

Jiaying Zhao et al.

Mortality from injury in urban China

This online first version has been peer-reviewed, accepted and edited,

but not formatted and finalized with corrections from authors and proofreaders.

Rising mortality from injury in urban China: demographic burden, underlying causes and policy implications

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(Submitted: 30 July 2011 – Revised version received: 13 December 2011 – Accepted: 14 December 2011 – Published online: 23 April 2012)

Abstract

In urban China, mortality from injuries has increased over the past five decades. By contrast, life expectancy has continued to increase and has come to nearly equal life expectancy in developed countries. Currently, most of the life expectancy lost due to injury (65%) in urban China would be recovered if injury rates were the same as in countries with low injury-related mortality. Fundamentally, the rising trend in urban injury mortality in China reflects a continued focus on injury treatment rather than prevention in the face of fast socioeconomic development and increasing exposure to risk factors for injury. Despite improved injury prevention legislation and a “Safe Community” campaign, urban China needs to modify its approach to urban injury management and focus on prevention. The gap between urban China and countries with low injury mortality can be closed by means of legislation, strengthened law enforcement and the establishment of safer communities. Risks affecting children and migrants deserve greater attention, and the government needs to allocate more resources to injury prevention, especially to urban areas in the central-west region of China. Based on the population size of urban China, measures for the prevention of injury mortality would save an annual 436.4 million years of life.

By 2005, mortality rates in urban China had fallen so much that life expectancy had reached 76.2 years, nearly as high as in developed countries.¹ By 2009 life expectancy in the city of Shanghai had climbed even higher – to 79.4 years in males and 84.1 years in females – while in Sweden the corresponding figures were 79.4 and 83.5 years.^{2–4} The drop in overall mortality in urban China has taken place, however, despite a pronounced rise in injury mortality in cities.⁵ Injury mortality in urban China is currently much higher than in urban areas in developed countries. This paradoxical contradiction between trends in overall mortality and in urban injury mortality takes place against a backdrop of rapid economic growth, unplanned urbanization, improved living standards and a rise in the risk of injury in urban areas.

The underlying causes of the rise in injury-related deaths in China's urban areas and its policy implications remain largely unexplored. This study aims to fill the gap by presenting evidence of this rise and examining its possible causes, contributing factors and policy implications. We argue that the upward trend in urban injury mortality is an outcome of fast socioeconomic development and a continued emphasis on saving the injured rather than on preventing injuries.

Mortality data in China

Our data came from multiple sources since no single source provides the data required to make secular estimates of injury mortality in Chinese cities. For the period from 1957 to 1995 we used the data cited by Zhao⁵ for crude, cause-specific mortality estimates. For more detailed analyses spanning the period from 1992 to 2005 we used data from the Chinese Disease Surveillance Points (DSP) system. More specifically, for 1992–1998 we used urban injury mortality data obtained directly from the DSP system, and for 2004–2005 we used data obtained indirectly from the DSP system via the Third National Retrospective Survey on Causes of Death (3rd NRSCD).

The 3rd NRSCD (May 2006 to January 2008) was a national retrospective survey in which all deaths detected in the DSP surveillance data for 2004–2005 were

investigated through a review of clinical histories or verbal autopsies.^{1,6} Data from this survey were enhanced by supplementation with mortality data obtained from police records, infant mortality data from population and family planning commissions and cremation records from civil administration agencies.¹ The 3rd NRSDC is a source of complete and reliable data on causes of death,¹ as demonstrated by comparison with census data. According to an expert review, its assignment of the cause of death has an accuracy rate of 97%.¹

Despite the above assurances, mortality data sets in China differ in their completeness and content validity.⁷ Rao et al. believe that China's mortality data may be failing to capture the true scale of the problem of injury mortality and have suggested a rate of underreporting in the DSP of approximately 13% overall and perhaps as high as 22% among children.⁸ Nevertheless, DSP data are the most geographically representative available in China, which explains why they have been used to make global burden of disease estimates.^{8,9} Furthermore, Rao et al. acknowledge that the DSP system represents the national population, and that its cause-of-death mortality estimates have remained consistent over time.⁸

Injury mortality analyses

We conducted two analyses to try to better understand the rates of death from injury mortality derived from different measures. First we analysed age-specific and sex-specific death rates and age-standardized death rates (taking the age and sex structure of the world population in 2000 as the reference). We also employed double decrement life tables¹⁰ to estimate the gain in life expectancy that would result from eliminating all deaths from injury if the rates of death from other causes remained the same.

