environmental conditions, or the behaviour of drivers and other road users (24). The use of appropriate indicators for road safety is discussed in more detail later in this chapter.

Researchers have also investigated the relationship between road traffic injuries and other socioeconomic indicators (1, 25–29). For instance, it is known that the mortality rate, especially that of infant mortality, tends to improve as the gross national product (GNP) per capita increases. As a nation develops economically, it is to be expected that part of the wealth generated will be devoted to efforts to reduce mortality, including road traffic mortality (27). In this context, mortality related to motor vehicles and road traffic can be seen as a “disease of development”.

A study of motor vehicle-related mortality in 46 countries (27) established a direct but weak correlation between economic development – as measured by GNP per capita – and deaths per vehicle. This relationship was found to be strongest among countries with low GNP per capita, yet it was precisely among these countries that the effects of factors other than GNP per capita on fatalities per vehicle were most important. Based on 1990 data, another study established a positive relationship between GNP per capita and road traffic mortality rates for 83 countries (29). In absolute terms, the middle-income countries had the highest mortality rates. When adjustments were made for the number of motor vehicles, the poorest countries showed the highest road traffic mortality rates.

A recent World Bank report (1) examined data from 1963 to 1999 for 88 countries. Unlike Smeed’s research, the authors were able to develop models based on time series data for each country. One of their main findings was a sharp increase in fatalities per head of population as gross domestic product (GDP) per capita increased – but only at low levels of GDP per capita, up to a peak of between \$6100 and \$8600 (at 1985 international dollar values), depending on the exact model. After that peak was reached, fatalities per head of population began to decline. Their results also showed that fatalities per vehicle declined sharply with income per capita GDP in excess of \$1180 (1985 international dollar values). The empirical results presented show the important contribution of economic development to mobility, which leads to increased motorization and increased exposure to risk.

Profile of people affected by road traffic injuries

Types of road user

Although all types of road user are at risk of being injured or killed in a road traffic crash, there are notable differences in fatality rates between different road user groups. In particular, the “vulnerable” road users such as pedestrians and two-wheeler users are at greater risk than vehicle occupants and usually bear the greatest burden of injury. This is especially true in low-income and middle-income countries, because of the greater variety and intensity of traffic mix and the lack of separation from other road users. Of particular concern is the mix between the slow-moving and vulnerable non-motorized road users, as well as motorcycles, and fast-moving, motorized vehicles.

Several studies have revealed marked differences in fatality rates between various groups of road users, as well as between road users in high-income countries and those in low-income and middle-income countries. A review of 38 studies found that pedestrian fatalities were highest in 75% of the studies, accounting for between 41% and 75% of all fatalities (30). Passengers were the second largest group of road users killed, accounting

for between 38% and 51% of fatalities. In Kenya, between 1971 and 1990, pedestrians represented 42% of all crash fatalities; pedestrians and passengers combined accounted for approximately 80% of all fatalities in that country each year (31). In the city of Nairobi, between 1977 and 1994, 64% of road users killed in traffic crashes were pedestrians (32).

Recent studies have shown that pedestrians and motorcyclists have the highest rates of injury in Asia (33–35). Injured pedestrians and passengers in mass transportation are the main issue in Africa (31, 36, 37). In Latin America and the Caribbean, injuries to pedestrians are the greatest problem (38–40).

By contrast, in most OECD countries, such as France, Germany and Sweden, car occupants represent more than 60% of all fatalities, a reflection of the greater number of motor vehicles in use. While there are fewer motorcyclist, cyclist and pedestrian casualties, these groups of road users bear higher fatality rates (41).

In several low-income and middle-income countries, passengers in buses and other informal public transport systems also constitute a significant group at high risk of road traffic casualties (30) (see Box 2.1).

BOX 2.1

Informal types of transport

Public transport systems – such as buses, trains, underground trains and trams – are not well developed in many low-income and middle-income countries. Instead, informal modes of transport, used largely by poorer people, have evolved to fill the gap, consisting of privately-owned buses, converted pick-up trucks and minibuses. Examples include the *matatu* in Kenya, the light buses of Hong Kong and the minibuses of Singapore, Manila’s *jeepneys*, the *colt* of Jakarta, the *dolmus* minibuses of Istanbul, the *dala dala* of Tanzania, the *tro-tro* of Ghana, the Haitian *tap-tap*, the *molue* (locally known as “moving morgues”) and *danfo* (“flying coffins”) in Nigeria, and the taxis of South Africa and Uganda (10).

The low fares charged by these forms of transport are affordable to poor people. The vehicles are also convenient, as they will stop anywhere to pick up or drop off passengers, and they do not adhere to any fixed time schedules. Against these advantages for poorer people in terms of mobility, there is a marked lack of safety. The vehicles are generally overloaded with passengers and goods. The drivers speed, are aggressive in their road behaviour and lack respect for other road users. The long hours that drivers are forced to work result in fatigue, sleep deprivation and reckless driving (42).

BOX 2.1 (continued)

These forms of transport thus present a real dilemma for road transport planners. On the one hand, the people who use them lack alternative safe and affordable public transport. These types of transport provide employment for poor people, and it is difficult to prohibit them. On the other hand, they are inherently dangerous. The drivers, subject to all-powerful vehicle owners, are not protected by labour laws. The owners frequently have their own private arrangements with the traffic enforcement authorities. All these factors increase the risk of vehicle crashes and injuries, and complicate possibilities for intervention.

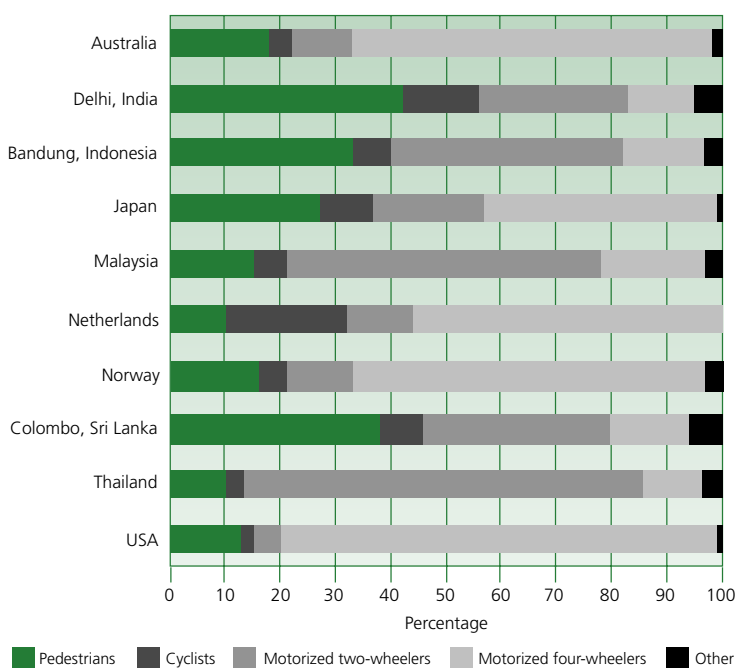
All the same, a strategy must be found to regulate this industry and make it into a safe and organized form of public transport. Such a strategy must address the safety of road users, the labour rights of drivers and the economic interests of the vehicle owners (10, 42, 43). One possibility is that vehicle owners could be encouraged to pool their resources through some form of joint venture and be given access to additional capital and management capacity, so that a safe and effectively-regulated public transport system could be developed.

As Figure 2.7 shows, numerically, there are clear regional and national differences in the distribution of road user mortality. Vulnerable road users – pedestrians and cyclists – tend to account for a much greater proportion of road traffic deaths in low-income and middle-income countries, than in high-income countries. This is further illustrated in Table 2.6, which shows that pedestrians, cyclists and motorized two-wheeler riders sustain the vast majority of fatalities and injuries on both urban and rural roads.

The type of traffic, the mix of different types of road user, and the type of crashes in low-income and middle-income countries differ significantly from those in high-income countries. Their traffic patterns have generally not been experienced by high-income countries in the past and so technologies and policies cannot be automatically transferred from high-income to low-income countries without adaptation. A good example of this provided by that of Viet Nam, where rapid motorization has occurred as a result of the proliferation of small and inexpensive motorcycles. These motorcycles, whose number is likely to remain

FIGURE 2.7

Road users killed in various modes of transport as a proportion of all road traffic deaths



Source: reference 44.

high, have recently been joined by a large influx of passenger motor vehicles, creating increased crash risks because of the mix of different types of road user.

