Road Traffic Crash and Injury

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Abstract –The road vehicle traffic collisions and associated injuries and consequences are recognized as a global public health issue and have attracted increasing attention worldwide. This paper described the characteristics of the road traffic injuries (RTI) between developed and developing countries. The trends of road traffic deaths in different countries was analysed and discussed

Keywords: Road traffic crash, Occupants, Vulnerable road users, Safety, Crash test, Injury prevention.

The World Health Organization (WHO) reported that road traffic crashes (RTC) kill about 1.2 million people a year or an average of 3,242 people every day, analogous to ten large aircraft (320 seats) crashes. Also, the crashes injure or disable between 20-50 million people a year.

The Chinese statistics analysis of road traffic injuries indicated that road traffic fatalities in China accounted for about 10% of fatalities reported by WHO. Some data of the road traffic injury in China are put forward as follows.

Drinking/Drunk drive: Traffic crashes from drink/drunk drive have been increased significantly since 1993. From 1996 to 2002, fatal drinking drive accounted for 1.24% to 1.60%. Actually the real percentage may much higher because of incomplete statistics, while in the United States it accounted for 40% of all traffic deaths.

Fatigue driving: From 1996 to 2002, fatal fatigue driving accounted for 0.81% to 1.50% of total crashes, while in the United States 1% to 3%; in France 10%; in Australia 33%.

Accident proneness: It was shown in foreign literature that about 75% of crashes resulted from 25% of MV drivers. In China, it was reported that 6% to 8% of drivers were prone to RTC, causing 30% to 40% of the total RTC.

The use rate of car seat-belt: On July 1, 1993, Traffic Administration Bureau declared that every driver and passenger at the front row of a car should take the seat-belt when running. However, a 9000 cases investigation in Chongqing city in 2002 showed that the use rate of car seat-belt was less than 8%.

Bicycle injury: There were more than 0.54 billion bicycles in China, accounting for about 1/3 of bicycles world wide. From 1987 to 1998, bicycle injury from RTC accounted from 9.65% to 15.47% of total road traffic injuries, while bicycle deaths from RTC accounted 8.30% to 17.35% of total fatalities from RTC. It was surprised that about 70% of RTC were related to bicycles.

Among road traffic deaths in 2002, automobile drivers accounted for 8.51% (9,308 persons), motorcyclists 20.03% (21,909 persons), cyclists 15.00% (16,407 persons), and pedestrians 25.21% (27,575 persons). It clearly showed that motorcyclists, cyclists and pedestrians were of "vulnerable

road users".

In 2002, road traffic deaths ranged 16 to 45yrs accounted for 58.99% of all traffic deaths, while the injured with same years old accounted for 72.38%. It indicated that majority of crash casualties were young and middle-aged people.

From the data mentioned above it may be concluded that road traffic crashes are a big public health problem both in China and in the whole globe.

A new lab called biological crash laboratory with sled tracks has been established recently. This lab primarily conducts car crash tests and biological sled crash experiments. The instruments such as H-III dummy, recorder on board, high speed camera and electric machinery control system and the major test parameters are in accord with the requirements of current international standards. The maximal crash speed is up to 120 km/h while the test vehicles or sleds weigh 1500 kg.

As everybody knows that automobiles have been greatly changing human beings live. However, they can also cause a great number of peoples' death and injury and considerable economic loss, which has constituted the globe burden. Last year, World Health Day (WHD, April 7) 2004 focused on road traffic injuries and measures to prevent them, and the slogan for the WHD 2004 was "**Road Safety is No Accident**" [1]. It definitely showed that road safety is a very important problem in all over the world.

1 Occurrence of road traffic injury (RTI)

It is estimated that in 2002 road crashes killed 1.18 million people and injured about 20 to 50 million more. Millions were hospitalized for days, weeks or months. About 5 million were disabled for life. Every day as many as 140 000 people are injured because of road crashes. More than 3 000 die and about 15 000 are disabled for life. It is predicted that by the year 2020, the annual number of deaths and disabilities from RTIs will increase by 60% or more, and could take third place in the rank order of disease burden (DALYs) by the year 2020 from the nine in 1990[2].

2 Characteristics of RTI

The characteristics of RTI between developed and developing countries are quite different. In 2002, the global rate of death from RTI was 19.0 per 100 000 people; the rate was lower at 12.6 in developed countries and higher, at 20.2 in developing countries. By 2020, the annual number of road traffic deaths and disabilities will decrease by 27.8%, while in developing countries they will increase by 83.3%[3]. In most developed countries, cars make up the largest portion of road traffic. The majority of those killed or injured on the road are car drivers and passengers. In developing countries, however, pedestrians and riders of bicycles, motorcycles and mopeds, are more common. They are called "vulnerable road users" and constitute the main part of the killed or injured by traffic crashes. In addition, passengers of two-wheelers and people traveling by public transportation are also easy to be crashed.