To estimate how much longer China's urban residents could live if deaths from injury were reduced to the low levels seen in developed countries. We used as benchmarks the rates of death from unintentional injury in Swedish children (0–14

years old) and Dutch adults (above 14 years of age) and from intentional injury in Greece (all age groups). Injury mortality rates in the chosen reference countries are low and the mortality data have almost 100% coverage and completeness, according to the World Health Organization (WHO).^{11–13} We applied to urban China these countries' age- and sex-specific injury mortality rates (Appendix A and Appendix B, both available at: <http://hdl.handle.net/1885/8988>) by using double decrement life tables while retaining the prevailing non-injury mortality rates.

Injury mortality: 1957–2005

Over the past five decades, China has achieved impressive gains in survival and in other important socioeconomic parameters.⁷ However, unintentional and intentional injuries have become increasingly important causes of death in urban areas. Fifty years ago they ranked seventh among the causes of death, but since 1985 they have consistently ranked fourth (Appendix C, available at: <http://hdl.handle.net/1885/8988>). A substantial increase in injury incidence has occurred since 1998, during the recent period of fast economic growth and urbanization (Fig. 1 and Fig. 2). In 2004–2005, injuries, especially traffic accidents, suicide and falls, accounted for more than 40% of deaths in urban areas among people aged 1–34 years. Drowning was the leading cause of death from injury among children aged 0–14 years, whereas falls ranked first among people aged 75 years or older.

According to our calculations, if injury as a cause of death could be eradicated in urban China, life expectancy would increase by up to 1.44 years among males and 0.89 years among females (Table 1). Given the huge and expanding urban population, this would translate into very large numbers and would help China to close the longevity gap that separates it from developed countries. Our comparison of urban China's age-specific injury mortality rates with benchmark rates showed that injury-related loss of life expectancy in urban China could be reduced by nearly 90% for children less than 15 years of age, by more than 60% for working adults aged 15–64 years and by more than 50% for people aged over 65 years (Table 1). By bringing

injury death rates in urban China down to the levels seen in benchmark countries, 0.28 years of life expectancy would be gained for transportation accidents, 0.12 years for drowning and 0.09 years for falls, respectively (Table 1). Furthermore, injury-related loss of life expectancy in urban China would be recovered by 65% overall, 64% in males and 68% in females. Based on the population of urban China in 2005 as estimated by a national survey with 1% population coverage, 436.4 million years of life lost due to injury in urban areas could be saved (Table 1).

Underlying causes and policy implications

In all societies, mortality can change quickly in response to political, social and economic changes.¹⁴ Accordingly, in recent decades urban development in China has been accompanied by a rise in mortality from injuries. However, little research has been conducted on the underlying causes of this increase or on appropriate remedial policies.

Many cross-sectional and secular analyses have shown that an inverted U captures the statistical relationship between changes in injury mortality and changes in per capita gross domestic product (GDP).^{15–20} In other words, injury mortality initially increases as GDP per capita grows,^{15,17} but once the GDP exceeds a certain threshold, injury mortality falls with further economic growth.^{15,17} However, the per capita GDP marking the turning points in injury mortality varies considerably across countries, even for a given injury category – from about 3000 to 15 000 United States dollars (US\$).^{15–20} These turning points reflect the adaptation of the national health-care system and of industrial, collective and personal countermeasures to lower injury risks, such as improved ambulance services, better occupational safety and helmet and seat belt use. Because injury mortality initially correlates with per capita GDP,^{15–20} it is not surprising that China's urban prosperity over the past two decades (Table 2) has been accompanied by an increase in mortality from injury.

The rise in urban injury mortality results from an increase in exposure to injury risk factors associated with a growth in income, labour-intensive manufacturing,

intensive construction and urban development. To date there has been little analysis of the putative risk factors for injury deaths in urban China. However, information for some leading Chinese cities shows how injury risk factors can vary over time in the face of rapid changes in the social and physical landscapes (Table 2).^{2,21–26} The motorization rate and the urban population exposed to road traffic accidents both increase substantially with a rising GDP. The low reported rates of traffic fatalities reflect police underreporting (Table 2). In 2002–2007, road traffic death rates based on death registration data were almost twice as high as the rates based on data reported by the police.²⁷ Thus, the actual risk of death from traffic injuries may be much higher than shown in Table 2.