In many low-income and middle-income countries, where bicycles and motorcycles are often the only affordable means of transport, two-wheeled

TABLE 2.6

Proportion of road users killed at different locations in India

Location	Type of road user (%)								Total
	Lorry	Bus	Car	TSR	MTW	HAPV	Bicycle	Pedestrian	
Mumbai	2	1	2	4	7	0	6	78	100
New Delhi	2	5	3	3	21	3	10	53	100
Highways ^a	14	3	15	–	24	1	11	32	100

TSR: three-wheeled scooter taxi; MTW: motorized two-wheelers; HAPV: human and animal powered vehicles.

^a Statistical summary of 11 locations, not representative for the whole country (tractor fatalities not included).

Source: reproduced from reference 44, with the permission of the publisher.

vehicles are involved in a large proportion of road traffic collisions (see Box 2.2). These road users increasingly have to share traffic space with four-wheeled vehicles, such as cars, buses and trucks. Road design and traffic management are generally

poor and fail to provide adequate safety in such a mix of traffic. High-income countries did not experience this phase of development, with fast vehicles mixing with vulnerable road users, to such a degree (50).

BOX 2.2**Bicycles and bicycle injuries**

There are some 800 million bicycles in the world, twice the number that there are cars. In Asia alone, bicycles carry more people than do all the world's cars. Nonetheless, in many countries, bicycle injuries are not given proper recognition as a road safety problem and attract little research (45).

In Beijing, China, about a third of all traffic deaths occur among bicyclists (46). In India, bicyclists represent between 12% and 21% of road user fatalities, the second-largest category after pedestrians (47).

China is one of the few developing countries where public policy until recently has encouraged the use of bicycles as a form of commuting. In the city of Tianjin, 77% of all daily passenger trips are taken by bicycle – compared, for instance, with just 1% in Sydney, Australia (48). There are estimated to be over 300 million bicycles in all of China. While about one in four people in China owns a bicycle, only 1 in 74 000 owns a car (45). Use of bicycle helmets in China is rare, though. In the city of Wuhan, for instance, their use is non-existent, despite the fact that 45% of all traffic deaths in the city occur among bicyclists (49).

Reducing bicycle injuries

To reduce bicycle injuries – in China, as elsewhere – several types of intervention are likely to be effective.

Changes to the road environment can be highly beneficial. They include:

- separating bicycles from other forms of traffic;
- engineering measures to control traffic flow and reinforce low speeds;
- bicycle lanes;
- traffic signals and signs aimed at bicyclists;
- painted lines on the side of the road;
- removing obstacles from roads and cycle paths;
- creating clear lines of sight;
- repairing road surfaces, to remove pot-holes and dangerous curbs.

Measures involving changes in personal behaviour include:

- use of a bicycle helmet;
- safe bicycling practices;
- respectful behaviour towards others sharing the road.

BOX 2.2 (continued)

Legislative and related measures that can be effective include:

- laws mandating helmet use;
- strict legal limits on alcohol use while bicycling;
- speed restrictions;
- enforcement of traffic laws.

Introducing a package of all these approaches is likely to be more effective than if they are used singly, and promises in all countries to significantly reduce the toll of bicycle-related injuries.

Occupational road traffic injuries

Motor vehicle crashes are the leading cause of death in the workplace in the United States, and contribute substantially to the road fatality burden in other industrialized nations. In the United States, an average of 2100 workers died from motor vehicle crashes each year between 1992 and 2001, accounting for 35% of all workplace fatalities in that country, and representing slightly over 3% of the total road crash fatalities (S. Pratt, personal communication, 2003) (51).

In the European Union, road traffic and transport crashes at work account for an even greater proportion of workplace fatalities – around 41% in 1999 (52). In Australia, the experience is similar, with nearly half of all workplace fatalities between 1989 and 1992 associated with either driving for work or commuting between home and the workplace. Work-related crashes were estimated to comprise 13% of all road fatalities (53). Data for Australia, however, differ from those for the European Union and the United States in that work-related crashes include those that occur during commuting to and from work in addition to driving during the workday. Data on work-related road traffic crashes in low-income and middle-income countries are scant.

Sex and age

The distribution of road traffic mortality rates by sex and age, globally, as well as for each WHO region, is shown in the Statistical Annex, Table A.2. Over 50% of the global mortality due to road traffic injury occurs among

young adults aged between 15 and 44 years (54), and the rates for this age group are higher in low-income and middle-income countries. In 2002, males accounted for 73% of all road traffic deaths, with an overall rate almost three times that for females: 27.6 per 100 000 population and 10.4 per 100 000 population, respectively. Road traffic mortality rates are higher in men than in women in all regions regardless of income level, and also across all age groups (Figure 2.8). On average, males in the low-income and middle-income countries of the WHO Africa Region and the WHO Eastern Mediterranean Region have the highest road traffic injury mortality rates worldwide (see Statistical Annex, Table A.2). The gender difference in mortality rates is probably related to both exposure and risk-taking behaviour.

Table 2.7 shows the burden of road traffic injuries in terms of DALYs by sex. Morbidity rates for males are considerably higher than those for females. Furthermore, about 60% of the DALYs lost globally as a result of road traffic injury occurs among adults aged between 15 and 44 years (54).

TABLE 2.7

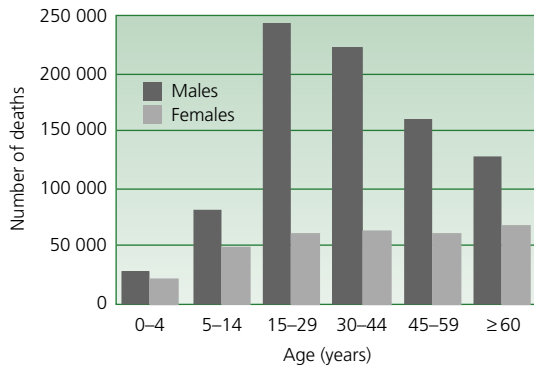
Road traffic injury burden (DALYs lost) by WHO region and sex, 2002

WHO region	Males	Females	Total
All	27 057 385	11 368 958	38 426 342
African Region	4 665 446	2 392 812	7 058 257
Region of the Americas	3 109 183	1 141 861	4 251 044
South-East Asia Region	7 174 901	2 856 994	10 031 894
European Region	2 672 506	937 945	3 610 451
Eastern Mediterranean Region	3 173 548	1 403 037	4 576 585
Western Pacific Region	6 261 800	2 636 309	8 898 110

DALYs: Disability-adjusted life years.

Source: WHO Global Burden of Disease project, 2002, Version 1 (see Statistical Annex).

FIGURE 2.8
Road traffic deaths by sex and age group, world, 2002



Source: WHO Global Burden of Disease project, 2002, Version 1 (see Statistical Annex).

As expected, when analysed by country, road traffic injury mortality rates are again substantially higher among males than among females. El Salvador's road traffic fatality rate for males, for instance, is 58.1 per 100 000, compared with 13.6 per 100 000 for females (see Statistical Annex, Table A.4). In Latvia, there is a similar gender difference, with a rate of 42.7 per 100 000 for men and 11.4 per 100 000 for females. Certain factors in some countries give rise to an even greater gap between the genders; females may be excluded as drivers or passengers, and in general may face less exposure to road traffic crash risk for cultural or economic reasons.

A comprehensive review of 46 studies in low-

income and middle-income countries found that, in terms of involvement in road traffic crashes, there was a consistent predominance of males over females; males were involved in a mean of 80% of crashes, and 87% of drivers were male (30). Recent studies from China, Colombia, Ghana, Kenya, Mexico, Mozambique, the Republic of Korea, Thailand, Trinidad and Tobago, Viet Nam and Zambia all indicate greater rates of male as opposed to female involvement in road traffic collisions (55).

According to WHO data, adults aged between 15 and 44 years account for more than 50% of all road traffic deaths. In high-income countries, adults aged between 15 and 29 years have the highest rates of injury, while in low-income and middle-income countries rates are highest among those over the age of 60 years (see Statistical Annex, Table A.2).