3 The Development of global motorization

At present, total motor vehicles in the world have been over 1 400 million, among which more than 80% are in the developed countries and less than 20% in the developing countries. However, less than 15% of population died of traffic crash belongs to the developed countries and more than 85% to the developing countries. The average global increase rate of automobile production is 3.5% and in the corresponding period the increase rate is 13.7% in China. The average global increase rate of total

motor vehicle production is also 3.5% and in the corresponding period 26.4% in China. In 2004, all the motor vehicles in China totaled at 107 834 424. The Figure 1 and Table 1 show the changes in the total number of motor vehicles in China these years[4].

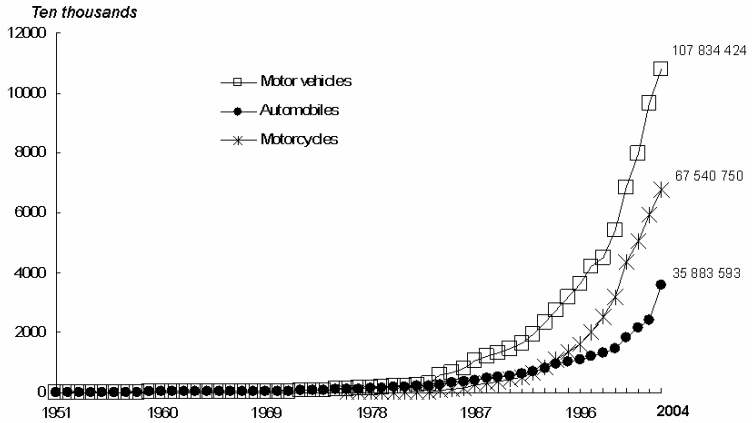

Fig.1 Changes in the total numbers of motor vehicles, automobiles and motorcycles in China

Table 1 Increase of motor vehicles in China

Year	Total amount of MV (ten thousands)	Total amount of automobiles (ten thousands)	Total amount of motorcycles (ten thousands)
1951	6.19	6.19	/
1978	158.89	135.49	12.60
2004	10 783.44	3 588.36	6 754.08
2004:1951	1 742.07	579.70	/
2004:1978	67.87	26.48	536.04

It indicates from Table 1, the total number of motor vehicles of China in 2004 is 1742.07 times of that in 1951, 67.87 times of that in 1978. The total number of automobiles in 2004 is 579.70 times of that in 1951 and 26.48 times of that in 1978. Total number of motorcycles in 2004 is 536.04 times of that in 1978. The increase is so rapid and it's rarely seen even in developing countries. However, compared with developed countries, China's MV remains in a lower level both in quantity and quality. In 2001, the average ownership of cars is 3.85/1 000 people in China[5], lagged far behind the developed countries.

4 Trends of road traffic deaths in different countries

Figure 2 shows the percentage change in fatalities resulting from traffic crash in developed and developing countries. If it takes 1980 as a cardinal number, the mortality is rising in many low-income countries, but it is dropping in developed countries. WHO predicted that the road traffic injuries will account for about 2.3 million deaths globally by 2020. Among them, developing countries accounts for 90% of the death[6].

As for in China, the death and the injuries from motor vehicle crashes increased years by years. The number of crashes, deaths and the injured in 2004 were 517 889, 107 077 and 480 864, respectively, about 87.45, 125.68 and 93.21 times, respectively, as compared with those in 1951, and 4.83, 5.61 and 6.21 times, respectively, compared to those in 1978 (Figure 3).

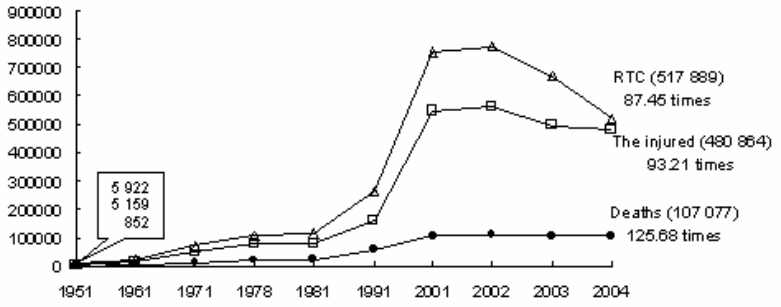

Fig.3 The Number of RTC, deaths and injured in China (2004)

In China, fatality rate per 10 000 MV and fatality rate per 100 000 persons in 2004 were 9.93 and 8.24, respectively. Figure 4, 5 show the dynamic changes of fatality rate per 10 000 MV and fatality rate per 100 000 persons from 1951 to 2004 in China.