Table 2 shows the enormous growth in China's investment in fixed assets during the past two decades. The resulting economic growth in Chinese cities generates resources for health care and education, both of which lengthen life expectancy. But economic growth also increases occupational risks by boosting the number of workers in the construction industry, largely uneducated,²⁸ and by increasing exposure to dangerous industrial processes, high-rise buildings, climbing population density and rising motorization rates. All of these factors heighten life-threatening risks.

Urban migrants are disproportionally exposed to hazardous environments. They are more likely to engage in high-risk occupations (e.g. construction workers) and they lack safety awareness and equipment.²⁸ In Shanghai for example, one study showed that in 2000–2005, injury accounted for 60% of overall mortality among migrants aged 15 to 39 years, and for 40% among local residents.²⁹ Furthermore, measurements are inaccurate because routine national mortality data in China are based on household registration rather than residence, so that the rates reported for urban China exclude migrant workers, which comprise a growing population in urban areas (Table 2). The plight of migrant workers is worsened by their lack of coverage with occupational injury insurance.³⁰

The approach to injury in Chinese cities has long focused on saving the injured rather than on preventing injuries; when a disastrous event occurs, resources are allocated to lessen fatalities and minimize economic losses. A recent fire in Shanghai serves to illustrate the relative indifference towards injury prevention on the part of both the government and the general public. The fire began on 15 November 2010 in downtown Shanghai and destroyed a 28-story occupied apartment building under renovation, killing at least 58 people and injuring more than 70 others.³¹ In the report, the government attributed the disaster to several factors: unlicensed workers hired through illegal multiple subcontracting; lax fire safety requirements; lack of an indoor fire sprinkler system; inadequate fire-fighting capacity for a high-rise building, and a low degree of risk awareness on the part of the general public.³¹ Shortly after the fire, the municipal government announced a citywide drive to increase fire and safety inspections at buildings and construction sites. The Shanghai tragedy is not an isolated case; similar tragedies have occurred in many Chinese cities. Insufficient attention to injury prevention has resulted in thousands of deaths that could have been affordably prevented.

Countries with low injury-related mortality have occupational, residential, and traffic laws and practices designed to reduce the incidence of injury.^{32–36} China also has many of these laws and is superficially comparable to Sweden in terms of legislation for preventing traffic injuries. Furthermore, China established an Injury Prevention Division within the National Center for Disease Control and Prevention (CDC) in 2002, and a National Injury Surveillance System was established in 2006. The Ministry of Health published its first report on injury prevention in 2007 and since 2009 has been developing a national injury prevention strategy in partnership with WHO.³⁷ Yet despite these institutional developments, injury prevention is not among the key health issues in the National Mid- & Long-term Science and Technology Development Planning Outline (2006–2020),³⁸ which includes all important national initiatives.

Many preventive measures are either not the subject of any law or the corresponding law is not tightly enforced. For instance, China has no laws preventing children aged less than 12 years from being home alone. In terms of traffic regulations, some important requirements (e.g. child restraint, cycling helmet, rear seat belt, hands-free mobile phone use) are not in place in China. Although front seat belt use is compulsory, usage rates are still very low.^{35,39} Furthermore, mechanisms for monitoring and evaluating safety law enforcement are few, and staffing and funding are major constraints. Only two of 31 provincial CDCs have set up departments for injury prevention and control, and only one third of the staff responsible for injury prevention works full time.⁴⁰ In 2005–2008, the fraction of CDCs with more than 500 000 yuan (about US\$77 000) in funding was 28% in eastern China, 29% in central China and 8% in western China.⁴⁰ The challenge, therefore, is for the relevant authorities to raise the priority of injury prevention within the national health agenda and to remove the institutional and financial constraints that hinder the implementation of prevention programmes.