Of all the age groups, children under 15 years of age have the lowest mortality rates (both sexes), due in large measure to the lower rate of exposure they experience (see Statistical Annex, Table A.2 and Box 2.3). These rates vary by region – the WHO African Region and the WHO Eastern Mediterranean Region both show fatality rates of above 18 per 100 000 for male children under the age of 15 years. Globally, the road traffic fatality rate for male children aged 5 to 14 years is slightly higher than that for female children (13.2 per 100 000, against 8.2 per 100 000).

BOX 2.3

Children and road traffic injury

Child road trauma is a major worldwide problem. Children are especially vulnerable, as their physical and cognitive skills are not fully developed and their smaller stature makes it hard for them to see and to be seen. Societies are concerned about the basic safety of their children.

Road trauma is a leading cause of injury to children. In high-income countries, child injury and road deaths rose sharply with motorization in the 1950s and 1960s. While many of these countries have had great success in prevention, road traffic crashes remain a leading cause of death and injury for children. In low-income and middle-income countries, child deaths and injuries are rising as the number of vehicles increases.

According to WHO estimates for 2002, there were 180 500 children killed as the result of road crashes. Some 97% of these child road deaths occurred in low-income and middle-income countries.

The level and pattern of child road injury is linked to differences in road use. In Africa, children are more likely to be hurt as pedestrians and as users of public transport. In south-east Asia, it is as pedestrians, bicyclists and, increasingly, as passengers on motor scooters, and in Europe and North America, it is as passengers in private motor cars and as pedestrians that children are at greatest risk of a road traffic injury.

BOX 2.3 (continued)

The burden of injury is unequal. More boys are injured than girls, and children from poorer families have higher rates of injury. Even in high-income countries, research has shown that children from poorer families and ethnic minority groups have higher rates of unintentional injury, particularly in the case of child pedestrians.

Many countries have made substantial improvements in child road safety. In Australia, for example, in the 25 years after 1970, the road fatality rate per 100 000 children fell by 60% (56).

Interventions that have done much to reduce child traffic injuries and deaths include:

- the development, promotion and increasing use of specifically-designed child restraints;
- improvements in the road environment that have reduced the number of child pedestrian injuries, since these injuries are associated with traffic volume and traffic speed (57);
- increased use of bicycle helmets, that has been associated with a reduction in head injuries among children.

The success, though, of prevention efforts in child road injury is not uniform, and much remains to be done.

As noted by Deal et al. (58), "Injuries, both violent and intentional, are one of the most significant public health issues facing children today, but public outrage is absent. As a result, proven solutions go unused, and thousands of children die each year."

Around the world, 193 478 older persons (aged 60 years and above) died in 2002 as a result of road traffic crashes; this figure is equivalent to 16% of the global total (see Statistical Annex, Table A.2 and Box 2.4).

In some countries, the over-60 years age group accounts for a higher proportion of all road traffic deaths than the global average. A study conducted in 1998 in the United Kingdom found that 25.4% of all road traffic fatalities were people aged 60 years or above. In terms of distribution by road user group, 46.6% of pedestrian fatalities and 53% of bus passenger fatalities were people aged 60 years and above. Except for bicyclists, this age group was overrepresented in all categories of road traffic fatalities (61). The OECD (62) found that in 1997, pedestrian fatalities among those aged 65 years and above were lowest in the Netherlands (5.5% of all road traffic fatalities) and highest in Norway (49%) and the United Kingdom (48.8%).

Qatar and the United Arab Emirates both display high mortality rates among the over-60 years age group. In Qatar, males over 60 years had a road traffic fatality rate more than twice that of those in the 15–29 years age group (110 per 100 000, against 48 per 100 000) (63). In the United Arab Emirates, the rates were lower but the difference between age groups was more marked: 29 per 100 000 for those aged 15–44 years and 91 per 100 000 for those aged 60 years or above (64).

No specific studies on older persons and road traffic injuries in low-income and middle-income countries

could be found. However, results of a study on adult pedestrian traffic trauma in Cape Town, South Africa, found that only 18% of persons involved in collisions were aged 60 years or above (65).

Socioeconomic status and location

Socioeconomic status is well known to be a risk factor for injury generally, and road traffic injury is no exception (10, 42, 66–68). Studies have found that individuals from disadvantaged socioeconomic groups or living in poorer areas are at greatest risk of being killed or injured as a result of a road traffic crash, even in high-income countries. The evidence suggests that explanations for these differences should be sought in variations in exposure to risk, rather than in behaviour (67), though behavioural differences do play some role. Even in industrialized countries, road traffic injuries as a cause of mortality have the steepest social class gradient, particularly in the case of children and young adults (67, 69).

There are several indicators that are widely used to assess socioeconomic status, educational and occupational level being two of the most common. In a New Zealand cohort study conducted in the 1990s, it was found that drivers with low-status occupations and lower levels of education had a higher risk of injury, even when adjusting for confounding variables such as driving exposure levels (70). In Sweden, the risk of injury for pedestrians and bicyclists was between 20% and 30% higher among the children of manual workers than those of higher-salaried employees (67).

BOX 2.4**Older people and road traffic injury**

From a public health point of view, the most serious problem facing the elderly relates to the fact that their mobility out of doors may be restricted because the transport system has failed to meet their needs. Safety issues tend to be a secondary issue.

Road traffic injuries are not a major cause of death for the elderly. However, relative to their proportion of the overall population, older people are often overrepresented in traffic fatalities, especially as vulnerable road users. Older pedestrians in particular are associated with a very high rate of road injury and death. This is mainly due to the increased physical frailty of the elderly. Given the same type of impact, an older person is more likely to be injured or killed than a younger one.

Because of the mobility it provides, private car travel can be more important for the elderly than for those in other age groups. Many people continue to drive vehicles until they are very old. For some, driving may be their only option for mobility, since certain illnesses can affect their ability to walk or to use public transport before affecting their ability to drive.

There is a widespread misconception that older drivers are a threat to traffic safety. Generally speaking, older drivers have the lowest crash rates of all age groups, but because of their frailty, have higher injury and fatality rates (59, 60). Their injury rates may also be affected by diseases such as osteoporosis, impaired homeostasis and poor tissue elasticity.

Older drivers face different types of crashes than younger ones. They experience relatively more crashes in complex traffic situations, such as at intersections, and relatively fewer through lack of caution, such as through speeding or careless overtaking. Injury patterns also differ, partly because of differences in the nature of collisions, with older people suffering more fatal chest injuries, for instance, than younger drivers.

Recent studies on ageing and transport have highlighted pedestrian safety as the main safety concern for the elderly. These studies have indicated that if good quality door-to-door public transport is not available for the elderly, then the use of private cars remains their safest option for getting around. While it is accepted that certain groups of older drivers should not drive – such as those suffering from advanced forms of dementia – mandatory screening of drivers based on age is not recommended. Improvements in pedestrian infrastructure, and interventions to support safe driving as long as possible for older people, are generally regarded as better investments for their safety and mobility than attempts to stop them from driving.

The choice of transport in developing countries is often influenced by socioeconomic factors, especially income. In Kenya, for example, 27% of commuters who had had no formal education were found to travel on foot, 55% used buses or mini-buses and 8% travelled in private cars. By contrast, 81% of those with secondary-level education usually travelled in private cars, 19% by bus and none walked (43).

In many countries, road traffic crashes are more frequent in urban areas, particularly as urbanization increases. However, injury severity is generally greater in rural areas. This could be related to road design and congestion in urban areas slowing traffic, while conditions in rural areas allow for travelling at greater speeds. In low-income and middle-income countries, fewer crashes happen

in rural areas, but the overall costs to the families can be greater when they do occur (71). In many countries there is concern over the vulnerability of people living along highways, since these roads are often built through areas where economic activity already exists, thus creating potential conflicts over space between the road users and the local population (55).

Other health, social and economic impacts

Estimating the cost to society of road crashes is important for several reasons. First, it is essential for raising awareness of the seriousness of road crashes as a social problem, Second, it serves to make proper comparisons between road traffic crashes and other causes of death and injury. Third, since

the social cost of road traffic crashes is a reflection of the social benefits of reducing crashes through safety interventions, scientific assessments of the costs enables priorities between different interventions to be made, using cost–benefit methods.