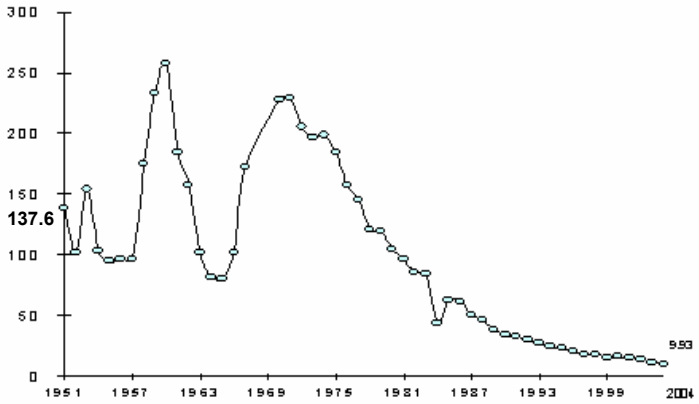

Fig. 4 Fatality rate per 10 000 MV in China (1951~2004)

Just as Dr. Wolfensohn, Per-president of World Bank Group, said: "Road safety is an issue of immense human proportions, it's an issue of economic and social proportions, and also an issue of equity. Road safety very much affects poor people".

5 Relationship between RTC and education

It has proved that education along won't reduce traffic crashes though it has long been considered to be a vital factors involving traffic safety during past 50 years.

Status Report from Insurance Institute for Highway Safety[7] says: "Research indicates that education has no effect, or only a very limited effect on driver's behavior like staying within speed limits, heeding stop signs, and using safety belts. The education might increase driver's knowledge (for example, about the benefits of using belts), but usually doesn't result in behavior changes" (Figure 6)


Special issue: what works and doesn't work to improve highway safety

STATUS REPORT

INSURANCE INSTITUTE FOR HIGHWAY SAFETY

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Education alone won't make drivers safer. It won't reduce crashes.

Why waste that competitive spirit on driving?

Drive Nice.

A billboard message by itself won't improve drivers or yield other safety benefits. Such messages waste resources and drain energy from effective highway safety approaches.

Highway safety is a much broader field now than it used to be. The focus has expanded from trying to prevent crashes by educating people to change their behavior. This approach was too narrow. And it failed because education alone almost never changes driver behavior. For more than 30 years, highway safety professionals have recognized that what's needed to reduce crash losses is a mix of measures aimed at drivers, vehicles, and the roadway environment. Today's vehicle and road safety programs are based largely on research and engineering. But when it comes to changing the behavior of drivers and others on the road, research findings often are ignored. Many programs are based on wishful thinking instead of science. This Status Report summarizes what the research literature tells us works — and what doesn't — to influence driver behavior for the better.

Fig.6 Status report: education alone won't make drivers safer.

It's interesting that the greater the compliance the more effective the traffic laws. If motorists don't know about a law or don't believe it will be enforced, compliance will be limited. Even the laws that frequently are violated can have positive effects, because drivers typically won't go more than 10 mph faster than a posted limit. Motorists are much more like to change their behavior in response to traffic laws than because of education about what increase crash risk. They believe their driving skill will enable them to avoid collisions, but won't enable them to avoid a ticket. Therefore, the effective program is the combination of education with traffic law enforcement. This is the key to changing driver behavior.

6 Some data of the road traffic injury in China

- **Drinking:** Traffic crashes from drink/drunk drive increased significantly since 1993. From 1996 to 2004, fatal drinking drive (BAC: 20~80mg/dl) and drunk drive (BAC≥80mg/dl) accounted for 1.40%, 1.60%, 1.60%, 1.59%, 1.24%, 1.43%, 1.33%, 1.65% and 2.31% in turn.
- **Fatigue driving:** From 1996 to 2004, fatal fatigue driving accounted for 1.40%, 1.50%, 1.42%, 1.15%, 1.01%, 0.81%, 0.84%, 1.16% and 1.53% of total crashes in turn[8].
- **Accident proneness:** It was shown in foreign literature that about 75% of crashes resulted from 25% of MV drivers. In China, it was reported that 6%~8% of drivers were prone to road traffic crashes, causing 30%~40% of the total RTCs[9].
- **The use rate of car seat-belt:** On July 1, 1993, Traffic Administration Bureau declared that every driver and passenger at the front row of a car should take the seat-belt when running. However, a 9000 cases investigation in 2002 showed that the use rate of car seat-belt was less than 8%.
- **Bicycle injury:** There were more than 0.54 billion bicycles in China, accounting for about 1/3 of bicycles world wide. From 1999 to 2004, bicycle injury from RTC accounted from 10.71% to 12.90% of total road traffic injuries, while bicycle deaths from TRC accounted 12.75%~16.49% of total fatalities from RTC. About 70% of RTC were related to bicycles (Table 2).

