

Trends in Injury-related Incidence and Mortality Among Inpatients in Guangdong Province in 1997-2001¹

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Objective Currently, China is in short of thorough and systemic data concerning the patterns and incidence of injuries and related deaths. Guangdong Province as one of the economically advanced areas in China is faced with a relatively serious injury problem, and investigation of this problem in this Province will provide valuable information for other provinces and areas in this Country, as well as scientific basis for policy making for injury prevention and control. **Methods** Analyses are based on the computerized hospital discharge data collected from 322 hospitals in Guangdong Province between 1997 and 2001. Diagnoses are coded according to the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM). **Results** The total hospitalization rate related with injuries increased year by year from 1997 to 2001. The ratio of case-fatality has a decline trend for all injury inpatients, who were mainly caused by motor vehicle accidents, unintentional falls, puncture and cut by machine and others. The constituent ratio of death among patients caused by motor vehicle accidents accounted for 56.13% among the total deaths, which ranked as the first place. The direct medical cost also had an increased trend. **Conclusions** Data on injuries requiring hospitalization can be used to design and target more effective injury prevention programs. Injury prevention would decrease human sufferings, disability, and associated economic losses.

Key words: Injury; Hospitalization; Motor vehicle accident; Medical care costs

INTRODUCTION

Today injuries constitute a major public health problem in both developed and developing countries and are a leading cause of years of potential life lost (YPLL) in these countries^[1-5]. In recent decades, the mortality rates from infectious diseases have been decreasing, in part due to the success of public health programs. However, injury related mortality and disability have been increasing as a result of factors such as increased motorized transport. In developed countries, epidemiological studies have begun to identify cause and means of the prevention of injuries, and many attempts have also been made to address this problem. Injury is now one of the leading causes of adult mortality in most developing countries^[6-8], and is also one of the leading causes of disability, accounting for 12% of all disability

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adjusted life years lost worldwide^[9]. Unfortunately, very little have been done in this respect in developing countries^[10,11]. Injuries are still a neglected health problem due to the scarcity of injury information in these countries. The awareness among policy makers and professionals about the level of the injury problem is not high, largely because they are not well informed regarding the scientific data relating to injuries. Therefore, efforts to combat the problem of injury in developing countries are hampered by lack of adequate information concerning its incidence and outcome.

Recent data in China also showed that injury occupied the fourth position among all the causes of death of the whole population, and the first one for those of children^[12]. However, thorough and systemic interpretation of the patterns and characteristics of injury incidence and deaths is still insufficient currently. Hospital discharge information are often used for surveillance and research regarding injuries^[13,14]. Computerized hospital discharge data can be used to estimate the number of injuries treated in hospital settings, and external causes of injury codes on hospital discharge records are a reliable source of information on the causes of injury^[15]. Additionally, Guangdong Province as one of the economically advanced areas in China is faced with a relatively serious injury problem, and investigation of this problem in this Province will provide valuable information for other provinces and areas in China. We analyzed injury related hospitalization and deaths in recent 5 years in Guangdong Province, expecting to identify the distribution characteristics and changing patterns of the injuries and causes of death and thus to provide scientific basis for policy making for injury prevention and control.

METHODS

The data was sourced from the computerized hospital discharge data in China's National Hospitalization Dataset, which is maintained by China Health Information Service. This is a single integrated collection of secondary and tertiary health data, developed in consultation with health sector representatives, which provides information for policy formulation, monitoring and evaluation of policy implementation, health status measurement, and meeting international requirements.

Information about inpatients discharged from public hospitals is supplied to the bureaus of health in various provinces via hospital based computer systems which is compiled to the National Hospitalization Dataset. For this study, the data was sourced from the public general hospitals above the county level (322 hospitals in total) in Guangdong Province, which have submitted all of their inpatients information from 1997 to 2001 at the requests of the National Ministry of Health and Guangdong Provincial Bureau of Health. The data collected include information on diagnosis, diagnostic and therapeutic procedures, death status, medical outcome and economic costs related to the injury. All discharges with an injury diagnosis have been coded according to the external causes of injury codes (E codes) and the nature of injury according to International Classification of Diseases or derivatives of it (for example, ICD-9-CM and ICD-9-CM-A).