Assessment of road traffic injury costs can be carried out with methods that are well known in the health valuation literature. Though the costs to society – such as lost productivity and economic opportunity, and diverted institutional resources – can be estimated in economic terms, valuing the suffering and loss of life associated with road traffic injuries is difficult and often contentious. Accordingly, some studies measure what people would pay – referred to as their “willingness to pay” – to reduce the risk of a fatal or non-fatal injury. Another method is to equate the loss of life through traffic crashes with lost earnings. This is known as the “human capital” approach. In any case, the social cost of an injury or premature death should at least include the associated costs of medical treatment – the direct costs of illness – as well as the loss in productivity associated with the death or injury – the indirect costs of illness. The costs of medical treatment normally include emergency treatment, initial medical costs, and, for serious injuries, the costs of long-term care and rehabilitation. Productivity losses include the value of lost household services and the value of lost earnings for the victim, caregivers and family. In practice, many analyses of the costs of traffic crashes, especially those in developing countries, use lost productivity, rather than willingness-to-pay, to value injury and death.

Industrialized countries regularly produce annual estimates of the overall cost of road traffic crashes. These estimates include the cost of injuries and fatalities sustained in crashes and the cost of damage to property, as well as administrative costs associated with crashes, such as legal expenses and the costs of administering insurance, and the value of the delays in travel caused by crashes. Of all of these costs, those of injuries and fatalities are perhaps the most difficult to value. Medical and rehabilitation costs can be prohibitively expensive and often continue for an indefinite time, particularly in the case of serious road traffic disabilities. Though most

attention is usually focused on fatalities, injuries and their ensuing disabilities take an unexpectedly costly toll.

Some major gaps exist in the research on the health and socioeconomic impacts of road traffic injuries. First, existing analyses of costs do not address particularly well those costs related to psychosocial issues, such as pain and suffering. Second, there is a lack of good international standards for predicting and measuring disability. In addition, there are far fewer studies of the cost of traffic crashes in developing countries than elsewhere. One reason for this is the scarcity of reliable data on the number and nature of crashes.

Health and social impacts

Injuries sustained by victims of a road traffic crash vary in type and severity. Data from the GBD 2002 project show that almost a quarter of those injured severely enough to require admission to a health facility sustain a traumatic brain injury; 10% suffer open wounds, such as lacerations, and nearly 20% experience fractures to the lower limbs (see Table 2.8). Studies in both developed and developing countries have found that motor vehicle crashes are the leading cause of traumatic brain injury (65, 72–76).

A review of studies in low-income and middle-income countries (30) revealed that road traffic-related injury accounted for between 30% and 86% of trauma admissions in these countries. Eleven of the 15 studies that included data on hospital utilization examined the length of stay. The overall mean length of stay was 20 days, ranging from 3.8 days in Jordan to 44.6 days in Sharjah, United Arab Emirates. Patients who sustained spinal injury had the longest duration of hospital stay.

The review further found the following:

- Road traffic injury patients comprised between 13% and 31% of all injury-related attendees in hospitals.
- Road traffic injury patients represented 48% of bed occupancy in surgical wards in some countries.
- Road traffic injury patients were the most frequent users of operating theatres and intensive care units.

TABLE 2.8

The 20 leading non-fatal injuries sustained^a as a result of road traffic collisions, world, 2002

Type of injury sustained	Rate per 100 000 population	Proportion of all traffic injuries
Intracranial injury ^b (short-term ^c)	85.3	24.6
Open wound	35.6	10.3
Fractured patella, tibia or fibula	26.9	7.8
Fractured femur (short-term ^c)	26.1	7.5
Internal injuries	21.9	6.3
Fractured ulna or radius	19.2	5.5
Fractured clavicle, scapula or humerus	16.7	4.8
Fractured facial bones	11.4	3.3
Fractured rib or sternum	11.1	3.2
Fractured ankle	10.8	3.1
Fractured vertebral column	9.4	2.7
Fractured pelvis	8.8	2.6
Sprains	8.3	2.4
Fractured skull (short-term ^c)	7.9	2.3
Fractured foot bones	7.2	2.1
Fractured hand bones	6.8	2.0
Spinal cord injury (long-term ^d)	4.9	1.4
Fractured femur (long-term ^d)	4.3	1.3
Intracranial injury ^b (long-term ^d)	4.3	1.2
Other dislocation	3.4	1.0

^a Requiring admission to a health facility.

^b Traumatic brain injury.

^c Short-term = lasts only a matter of weeks.

^d Long-term = lasts until death, with some complications resulting in reduced life expectancy.

Source: WHO Global Burden of Disease project, 2002, Version 1.

- Increased workloads in X-ray departments and increased demands for physiotherapy and rehabilitation services were, to a large extent, attributable to road traffic crashes.

Individual country studies report similar findings. For instance, out of a total of 2913 trauma patients who had attended the University of Ilorin teaching hospital in Nigeria over a period of 15 months, 1816, or 62.3%, had suffered road traffic injuries (77). In Kenya, a survey on the perceived capacity of health care facilities to handle more than 10 injured persons simultaneously, showed that only 40% of health administrators thought that their facilities were well prepared. Of the hospitals that were least prepared, 74% were public hospitals – the facilities that poor people use most frequently (43).

The results of a study in the United States (78) revealed that 5.27 million people had sustained

non-fatal road traffic injuries in 2000, 87% of which were considered “minor”, according to the maximum injury severity scale. These injuries resulted in medical costs of US\$ 31.7 billion, placing a huge burden on health care services and individual finances. In terms of unit medical costs per injury level, the most severe level of injury – MAIS 5, that includes head and spinal cord injury – cost by far the largest amount, at US\$ 332 457 per injury, exceeding the combined cost per unit of all other injuries, including fatalities.

Injured people often suffer physical pain and emotional anguish that is beyond any economic compensation. Permanent disability, such as paraplegia, quadriplegia, loss of eyesight, or brain damage, can deprive an individual of the ability to achieve even minor goals and result in dependence on others for economic support and routine physical care. Less serious – but more common – injuries to ankles, knees and the cervical spine can result in chronic physical pain and limit an injured person’s physical activity for lengthy periods. Serious burns, contusions and lacerations can lead to emotional trauma associated with permanent disfigurement (79).

Psychosocial impact

Medical costs and lost productivity do not capture the psychosocial losses associated with road traffic crashes, either to those injured or to their families. These costs might possibly exceed the productivity losses and medical costs associated with premature death, were they accurately quantifiable. A study conducted in Sweden showed that there was a high rate of psychosocial complications following road traffic crashes, even for minor injuries. Almost half the respondents in the study group still reported

travel anxiety two years after the crash. Pain, fear and fatigue were also commonly found. Of those employed, 16% could not return to their ordinary jobs, while a third reported a reduction in leisure-time activities (80).

Road traffic crashes can place a heavy burden on the family and friends of the injured person, many of whom also experience adverse social, physical and psychological effects, in the short-term or long-term. In the European Union, more than 40 000 people are killed and more than 150 000 disabled for life by road traffic crashes each year. As a result, nearly 200 000 families annually are newly bereaved or have family members disabled for life (81). In a study on how families and communities cope with injured relatives, the most frequently reported coping strategy was reallocation of work within the family, with at least one family member having to take time off from their usual activity to help the injured person or to carry on that person's work. As a result of individuals changing their work patterns for this reason, about a third of them lost income. In some cases, the injury of a family member caused children to stay away from school (82).

The Fédération Européenne des Victimes de la Route (FEVR) conducted a comprehensive study in Europe of the physical, psychological and material damage suffered by victims and their families subsequent to road crashes (83). The results showed that 90% of the families of those killed and 85% of the families of those disabled reported a significant permanent decline in their quality of life, and in half of the cases the consequences were especially severe. In a follow-up study, FEVR sought to determine the causes of this decline. Most of the victims or their relatives suffered from headaches, sleeping problems, disturbing nightmares and general health problems. Three years after the incident, these complaints had not significantly decreased (84). In addition, it was found that victims and their families were often dissatisfied with such matters as criminal proceedings, insurance and civil claims, and the level of support and information received on legal rights and other issues (84).