Table 2 The number of deaths and the injured of bicyclists (1999~2004)

Year	Deaths		The injured	
	Number	%	Number	%
1999	13 773	16.49	36 918	12.90
2000	14 979	15.96	52 340	12.50
2001	16 190	15.28	65 867	12.05
2002	16 407	15.00	65 763	11. 70
2003	14 664	14.05	52 944	10.71
2004	13 655	12.75	54 286	11.29

- **Bio-impact machines:** In 1989, a series of bio-impact machines were made for impact research. They consist of BIM-Ⅰ(erected type), BIM-Ⅱ(horizontal type) and BIM-Ⅲ(small type). They may produce impact injuries at various regions (craniocerebral, maxillofacial, thoracic and abdominal) in different animals with various degrees of severity. Also, the machine may be used for the test of impacting spine.
- **New lab:** beside previously built impact laboratories mentioned above, a new lab called biological crash laboratory with sled tracks has been established recently. It may carry out not only car crash tests but also biological sled crash experiments. The instruments such as H-Ⅲ dummy, recorder on board, high speed camera and electric machinery control system and the major test parameters are in accord with the requirements of current international standards. The maximal crash speed is up to 120km/h while the test vehicles or sleds weigh 1500kg.
- **Bio-mechanical studies:** the experiments indicated that in the cranium the stress is the largest when loading is on the parietal lobe at sagittal section, and on the parietal lobe and temporal lobe at coronary section, while the stress is the smallest when the loading is on the frontal lobe at sagittal section. In the brain, the stress is the largest when loading is on the parietal lobe both at sagital and coronary section, while the stress is the smallest when the loading is on the frontal lobe at sagittal section. The ratio between the two is 3:1. Among several response parameters, there is a close relationship between viscous criterion (maximum multiplication of initial velocity of body deformation **V** and compressed volume) and the severity of injury, showing "**S**" curve relation between the two. Therefore viscous criterion may be considered as an important parameter for determination of injury severity. The study of impact on rabbit's thorax shows that the heart is easier ruptured in terminal diastole than in systole. The occurrence of cardiac rupture is positively related with impact velocity, impact mass and compressed volume, and negatively related with the impacted dimension. The incidence of left ventricle rupture is much higher than right one. Using high-speed photography for the study of impacting on dog's abdomen, it indicates that the compressed deformation rate of the abdomen is related with impact velocity, while the compressed volume is related with impact mass.

7. Prediction of the future

Evans[10] says that the world fatalities are expected to increase beyond the current level of more than a million per year but eventually to reach a peak and then decline. We cannot know how high fatalities will climb before peaking when the peak will occur and the rate of decline from the park, but these phenomena will profoundly affect many millions of human lives.

In 1997, Sweden's parliament adopted Vision Zero, i.e. the idealistic goal of zero killed or severely injured road users. This is a bold and new road safety policy. Several other countries have followed the Swedish example. Vision Zero provides a model suitable for many countries.

Based on the experience with 30 years of traffic-safety research, Evans emphasized that two factors overwhelmingly determine on individual risk in traffic. They are: **the individual behavior** and **the behavior of other road users**.

Table 3 shows that in the United States in 2002, only 31% of fatalities involved the driving of only the person killed. The vast majority of fatalities (69%) were crashes in which a driver other than the person killed was involved. The fraction is especially large for less motorized countries.

Table 3. The 42 815 traffic fatalities in the US in 2002 separated according to whether or not a driver other than the person killed was involved

Persons killed	Deceased is only driver involved	Driver other than deceased involved
Drivers in single-vehicle crashes	13 399	
Drivers in multiple- vehicle crashes		13 150
Passengers		10 571
Pedestrians		4 875
Bicyclists		662
others		158
Total number of fatalities	13 399	29 416
Percent of all fatalities	31.3%	68.7%

Source: L. Evans. Traffic Safety. Science Serving Society (SSS), Bloomfield Hills, Michigan, 2004. 413-414

We hope, as a road user, everybody should do your best to pay attention to your own behavior in order to improve road traffic safety.

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