Since the mid 2000s, China has worked in partnership with major international organizations such as the World Bank and WHO to undertake research and pilot programmes for general injury prevention.⁴¹ The safe community campaign is one of them. A “safe community” promotes safety and prevents injury, violence and suicide in all age groups.⁴² The tally of designated safe communities in China shows encouraging signs as well as challenges as the country shifts towards injury prevention. China has participated in the community-based safety programme, under the safe community accreditation programme initiated by WHO, since 2006.⁴² On the positive side, by November 2011 the designated international safe communities in Chinese cities numbered 46 – a figure representing 20% of the global total – and another 27 such communities were in development.⁴² In addition, 244 communities had been designated as national-level safe communities by China’s Occupational Safety and Health Association, an arm of the State Administration of Work Safety charged with

promoting injury prevention.⁴³ While the tally suggests a degree of government commitment to help communities control intentional and unintentional injuries, it represents no more than 1% of the total number of urban communities. Moreover, the designated communities are concentrated in a few relatively developed cities of the eastern coastal area.^{42,43} Nationwide, safety promotion is still very poor in urban China as a whole.

Conclusion

Mortality from injuries in urban China has risen over the past five decades as a result of increased exposure to risk factors related with economic prosperity. In response, Chinese cities have focused on rescuing the injured rather than on preventing injury.

Currently, most of the life expectancy in urban China lost to injury (65%) can be recovered by adopting measures designed to lower injury mortality to the levels seen in certain European countries. China must increase its focus on prevention, improve the quality of both death registration and non-fatal injury monitoring in urban areas, and include migrants in urban injury mortality surveillance. To achieve these aims, priority should be given to legislating or amending laws and regulations making it mandatory to use helmets and seat belts, to supervise children less than 12 years in situations of potential danger, to fence swimming pools, to make packaging materials child resistant and to engage in drug and pesticide distribution practices. Laws for the prevention of occupational injuries are also needed. Human and financial resources need to be allocated in a way that will ensure that laws and regulations are enforced. Most of the laws and regulations mentioned have proved effective, affordable and feasible in developing countries and are recommended by the World Bank and WHO.^{32,33,44,45} In Taiwan, Special Administrative Region, for example, a 1997 law making helmet use mandatory has substantially lowered mortality from road traffic injury.^{20,46}

Furthermore, community interventions should concentrate on local environments and on raising public awareness surrounding safety and how to prevent

injuries, especially among children and migrants. Education for injury prevention has given good results and is affordable in developing countries.⁴⁵ The “Safe Community” programme in urban China shows that it is possible to create safer environments in Chinese cities, but the government needs to allocate more resources to injury prevention, especially to urban areas in the central-west region of China. Many effective interventions in countries with low injury mortality have shown the way. China should build on their example to change its approach to the control of injuries in urban areas.

Acknowledgements

We thank Zhongwei Zhao, Li Zhang, and Sage Leslie-McCarthy for their help and comments.

Competing interests:

None declared.

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Table 1. **Amenable loss of life expectancy (LE) in urban China owing to preventable injury, by sex, age and type of injury, 2004–2005**

Characteristic	LE if injury eliminated (years)	Loss of LE from injury ^a (years)	Benchmark LE ^b (years)	Potential increase in LE ^c (years)	Amenable loss of LE ^d (%)
	A	B	C	D	E
Sex					
Both	77.40	1.19	76.99	0.78	65.44
Males	75.32	1.44	74.80	0.91	63.57
Females	79.67	0.89	79.38	0.60	67.71
Age group					
0–14	76.40	0.19	76.38	0.17	89.33
15–44	76.70	0.49	76.52	0.30	61.81
45–64	76.46	0.24	76.38	0.17	68.78
> 65	76.47	0.25	76.34	0.13	51.18
Type of injury					
Road traffic	76.61	0.40	76.49	0.28	70.23
Suicide	76.41	0.19	76.33	0.12	62.59
Drowning	76.33	0.12	76.32	0.11	90.15
Falling	76.37	0.16	76.30	0.09	56.80

^a Column B = column A minus actual LE in 2004–2005 (76.21 years overall, 73.88 years for males and 78.78 years for females).

^b Column C shows the LE benchmarks used (drawn from Greece, the Netherlands and Sweden, countries with low mortality from injuries).

^c Column D = column C minus actual LE in 2004–2005.

^d Column E = (D/B) x 100. “Amenable loss of LE” refers to years of life expectancy attributable to the avoidable component of injury. In column E the amenable loss of LE is expressed as a proportion (%) of the total LE lost due to injury.