During the study period, the vast majority of injured persons requiring acute inpatient treatment were admitted to public hospitals, while the private sector has played an increasing part in the delivery of inpatient health services in recent years.

Considering the fact that the total population in the areas under study were regarded to be exposed to the risk of injury, the population base consisted of all residents of Guangdong Province, and annual population estimates were obtained from the Guangdong population control website (<http://www.gdpic.gov.cn/>) for the purposes of calculating rates. The studied

subjects suffered from an injury and admitted to the hospital from 1997 to 2001.

Descriptive statistics were calculated using the SPSS10.0 software package for Windows. A determination of statistical significance in this paper was based on 0.05 level of significance. When an estimate is referred to as higher or lower than another estimate, this means that the difference is statistically significant.

RESULTS

Yearly Increasing Trend of Injury Occurrence

The yearly change of the whole population in Guangdong Province from 1997 to 2001 was minor (Table 1). The numbers and incidence rate of injury hospitalized patients, namely severe injury patients, were calculated and analyzed on the basis of this whole population. The results showed that there was significant difference between these years in jury hospitalization rate ($\chi^2=46266.8$, $P<0.000$), which had an yearly increasing trend. It could be discerned that the overall injury hospitalization rate had an increasing trend in recent 5 years in Guangdong Province ($r_s=0.90$, $0.01<P<0.025$), however, the ratio of inpatient case-fatality had significant differences ($\chi^2=21.1$, $P<0.001$), which showed an decreasing trend.

TABLE 1
Fatality Data of Injured Hospitalized Patients in Hospitals of Guangdong Province

Year	End Year Population (Million)*	Hospitalized		Inpatient fatality	
		Number Rate		Number Rate	
		(1/0.1 Million)		(1/1000)	
1997	7.01373	178 477	254.47	3126	17.51
1998	7.11565	154 647	217.33	2510	16.23
1999	7.29888	204 763	280.54	3383	16.52
2000	7.49854	269 579	359.51	4250	15.77
2001	7.56533	285 767	377.73	4661	16.31
Total	—	1 093 233	—	17 930	—

Note. *The data was sourced from the Guangdong population controlling website: <http://www.gdpc.gov.cn/>

Fatalities of Inpatients From Different Injuries

The patients hospitalized from injury were divided into 16 groups according to their external causes of injury. The total case-fatality rate was 1.64% (0.11-4.77%) in the patients of 16 groups. Types of injury sequenced by the case-fatality rate from high to low were as follows: suicide/self-harm, unintentional drowning, unintentional mechanical suffocation, fire, motor vehicle accident, electric shock, hurts from medicine and therapeutic agents, unintentional poisoning, unintentional falls, accidents from natural and environmental factors, accidental strike by falling objects, transportation accidents of motor vehicles, medical malpractice, abnormal reaction and late-stage complication, homicide/hurt by other people, and other injuries. There were 8 types of injury with a case-fatality rate above the total level, which were suicide/self-harm, unintentional drowning, unintentional mechanical suffocation, fire, motor vehicle accident, electric shock, hurts from medicines and therapeutic

agents, unintentional poisoning. Further analysis of the fatality situation of injury inpatients showed (Table 2) that the injury inpatients case-fatality rate had significant difference among different years from 1997 to 2001 ($\chi^2=21.09$, $P < 0.001$), and 2×R table linear trend test showed that those of suicide/self-harm, unintentional drowning and unintentional mechanical suffocation had an increasing trend, those of hurts from medicines and therapeutic agents had and decreasing trend, while those of fire, motor vehicle accident, unintentional poisoning, and electric shock maintained their original level.