The psychological and social consequences of road traffic trauma are not always directly propor-

tional to the severity of the physical injury; even relatively minor injuries can have profound psychosocial effects. Nearly a fifth of those injured, according to one study, developed an acute stress reaction and a quarter displayed psychiatric problems within the first year. Long-term psychiatric problems consisted mainly of mood disorder (in around 10% of cases), phobic travel anxiety (20%) and post-traumatic stress disorder (11%). Phobic travel disorder was frequent among drivers and passengers (85).

Other consequences

In a recent study, 55% of those attending an accident and emergency unit following a road traffic crash reported significant medical, psychiatric, social or legal consequences one year later. Many patients with less serious or no injuries still suffered long-term health and other problems not necessarily related to their injury. Furthermore, reports of continuing physical problems one year on, largely musculoskeletal in nature, were considerably more common than would be expected from the nature of injuries sustained (86).

Pedestrians and motorcyclists suffer the most severe injuries as a result of motor vehicle collisions, report more continuing medical problems and require more assistance, compared with other types of road user. There are few psychological or social differences, however, between different road users (87).

In many low-income and middle-income countries, and sometimes in high-income countries as well, the cost of prolonged care, the loss of the primary breadwinner, funeral costs, and the loss of income due to disability, can push a family into poverty (10, 38). The process of impoverishment can affect children especially strongly. The second leading cause of orphaned children in Mexico is the loss of parents as a result of road traffic crashes (38).

Other consequential effects of transport and motorization on the environment and health are dealt with more comprehensively in recent WHO documents (88, 89).

Economic impact

As part of the recent review undertaken by the United Kingdom-based TRL Ltd on the number of road traffic collisions globally, information on

road crash costs from 21 developed and developing countries was analysed (2). This study found that the average annual cost of road crashes was about 1% of GNP in developing countries, 1.5% in countries in economic transition and 2% in highly-motorized countries (see Table 2.9). According to this study, the annual burden of economic costs globally is estimated at around US\$ 518 billion. On a country basis, the economic burdens are estimated to represent proportions of GNP ranging from 0.3% in Viet Nam to almost 5% in Malawi and in Kwa-Zulu-Natal, South Africa (2), with a few countries registering even higher percentages. In most countries, though, the costs exceed 1% of GNP.

TABLE 2.9

Road crash costs by region

Region ^a	GNP, 1997 (US\$ billion)	Estimated annual crash costs	
		As percentage of GNP	Costs (US\$ billion)
Africa	370	1	3.7
Asia	2 454	1	24.5
Latin America and Caribbean	1 890	1	18.9
Middle East	495	1.5	7.4
Central and Eastern Europe	659	1.5	9.9
Subtotal	5 615		64.5
Highly-motorized countries ^b	22 665	2	453.3
Total			517.8

GNP: gross national product.

^a Data are displayed according to the regional classifications of the TRL Ltd, United Kingdom.

^b Australia, Japan, New Zealand, North America, and the western European countries.

Source: reproduced from reference 2, with minor editorial amendments, with the permission of the author.

The total annual costs of road crashes to low-income and middle-income countries are estimated to be about US\$ 65 billion, exceeding the total annual amount received in development assistance (2). These costs are especially damaging for countries struggling with the problems of development. In the high-income countries of the European Union, it has been estimated that the cost of road crashes each year exceeds €180 billion – twice the European Union annual budget for all of its activities (90, 91).

A study carried out in the United States, using the human capital – or lost productivity – approach, estimated the national economic costs of road traffic crashes at US\$ 230.6 billion, or 2.3% of GDP (78).

Research in Australia put that country's economic costs at 3.6% of GDP (92). The cost of traffic crashes as a proportion of GDP for other high-income countries, calculated using the human capital approach, ranges from 0.5% for Great Britain (1990) and 0.9% for Sweden (1995) to 2.8% for Italy (1997) (93). Averaging the cost of traffic crashes in the 1990s across 11 high-income countries, gives an average cost equivalent to 1.4% of GDP (93).

Information on costs from low-income and middle-income countries is generally scant. A recent study from Bangladesh, comparing data from a household survey with official police reports, suggests that the police record about one-third of all

traffic fatalities and 2% of serious injuries (94). When adjustments were made for this level of underreporting, the cost of traffic crashes in Bangladesh in 2000 was estimated at Tk38 billion (US\$ 745 million) or about 1.6% of GDP.

The cost of road traffic collisions in South Africa for 2000 were estimated at approximately R13.8 billion (US\$ 2 billion) (95). On the assumption that 80% of seriously-injured and 50% of slightly-injured road traffic collision victims would seek care at a state hospital, basic hospital costs alone for the first year of treatment were calculated to cost the govern-

ment of the order of R321 million (US\$ 46.4 million) (96).

Uganda has an annual road traffic fatality rate of 160 deaths per 10 000 vehicles, one of the highest in Africa. Based on average damage costs per vehicle of US\$ 2290, an average fatality cost of US\$ 8600 and average injury costs of US\$ 1933, road traffic collisions cost the Ugandan economy around US\$ 101 million per year, representing 2.3% of the country's GNP (97). In the mid-1990s, the cost of road traffic injuries in Côte d'Ivoire was estimated to be 1% of GNP (98).

Eastern Europe does not fare much better. The estimated economic costs of motor vehicle traffic

incidents in 1998 were in the range US\$ 66.6 – 80.6 million for Estonia, US\$ 162.7 – 194.7 million for Latvia, and US\$ 230.5 – 267.5 million for Lithuania. The majority of these costs are related to injury, in which the loss of market and household productivity and the cost of medical care predominate. Property damage represents around 16% of the total for Estonia and 17% for Latvia and Lithuania (79).

Using the notion of, “potentially productive years of life lost”, injuries in 1999 cost China 12.6 million years, more than any other disease group. The estimated annual economic cost of injury in China is equivalent to US\$ 12.5 billion – almost four times the total public health services budget for the country and a productivity loss that more than offsets the total productivity gains of new entrants to the labour force each year. Motor vehicle fatalities alone accounted for 25% of the total number of potentially productive years of life lost from all injury deaths, with their potential impact on economic development being particularly acute in rural areas (99).

The most productive age group, those aged between 15 and 44 years, is heavily represented in road traffic injuries; the economic impacts of injuries in this age group are therefore especially damaging. According to WHO, injuries to individuals in this age group, “tend to affect productivity severely, particularly among the lowest-income groups whose exposure to risk is greatest and whose earning capacity is most likely to rely on physical activity” (100). The incidence of road traffic crashes in Kenya illustrates this point; more than 75% of road traffic casualties are among economically productive young adults (30).

A case study conducted in Bangladesh found that poor families were more likely than those better off to lose their head of household and thus suffer immediate economic effects as a result of road traffic injuries. The loss of earnings, together with medical bills, funeral costs and legal bills, can have a ruinous effect on a family’s finances. Among the poor, 32% of the road deaths surveyed occurred to a head of household or that head’s spouse, compared with 21% among those not defined as poor. Over 70% of households reported that their

household income, food consumption and food production had decreased after a road death. Three quarters of all poor households affected by a road death reported a decrease in their living standard, compared with 58% of other households. In addition, 61% of poor families had to borrow money as a result of a death, compared with 34% of other families (94).

In cases where there is prolonged treatment or the death of the victim, the family may end up selling most of its assets, including land, and possibly becoming trapped in long-term indebtedness (82).

Data and evidence for road traffic injury prevention

Two of the central aims of modern medicine are to advance knowledge and promote practices that are based on evidence. This emphasis on evidence reflects the need to continuously review and strengthen the evidence base for public health interventions. This applies not only to communicable diseases but also to noncommunicable diseases and injuries, such as road traffic injuries. This section discusses issues and concerns related to road traffic injury data and evidence.

Why collect data and build evidence on road traffic injuries?

Road safety is of prime concern to many individuals, groups and organizations, all of whom require data and evidence. While different users have different data needs, reliable data and evidence are essential for describing the burden of road traffic injuries, assessing risk factors, developing and evaluating interventions, providing information for policy-makers and decision-makers, and raising awareness. Without reliable information, the priorities for road traffic injury prevention cannot be rationally or satisfactorily determined.