Data on life expectancy were obtained from the World Health Organization and the Third National Retrospective Survey on Causes of Death.^{5,13}

Table 2. Trends in demographic and development indicators of injury risk for selected cities, China

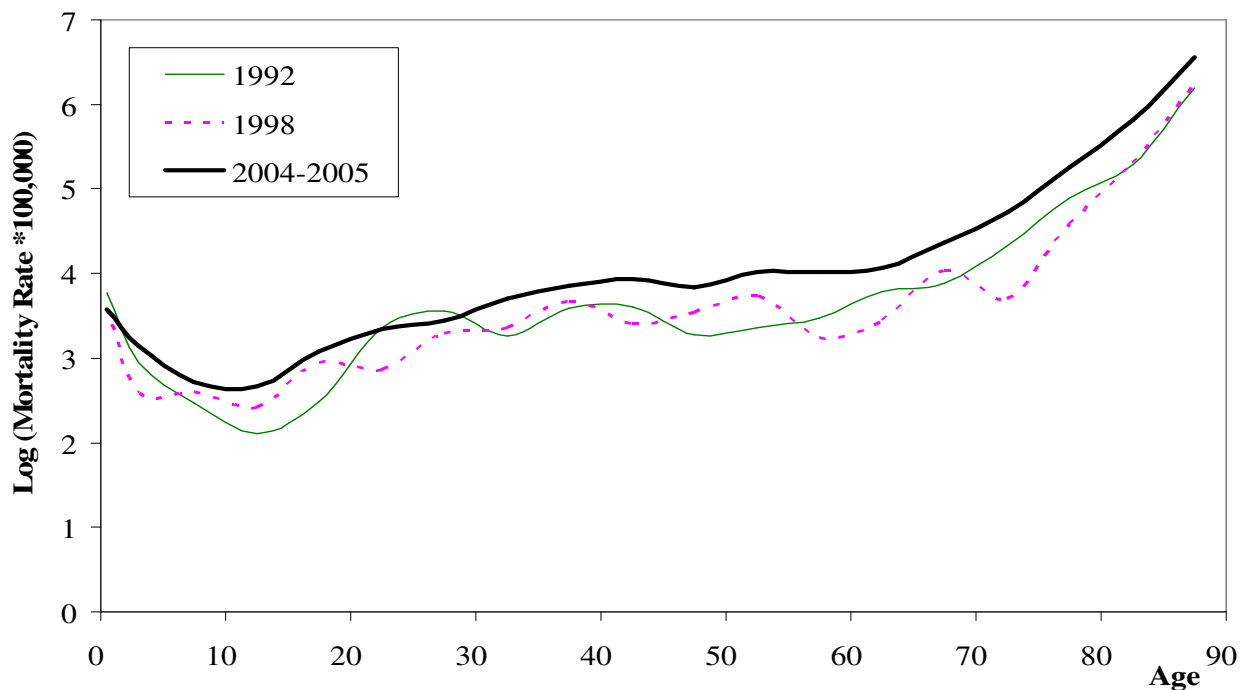
Injury risk Indicator	Beijing		Shanghai		Guangzhou		Xi'an	
	1992	2010	1992	2010	1992	2009	1992	2009
Population factors								
Population size (millions)	11.02	19.62	13.65	23.03	6.12	10.33	6.23	8.43
Population density (people per square km)	656	1195	2154	3632	823	1390	624	834
Proportion of migrants (%)	5.2	35.9	4.5	39.0	–	23.1	–	7.3
Economic growth								
Per capita GDP (US\$) ^a	1171	11 684	1488	11 704	1525	13 705	483	4969
Investment in fixed assets (US\$ per capita)	438	4308	475	3553	560	3960	96	4560
Motorization (vehicles per 10 000 population)	429	2451	196	1345	233	1891	96	895
Injury risks per year								
No. of fire accidents (events per 10 000 households) ^b	2.07	7.94	3.94	6.91	1.57	3.26	2.58	5.93
Fatalities per 10 000 population	0.45	0.50	0.43	0.44	1.37	1.09	0.57	0.63
Fatalities per 10 000 vehicles	10.50	2.03	22.11	3.26	58.74	5.79	59.01	7.03

GDP, gross domestic product; US\$, United States dollars.

^a US\$ 1 = 5.5 Chinese yuan in 1992; US\$ 1 = 6.5 Chinese yuan in 2009 or 2010.