TABLE 2
Case-fatality Ratio of Inpatients for Different Injuries in Guangdong Hospitals

Year	Suicide/Self Harm	Unintentional Drowning	Unintentional Mechanical Suffocation	Fire	Motor Vehicle Accident	Electric Shock	Hurts From Medicine and Agent Therapies	Unintentional Poisoning
1997	35.63	17.50	37.82	35.33	25.88	15.87	29.56	15.95
1998	40.63	30.30	0	26.92	23.90	14.49	26.52	16.83
1999	56.76	48.67	29.41	33.52	25.92	20.95	12.97	20.13
2000	52.99	55.74	117.65	32.16	25.39	14.09	10.08	17.98
2001	57.23	71.81	62.50	29.26	25.96	21.68	10.10	15.02
Trend	↗	↗	↗	—	—	—	↘	—
χ^2	46.4836	16.8859	1.135	4.9956	7.9283	4.5595	24.3011	54421
P	0.0000	0.0047	0.0488	0.4164	0.1602	0.4720	0.0002	0.3643

Composition of Different Types of Injury in Inpatients

The analysis of the proportional composition of injuries in inpatients showed that the composition of types of injuries was similar among these 5 years (rank consistency checking, $\chi^2=0.80$, $P>0.90$), while some tendency was showed in the proportion of different types of injuries (rank consistency checking, $\chi^2=19.04$, $P<0.001$), and motor vehicle accident, unintentional falls, puncture and cut by machine, hurt by others and homicide accounted for an large proportion (Table 3), in which number of death from motor vehicle accident was 10 064, which constituted 56.13% of the total deaths, that is, above half number of fatalities was caused by injury of traffic accidents, which was far more higher than other types of injury ($\chi^2=5571.94$, $P<0.005$).

Therapeutical Effects of the Injured Hospitalized Patients

The curative rate, improvement rate, non-curative rate and case-fatality rate from 1997 to 2001, which reflected the medical quality, were comprehensively evaluated using Topsis methods (Table 4), and rank correlation analysis was done to the yearly and sequenced data. The results showed $r_s=0.90$, $0.01<P<0.025$, which means that though the inpatient rate caused by injury showed an annually increasing trend, the injured patients' case-fatality rate showed a decreasing trend, while the improvement rate manifested an increasing trend.

TABLE 3

Main Composition of the Injuries of The Hospitalized Patients in Guangdong Hospitals (%)

Year	Motor Vehicle Accident		Others		Unintentional Falls		Puncture and Cut by Machine		Killed and Hurt by Others		Total Number
	<i>n</i>	Ratio%	<i>n</i>	Ratio%	<i>n</i>	Ratio%	<i>n</i>	Ratio%	<i>n</i>	Ratio%	
	1997	62 269	34.89	54 647	30.62	27 921	15.64	14 883	8.34	18 757	
1998	58 994	38.15	39 972	25.85	24 474	15.83	14 721	9.52	16 486	10.66	154 647
1999	72 787	35.55	49 057	23.96	30 261	14.78	27 092	13.23	25 566	12.49	204 763
2000	95 849	35.56	63 703	23.63	40 557	15.04	36 397	13.50	33 073	12.27	269 579
2001	104800	36.67	66 584	23.30	44 347	15.52	37 264	13.04	32 772	11.47	285 767
Total	394 699	36.10	273 963	25.06	167 560	15.33	130 357	11.92	126 654	11.59	1 093 233

TABLE 4

Therapeutic Effects of the Injured Inpatients in Guangdong Province

Year	Cure		Improvement		Un-cure		Death in Hospital		Number of Hospitalized
	<i>n</i>	Ratio%	<i>n</i>	Ratio%	<i>n</i>	Ratio%	<i>n</i>	Ratio %	
1997	144 990	81.24	27 642	15.44	2719	1.52	3126	1.75	178 477
1998	123 448	79.82	26 332	17.03	2457	1.59	2510	1.62	154 647
1999	162 415	79.32	35 723	17.45	3242	1.58	3383	1.65	204 763
2000	209 570	77.74	51 186	18.99	4573	1.70	4250	1.58	269 579
2001	219 822	76.92	56 220	19.67	5064	1.77	4661	1.63	285 767
Total	860 245	78.69	197 103	18.03	18 055	1.65	17 930	1.64	1 093 233

Mean Length of Stay and Medical Costs of Injured Hospitalized Patients

The mean length of stay of discharged injured inpatients was shortened from 18 days to 15 days in 1997-2001, which decreased annually at a rate of 4.46%. The mean length of stay of the healed injured patients was shortened from 17 to 19 days, which decreased annually at a rate of 2.74% (Table 5).