Sources and types of data

Police departments and hospitals provide most of the data used in road traffic injury prevention and road safety. In addition to the sources indicated in Table 2.10, data are also available from published

documents, such as journals, books and research reports, as well as on the Internet.

There are a number of approaches to collecting and keeping data and evidence on road traffic injuries. These approaches are well documented, both for injuries in general and road traffic injuries in particular (101–104).

Injury surveillance systems

Most countries have some form of national system for aggregating data on road crashes using police records or hospital records, or both. However, the quality and reliability of data vary between surveillance systems in different countries and also between systems within the same country. For road traffic injuries, certain key variables need to be collected. WHO, in its recently

TABLE 2.10

Key sources of road traffic injury data

Source	Type of data	Comments
Police	Number of road traffic incidents, fatalities and injuries Type of road users involved Age and sex of casualties Type of vehicles involved Police assessment of causes of crashes Location and sites of crashes Prosecutions	Level of detail varies from one country to another. Police records can be inaccessible. Underreporting is a common problem, particularly in low-income and middle-income countries.
Health settings (e.g. hospital inpatient records, emergency room records, trauma registries, ambulance or emergency technician records, health clinic records, family doctor records)	Fatal and non-fatal injuries Age and sex of casualties Costs of treatment	Level of detail varies from one health care facility to another. Injury data may be recorded under “other causes”, making it difficult to extract for analysis.
Insurance firms	Fatal and non-fatal injuries Damage to vehicles Costs of claims	Access to these data may be difficult.
Other private and public institutions, including transport companies	Number of fatal and non-fatal injuries occurring among employees Damage and losses Insurance claims Legal issues Operational data	These data may be specific to the planning and operation of the firms.
Government departments and specialized agencies collecting data for national planning and development	Population denominators Income and expenditure data Health indicators Exposure data Pollution data Energy consumption Literacy levels	These data are complementary and important for analysis of road traffic injuries. The data are collected by different ministries and organizations, though there may be one central agency that compiles and produces reports, such as statistical abstracts, economic surveys and development plans.
Special interest groups (e.g. research institutes, advocacy nongovernmental organizations, victim support organizations, transport unions, consulting firms, institutions involved in road safety activities)	Number of road traffic incidents, fatal and non-fatal injuries Type of road users involved Age and sex of casualties Type of vehicles involved Causes Location and sites of crashes Social and psychological impacts Interventions	The various organizations have different interests.

published *Injury surveillance guidelines*, makes recommendations for a minimum data set for surveillance of road traffic injuries in emergency rooms (101).

Most high-income countries have well established injury surveillance systems. Recently, a number of low-income and middle-income countries have set up systems to monitor injuries, including road traf-

fic injuries. Examples include Colombia (C. Clavel-Arcas, unpublished observations, 2003), El Salvador (C. Clavel-Arcas, unpublished observations, 2003), Ethiopia (105), Ghana (106), Jamaica (107), Mozambique (105), Nicaragua (C. Clavel-Arcas, unpublished observations, 2003), South Africa (108), Thailand (109) and Uganda (110) (see Box 2.5).

BOX 2.5

The national injury surveillance system in Thailand

Thailand's provincial injury surveillance system started in 1993. Its objectives were to establish a database to evaluate, at a provincial level, the quality of acute trauma care and the referral services provided to the injured, and to improve injury prevention and control at both local and national levels (109). Previously, data providers in hospitals had not been responsible for information on road traffic crashes at a provincial level. Existing information systems were poorly designed and managed, not computerized, and not standardized as regards definitions, sources of data and methods of data collection. Consequently, regional or national comparisons were impossible (109).

A trauma registry system had been developed in the large provincial hospital in Khon Kaen. This system was chosen as the prototype for the new surveillance system, because of its achievements over eight years in injury prevention and improving the quality of acute care (111). The Noncommunicable Diseases Epidemiology Section of the Ministry of Public Health revised the hospital's trauma registry form and set up appropriate reporting criteria, definitions of terms and methods of coding. Appropriate computer software for processing the data was developed. The hospital produced manuals and ran training courses to help personnel operate the surveillance system effectively (109).

In January 1995, a provincial injury surveillance system was established in five sentinel hospitals, one in Bangkok and four in other regions of Thailand. Each was a large general hospital with a sufficient number of injuries and mix of cases, receiving referrals from other local hospitals (109).

All those acutely injured within seven days before admittance, including those who had died, were included in the surveillance system. Data were forwarded every six months by the local authorities to the central coordinating unit in the Epidemiology Division of the Ministry of Public Health.

Within six months, it had become clear that traffic injuries were the most important cause of injury in each sentinel hospital. The epidemiology of other major causes of injuries was also investigated, and the quality of pre-hospital service and of inter-hospital transfers was monitored. Information obtained was fed into the eighth five-year National Health Development Plan (112).

Data on alcohol-related traffic injuries were instrumental in the introduction of obligatory warnings on the labels of alcoholic beverages and of other interventions against drink-driving. The surveillance reports were sent to policy-makers in a range of sectors, including parliamentarians and governors of the provinces in which the sentinel hospitals were located – as well as to police departments and the mass media (109, 76).

Although the extra workload arising from the surveillance activities created problems in the sentinel hospitals, the advantages of the scheme were such that 20 more hospitals voluntarily joined the surveillance network (76). Simplifications to the system were subsequently made, though, to reduce the workload on medical records departments, so that the sentinel hospitals were required to report only cases of severe injury, including:

- deaths before arrival;
- deaths in the emergency department;
- observed or admitted injury cases.

This caused only minor changes in ranking among the top five leading causes of injury (76).

In January 2001, Thailand's National Injury Surveillance was officially launched. By 2003, the national network had grown to include 28 large hospitals, as well as almost 60 general hospitals and one university hospital. The system is one of only a few injury surveillance systems in low-income and middle-income countries that operate nationally and involve a model that WHO recognizes and encourages for technology transfer between countries.

In addition to country-specific information systems, a number of regional systems exist. Countries belonging to the OECD support and make use of the International Road Traffic Accident Database (IRTAD), to which they submit standardized crash and injury data, together with some basic transport statistics and other safety-related information (13). The United Nations Economic and Social Commission for Asia and the Pacific has developed a regional road crash database known as the Asia-Pacific Road Accident Database (113) which, like IRTAD, requires countries in the region to submit data in a standard format. The Caribbean Epidemiology Centre has introduced an injury surveillance system in the Bahamas, Barbados, and Trinidad and Tobago (114).

Europe has its own regional system, known as CARE – Community Database on Accidents on the Roads in Europe – which differs from the above-mentioned systems in that country returns are mandatory. However, the system allows countries to make returns in their own national formats and it includes disaggregated data on individual crashes. After being received, the data are adjusted for variations in definitions. To this end, a number of correction factors have been developed (115).

International and regional guidelines are available on crash and injury information systems to help countries decide on which data to collect. For example, in the transport sector, the Association of South East Asia Nations has developed road safety guidelines that include advice on what information is required (116). The WHO guidelines for developing and implementing injury surveillance systems in hospital settings contain recommendations on the core minimum data set and supplementary data that should be collected on all injury patients, including road traffic casualties (101).

Community-based surveys

A second approach to gathering data on road traffic injuries is to conduct community-based surveys. Some injured patients fail to reach hospital for a variety of reasons, in which case they will not be captured by hospital-based injury surveillance systems. Community-based surveys not only pick

up these otherwise unreported cases, but also provide useful information on injuries and may be of particular relevance in countries where basic population and mortality data are not available (102). Community surveys have been recently conducted in Ghana (117), India (118), Pakistan (119), South Africa (120), Uganda (121) and Viet Nam (122). These surveys, though, require methodological expertise which may not be widely available. To this end, WHO is currently developing *Guidelines for conducting community surveys on injuries and violence*, which will provide a standardized methodology for carrying out such studies (102).

Surveys on selected themes

A third approach is to conduct surveys on particular themes related to road traffic injuries and transport. Examples are road user surveys, roadside surveys, origin–destination surveys, pedestrian surveys, cyclist surveys and speed surveys – as well as studies on such issues as alcohol use and the cost of crashes. These surveys may arise from the need for specific data that are not available from hospital-based surveillance systems or community surveys.