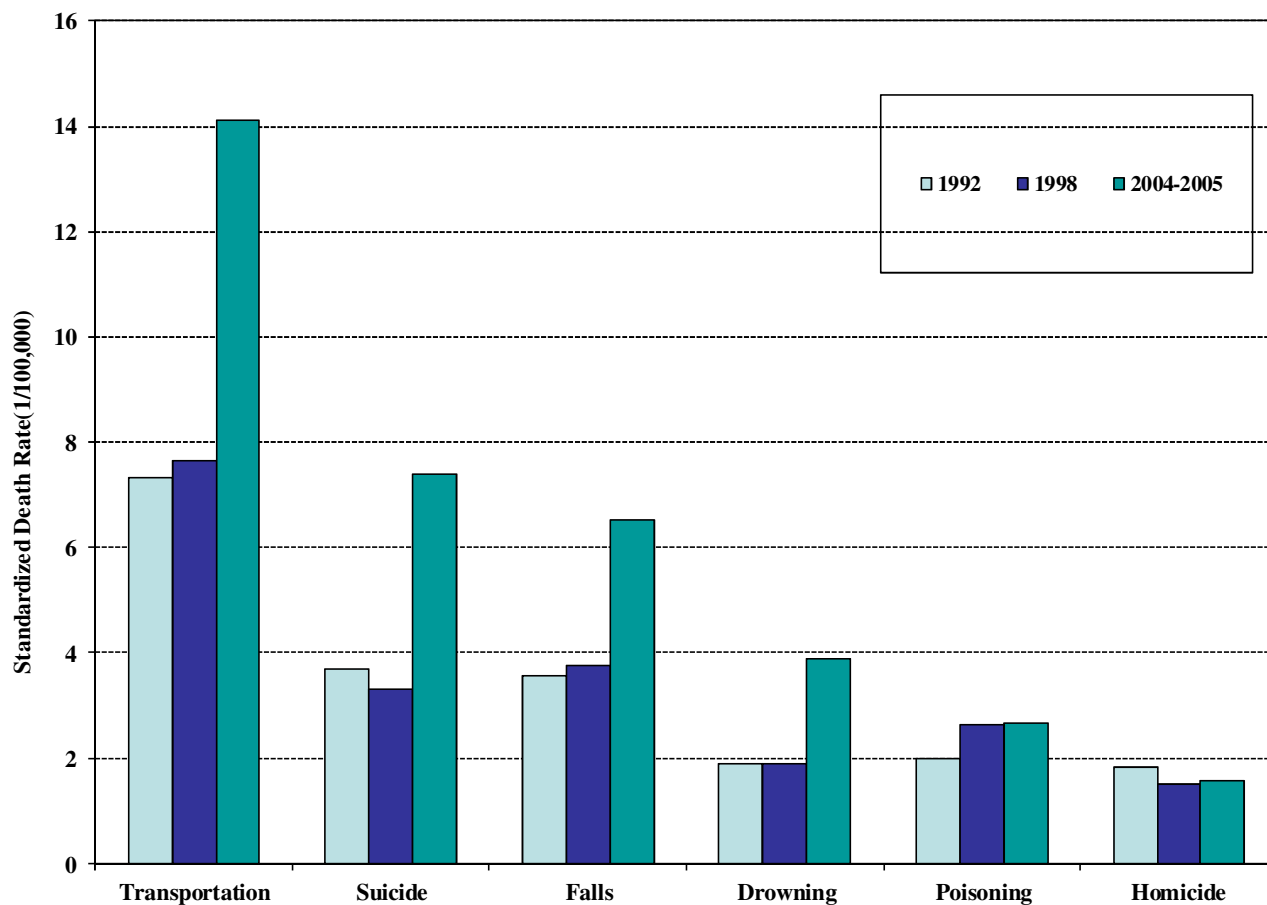
^b Household number is based on the 2010 census (for 2009 and 2010) and on data from statistical yearbooks (for 1992).

Fig. 1. Log age-specific mortality rate due to injuries in urban China, 1992, 1998, 2004–2005



Sources: 1992, 1998: Chinese Disease Surveillance Points system; 2004–2005, Third National Retrospective Survey on Causes of Death.

Fig. 2. Standardized death rates^a for injuries in urban China, 1992, 1998, 2004–2005



^a Using the world population in 2000 as the standard population.

Sources: 1992, 1998: Chinese Disease Surveillance Points system; 2004–2005, Third National Retrospective Survey on Causes of Death.