TABLE 5

Medical Expenditure of Injured Hospitalized Patients in Guangdong Hospitals

Year	Mean Length of Stay	Mean Length of Stay of Healed Patients	Mean Costs (Yuan)	Mean Costs of Healed Patients (Yuan)	Mean Costs Per Patient Per Day (Yuan)	Mean Costs Per Patient Per Day of Healed Patients (Yuan)
1997	18	19	4885	5004	274	264
1998	17	18	5056	5200	306	294
1999	16	17	5287	5505	338	325
2000	15	17	5651	5963	366	351
2001	15	17	5912	6299	392	376

The medical care index of general consumer price index in China price indices in 2000-2001 in urban and rural areas of China were both about 100 (taken the price in the same term of the former year as 100) (quoted from China Statistics in China Internet Information Center, <http://www.china.org.cn/>), which means that the change of the prices was minor and can be neglected. This study showed that (Table 5) the mean costs of the injured hospitalized patient in the same term in Guangdong had been increased from 4885 Yuan in 1997 to 5912 Yuan, with a rate of 4.86% annually, and mean costs for healed patients had been increased from 5004 Yuan to 6299 Yuan, the rate of which was 4.71% annually, and averagely the costs per patient per day had been increased from 274 Yuan to 392 Yuan, with a yearly rate of 9.37%.

DISCUSSION

The patients hospitalized by injury are generally a population with more serious conditions, and injuries serious enough to result in hospitalization are particularly costly in terms of human suffering, health care resource consumption, and time lost from work. Because an universal system for reporting nonfatal injuries does not exist, hospital discharge data are valuable sources of information on these injuries^[16]. The causes and characteristics of injuries should be considered as a priority in injury prevention studies. Therefore, to explain the pattern of injury occurrence in the hospitalized patients might be very meaningful in the respect of injury prevention and control. For this reason, we investigated all the patients treated and hospitalized due to injury in 322 general hospitals above the county level in Guangdong Province, the purposes of which were to find out the external causes, death status, medical outcome and economic costs related to the injury, and so to provide scientific basis for policy making in injury prevention and control.

The results of the investigation and analysis showed that the patients hospitalized by injury in Guangdong Province in 1997-2001 displayed an annually increasing trend, while the case-fatality rate of the injured hospitalized patients displayed an yearly decreasing trend, which is consistence with the rerults of O' Keefe *et al.* and Fabino *et al.*^[17,18].

Mean length of stay of the injured patients in hospitals has decreased from 18 days to 15 days with an annual rate of 3.58% over the 5 years period, while those of healed injury patients has decreased from 19 days to 17 days at a rate of 2.20% yearly. The mean costs of the patients hospitalized by injury in the same term in Guangdong Province increased annually with a rate of 3.89%, those of the healed injury patients increased annually with a 4.71% rate, and the mean costs per patient per day increased with an annual rate of 7.33%. The study of O' Keefe *et al.* also showed that: although the mean days of hospitalization of the injured patients decreased by 28.4%, that was from 9.5 days to 6.8 days, their costs increased by 16.7%, that was from 14 174 dollars to 16 547 dollars, partially due to the newly additional application of special radiological examinations. Kreutzer *et al.* has done trend analysis on the costs and length of stay of short time therapies and rehabilitations of patients with brain injury over a 7 years period (1990-1996)^[19], the results of which also showed that the mean short time therapeutic costs per day of patients with brain injury increased with a rate of 550 dollars per year averagely, while the length of stay decreased by 2.25 days averagely every year.

Our study showed that most injuries of those hospitalized were caused by motor vehicle accident, unintentional falls, puncture and cut by machine, hurt by others and homicide, in which the number hospitalized by motor vehicle accident increased annually, and fatality number of which occupied 56.13% of the total fatalities, which was not identical to the

results of Li *et al.*^[20]. Li *et al.* evaluated the trend, patients age and sex of those patients hospitalized by injury in Victoria from 1987/88 to 1996/97, and showed that the hospitalization rate of motor vehicle accident and burn decreased greatly while those for attempted suicide and homicide increased more than 1 folds. This difference illustrated that the changing trend of different types of injury has its own specialty, with motor vehicle accident as the most life-threatening type. Therefore, we should pay more attention to the prevention and control work of this type of injury, adopting effective preventive measures preferentially to reduce the occurrence of motor vehicle accident and the severe degree of the injured patients.

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