Data linkages

As shown in Table 2.10, road traffic injury data and evidence is collected and stored by a range of agencies. This is in itself a positive feature, as it reflects the multisectoral nature of the phenomenon. However, it also raises important issues to do with access, harmonization and linkages between different data sources and users. Ideally, where there are a number of data sources available, it is important that the data should be linked, to obtain maximum value from the information (see Box 2.6). However, for many countries, especially those with a number of systems at the local level, this is not always the case. A major problem is coordination and sharing of information among different users. While there are usually issues of confidentiality and other legal restrictions involved, it should still be possible to find ways of summarizing the relevant information and making it available, without violating any legal prohibitions.

BOX 2.6**Multidisciplinary crash investigation**

An example of in-depth multidisciplinary crash investigation is the Finnish national system, steered and supervised by the Ministry of Transport and Communications and maintained by the Motor Insurers' Centre and the Motor Traffic Insurers Committee (VALT).

The Centre started in-depth crash investigation in 1968 and its 21 law-based investigation teams investigate about 500, mainly fatal crashes, at the scene of the crash, annually. Each team consists of police, a road safety engineer, a vehicle inspector, a medical doctor and sometimes a psychologist. Specific information is collected by each person and a combined report is produced on each case. In each case, more than 500 variables are collected on standardized forms. The emphasis is placed on data that will contribute to crash avoidance and injury prevention. In addition, the teams have legal rights to access information from official and private records and health care systems to obtain human, vehicle and road information.

Coordinated data management systems do exist in a handful of countries. One such example is the United States National Automotive Sampling System, that combines information from four data systems – the Fatality Analysis Reporting System, the General Estimates System, the Crashworthiness Data System and the Crash Injury Research and Engineering Network – to provide an overall picture for policy-makers and decision-makers at the national level (123).

For the regular monitoring of road traffic injuries, a system that integrated information from both police sources and health care sources would be ideal. Although there have been a number of pilot projects, such as the one combining police data on fatal crashes with the Hospital In-Patients Statistics database in Scotland (124), few countries have established such linked systems on a routine basis.

Analysis of data

Analysing data, producing regular outputs and disseminating information on road traffic injuries are all vital activities. For the purposes of data analysis, there are some excellent software packages available. These systems can build automatic validity checks and quality control into the data management process. Software packages also provide powerful analysis features for diagnosing problems that enable rational decisions to be made on priorities for intervention (125).

High standards in data quality assurance and analysis alone are not enough. Road traffic injury information systems also need to allow all appropriate

outside bodies access and to ensure that the information is effectively distributed. The design of databases should therefore take account of the principal needs of all their users, providing quality data without overburdening those collecting the data. Databases also require sufficient resources to ensure their sustainability. Countries should collaborate and help support regional and global systems so that the monitoring and evaluation of road safety can be improved and sustained.

Data issues and concerns**Indicators**

Indicators are important tools not just for measuring the magnitude of a problem but also for setting targets and assessing performance. The most frequently used absolute and relative indicators for measuring the magnitude of the road traffic injury problem are presented in Table 2.11.

Two very common indicators are the number of deaths per 100 000 population, and the number of deaths per 10 000 vehicles. Both of these indicators have limitations regarding their reliability and validity that place restrictions on how they can be used and interpreted. The number of deaths per 100 000 population is widely used with reasonable confidence to monitor changes over time in “personal risk” levels and to make comparisons between countries. Errors in population statistics are assumed to have little impact on the observed changes or comparisons.

The use of vehicle registrations as an estimate of motorization is also problematical as there can

TABLE 2.11

Examples of commonly used indicators of the road traffic injury problem

Indicator	Description	Use and limitations
Number of injuries	Absolute figure indicating the number of people injured in road traffic crashes	Useful for planning at the local level for emergency medical services
	Injuries sustained may be serious or slight	Useful for calculating the cost of medical care
		Not very useful for making comparisons A large proportion of slight injuries are not reported
Number of deaths	Absolute figure indicating the number of people who die as a result of a road traffic crash	Gives a partial estimate of the magnitude of the road traffic problem, in terms of deaths
		Useful for planning at the local level for emergency medical services
		Not very useful for making comparisons
Fatalities per 10 000 vehicles	Relative figure showing ratio of fatalities to motor vehicles	Shows the relationship between fatalities and motor vehicles A limited measure of travel exposure because it omits non-motorized transport and other indicators of exposure
Fatalities per 100 000 population	Relative figure showing ratio of fatalities to population	Shows the impact of road traffic crashes on human population Useful for estimating severity of crashes
Fatalities per vehicle-kilometre travelled	Number of road deaths per billion kilometres travelled	Useful for international comparisons Does not take into account non-motorized travel
Disability-adjusted life years (DALYs)	Measures healthy life years lost due to disability and mortality	DALYs combine both mortality and disability
	One disability-adjusted life year (DALY) lost is equal to one year of healthy life lost, either due to premature death or disability	DALYs do not include all the health consequences associated with injury, such as mental health consequences

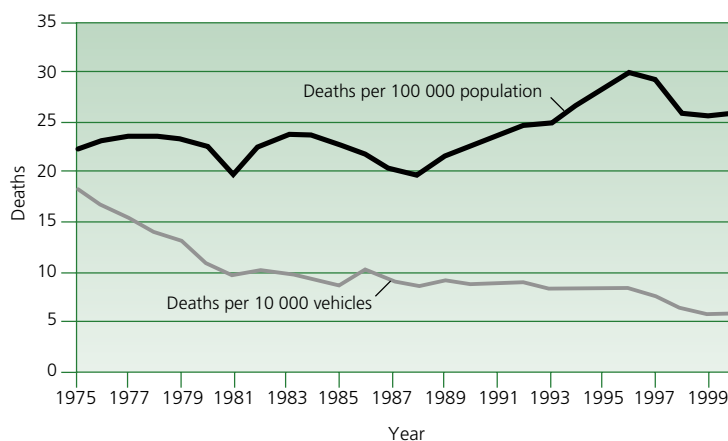
be errors in country databases due to delays in adding or removing records of vehicles. Furthermore, changes in vehicle numbers do not generally provide a good estimate of changes in exposure to, and travel on, the road network, especially when making comparisons between countries. A better indicator of traffic safety risk is deaths per vehicle-kilometres, but this also fails to allow for non-motorized travel.

The measurement of exposure to the risk of road traffic injuries presents conceptual and methodological difficulties (127). An example of the use of two indicators – fatalities per 100 000 population and fatalities per 10 000 vehicles – is presented in

Figure 2.9. The figure shows that since 1975 Malaysia has experienced a continuous decline in deaths per 10 000 vehicles, whereas the rate of deaths per 100 000 population has shown a slight increase. Over the same period, there has been a rapid growth in motorization and increased mobility among Malaysia's population. The opposing trends in the two indicators reflect the fact that road traffic fatalities have increased more slowly in Malaysia than the growth in the vehicle fleet, but that they have increased a little faster in recent years than the growth in the population. More information is needed to understand how changes in mobility and safety standards have contributed to such trends.

FIGURE 2.9

Road traffic deaths in Malaysia



Source: reference 126.

The relationships between road traffic injuries, motorization and other major risk factors are discussed in more detail in the next chapter.

Though road traffic injury statistics are used as measures of road safety, they are often inadequate and may even be misleading. This highlights the need for existing measures to be refined and new ones to be explored.

Definitions and standardization of data

There are a number of potential problems with the definitions of a road traffic death or injury, arising from:

- variations in the interpretation of the specified time period between the injury event and death;
- the actual interpretation of the definition in different countries and by different people recording the information;
- differing levels of enforcement of definitions;
- differing techniques for assessing the severity of injuries.

The most commonly cited definition of a road traffic fatality is: “any person killed immediately or dying within 30 days as a result of an injury accident” (128). However, a recent study has revealed considerable variations in working definitions. For example, in the European Union, Greece, Portugal and Spain use 24 hours, France uses 6 days, Italy uses 7 days and the other countries use 30 days (129). To adjust for this

variation, various correction factors are applied to arrive at a 30-day equivalent. Such factors, though, themselves introduce uncertainty as to what the real numbers would be at 30 days.

There are a number of other definitional issues relating to the classification of an injury death as one caused by a road traffic crash, including (14, 129):

- the method of assessment;
- the location of a fatal crash (i.e. whether on a public or private road);
- the mode of transport (some classifications stipulate the presence of at least one moving vehicle);

- the source reporting the data (i.e. whether police or a self-report);
- whether or not to include confirmed suicides;
- whether or not post-mortem examinations are routinely conducted on road traffic deaths.

Definitional issues also arise with regard to survivors of road traffic crashes, including:

- the actual definition and interpretation of a serious injury in different countries;
- whether the police, who record most of the information, are sufficiently trained to ascertain and correctly assign injury severity.

In Finland, for example, a serious road traffic injury is considered to involve hospital admission or three days off work; in Sweden, it involves hospital admission as well as fractures, whether or not the patient is admitted; while in France, it involves a hospital stay of at least six days (129).

Road traffic injury and death cases can be missed by the data collection system because of differences in the definitions used in different countries and contexts. This issue highlights the need for the standardization of definitions and their application across different countries and settings.

Underreporting

It is clear from studies that underreporting of both deaths and injuries is a major global problem

affecting not only low-income and middle-income countries but also high-income ones (30, 129–131). In the United Kingdom, studies comparing hospital and police records suggest that some 36% of road traffic injury casualties are not reported to the police (129). In addition, around 20% of incidents reported to the police remain unrecorded. In some low-income and middle-income countries, levels of underreporting can be as high as 50% (2, 132). Underreporting can arise out of:

- a failure on the part of the public to report;
- the police not recording cases reported to them;
- hospitals not reporting cases presenting to them;
- an exemption for certain institutions, such as the military, from reporting directly to the police.

In some low-income and middle-income countries, underreporting may stem from the basic fact that some victims cannot afford to attend hospital (133, 134).

The problem of underreporting highlights a number of structural, methodological and practical issues affecting the quality of data collected on road traffic injuries, including:

- the coordination and reconciliation of data between sources;
- the harmonization and application of agreed definitions, especially the definition of a road crash fatality;
- the actual process of classification and the completion of data forms.

These problems make it difficult to obtain reliable estimates on road traffic fatalities and injuries worldwide and also for certain countries. Harmonization of data at the national and international levels can be facilitated by adopting international definitions. The International Classification of Diseases (ICD-10) (135) and the Abbreviated Injury Scale (AIS) can be used for non-fatal road crash injuries (136). Agreements to adhere to regional systems such as IRTAD and the Asia-Pacific Road Accident Database will encourage the uniformity of definitions.

Other issues

Studies have uncovered a number of other problems related to road traffic injury data and evidence.

These include:

- missing information within individual records;
- the unavailability of certain specific data (e.g. the crash location, type of injury, identification of the vehicle in which the casualty occurred);
- the scientific soundness of the methods used;
- inadequate quality control;
- lack of data collection on cycling and walking in transport information systems;
- lack of data on exposure;
- the accuracy and completeness of police assessment of cause of crash;
- lack of professionals trained in road safety;
- lack of rigorous evaluation of interventions, particularly in low-income and middle-income countries.

Limitations of the data sources used in this chapter

Although the present assessment of the extent of the burden of road traffic injury is based on the best available global data, it is recognized that the underlying data sources do suffer from a number of limitations. The main ones are outlined below:

- The WHO mortality database lacks complete coverage of vital registration data from all WHO regions. Several countries do not report road traffic incidence data at all. Projected data for some regions are therefore based on relatively small samples of data and can be in error because of missing country information. This has been dealt with by computing estimates using a methodology described in the Statistical Annex. The limitation highlights the need for more countries to submit road traffic injury data to the WHO mortality database.
- The GBD estimates are based largely on 1990 data and although they have been adjusted repeatedly since then, regional and national changes may have made some of the regional projections unreliable. In addition, there is a clear absence of routinely available data, both global and national, on the long-term health and social impacts of road traffic crashes. This shortcoming has led to a reliance on studies

undertaken primarily in high-income countries and a corresponding risk of bias if the projected assumptions for low-income and middle-income countries are not accurate.

- The World Bank and TRL Ltd both rely on road traffic mortality data that originated from police sources, and which, in common with WHO data, suffer from problems related to incomplete coverage. There is also the problem of differing definitions of death, that vary from “dead on the spot” to death some time after the crash occurred. The standard definition is “death within 30 days of the crash”, though in practice, many countries do not follow it. Both the World Bank and TRL Ltd have made attempts to correct for the underestimates arising from these problems. To correct for different definitions of death, they used the European Conference of Ministers of Transport adjustment for high-income country values (a maximum of 30%, depending on the definition used), and they added 15% to all figures from low-income and middle-income countries (1, 2). In addition, both groups made a further correction, adding 2% to the data for high-income countries and 25% for low-income and middle-income countries, to allow for underreporting of road traffic fatalities generally. The TRL study regarded this as a minimum adjustment for underreporting, and set a maximum at +5% for high-income country figures and +50% for low-income and middle-income countries (2). The World Bank study base-year data was comparable to the TRL Ltd minimum underreporting data (1).

Information on specific topics such as road safety and the elderly, inequality, location (including rural–urban differences), road safety and public transport, and occupational road traffic injuries was extremely limited. Nevertheless, a concerted effort was made to secure all available studies from online databases, published sources and the “grey literature” – such as information published in local, non-indexed journals, government reports and unpublished theses – on these as well as other themes. This yielded a number of studies that have been used to illustrate these topics throughout the chapter.

Conclusion

The problem of road traffic crashes and injuries is growing both in absolute numbers and in relative terms. It is a serious public health and development issue, taxing health care systems and undermining their ability to devote limited resources to other areas of need. The magnitude of road traffic injuries globally can be summarized as follows:

- More than one million people are killed worldwide every year as a result of road traffic crashes.
- Road traffic injuries are the 11th leading cause of death and the 9th leading cause of disability-adjusted life years lost worldwide.
- The poor and vulnerable road users – pedestrians, cyclists and motorcyclists – bear the greatest burden.
- Some 90% of road traffic deaths occur in the developing world, which comprises two thirds of the global population.
- As motorization increases, many low-income and middle-income countries may face a growing toll of road traffic injuries, with potentially devastating consequences in human, social and economic terms.
- Males are more likely to be involved in road traffic crashes than females.
- Economically active adults, aged 15–44 years, account for more than half of all the road traffic deaths.
- Without new or improved interventions, road traffic injuries will be the third leading cause of death by the year 2020.

The health, social and economic impacts of road traffic crashes are substantial.

- Between 20 million and 50 million people sustain an injury as a result of motor vehicle crashes each year.
- Nearly a quarter of all non-fatally injured victims requiring hospitalization sustain a traumatic brain injury as a result of motor vehicle crashes.
- Between 30% and 86% of trauma admissions in some low-income and middle-income countries are the result of road traffic crashes.
- Millions of people are temporarily or permanently disabled as a result of road traffic crashes.

- Many people suffer significant psychological consequences for years following a motor vehicle crash.
- Road traffic crashes cost governments, on average, between 1% and 2% of their gross national product.
- The social costs – more difficult to quantify – exact a heavy toll on victims, their families, friends and communities.
- The death of a breadwinner often pushes a family into poverty.

Accurate data are essential for prioritizing public health issues, monitoring trends and assessing intervention programmes. Many countries have inadequate information systems on road traffic injury, making it difficult to realize the full nature of the problem and thus gain the attention that is required from policy-makers and decision-makers. There are a number of areas where road traffic injury data are often problematic, and these include:

- sources of data (e.g. whether data are from police or health sources);
- the types of data collected;
- inappropriate use of indicators;
- non-standardization of data;
- definitional issues related to traffic deaths and injuries;
- underreporting;
- poor harmonization and linkages between different sources of data.

Governments can help foster stronger collaboration between different groups that collect and keep data and evidence on road traffic injuries. Furthermore, it is essential that data collection and global standards be better coordinated – an area in which the United Nations regional commissions could take a leading role. With such improved collaboration and improved management of data, significant reductions can be achieved in the magnitude of road traffic casualties.

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