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Chinese Traffic Fatalities and Injuries in Police Reports, Hospital Records, and In-depth Records From One City

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Objectives: Claims of sharp reductions in Chinese traffic casualties after 2002 based on police-reported data have been questioned in the literature. The objective of this study is to determine whether a decline in casualties occurred and to better understand the police data.

Methods: The first of 2 unrelated studies analyzed data from 210 military hospitals throughout China providing records for inpatients injured in traffic accidents (2001–2007). The second compared in-depth crash records (2000–2006) from one city to officially released data.

Results: Hospital data showed that casualties increased from 2002 to 2007. The city investigation showed consistently far more fatalities and injuries in the in-depth data than officially released. For example, in-depth data showed 1,720 fatalities. Only 557 of these were reported officially (data loss = 68%). Disaggregating into 3 regions showed a data loss of 41% in urban areas, 63% in rural areas, and 90% in rural–urban fringe zones. For injuries, data losses were even greater.

Conclusions: Traffic fatalities and injuries did not decrease from 2002 to 2006. The in-depth city data contained 3 times as many fatalities and 5 times as many injuries as reported by police. Reasons why this occurred and suggestions to improve data collection and reduce casualties are given.

Keywords: road crash, traffic injury, traffic fatality, data bias, China

Introduction

China had built 4.0 million kilometers of paved road by 2010, compared to 1.4 million in 2000, and only 0.9 million in 1980. (The United States has a fairly stable 6.5 million.) Freeway construction is less developed, with just 0.07 million kilometers completed by 2010.

Even greater growth in vehicles occurred. In 2010 there were 207 million vehicles in China, compared to 60 million in 2000 and only 2 million in 1980. Such rapid growth in roads and vehicles is expected to be accompanied by a rapid growth in death and injury, thus increasing the need for effective countermeasures. Effective countermeasures require an understanding of the problem based on reliable accurate data (Evans 2004). One main purpose of this study is to address the quality of Chinese data.

Figure 1 shows the number of traffic crashes, injuries, and fatalities reported by the Traffic Management Bureau of the Ministry of Public Security of China (police-reported data; Traffic Management Research Institute, Ministry of Public Security Traffic 2011). This shows steep declines in crashes, injuries, and fatalities after a peak in 2002. For example, for 2007 the number of fatalities reported is 81,649. This is 25.4% below the 2002 value of 109,381 fatalities. After 2007, further declines occur. Such reductions have been interpreted to show impressive progress in reducing harm from traffic crashes (Evans 2011; Zhang et al. 2008). The reductions have been credited to the establishment and implementation of "Law of The People's Republic of China on Road Traffic Safety" on May 1, 2004 (Beijing Traffic Management Bureau 2014). This is the first traffic safety law in P.R. China to legally standardize traffic behavior and strengthen the management of road traffic and penalties for violations. It ends decades of managing road traffic according to department regulations.

Serious questions have arisen about the accuracy of the data in Figure 1. Wang et al. (2008) assigned causes to all 8.4 million annual deaths in China and concluded that 846,510 were due

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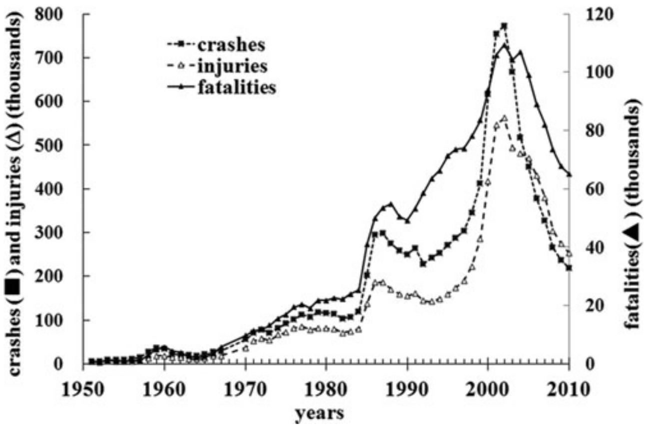

Fig. 1. Numbers of traffic crashes, injuries, and fatalities reported by the Traffic Management Bureau of the Ministry of Public Security of China.

to injury, of which 32.35%, or 273,879, were traffic related. Hu et al. (2011) compiled death certificates that identified road trauma as the cause of death in 2002–2007 data from China's Ministry of Health and found twice as many cases as included in police reports.

Alcorn (2011) reviewed the situation and mentioned a World Health Organization model that used the average number of fatalities per million population from other countries in a similar stage of motorization to China to estimate that traffic deaths in China might exceed 124,000. He concluded that a great deal of uncertainty clouded China's road traffic fatality data and claims of recent reductions in traffic casualties.

It is the purpose of this article to shed additional light on this confusing situation by performing 2 studies unrelated to each other or to any prior work. In the first, the hospital study, we examine trends in fatalities and injuries in inpatients in 210 military hospitals in China. In the second, the city study, we compare injuries and fatalities documented by in-depth original paper reports recorded by the police for 3 regions in a city with the later released police-reported data.

Methods

Hospital Study—210 Military Hospitals

Two hundred and ten military hospitals with hospital medical record reporting systems were chosen as the data sources for traffic injury inpatients. The hospitals were located in 31 provinces, municipalities, and autonomous regions in China, including all provinces except for Taiwan, Hong Kong, and Macao. Of those injured, 99% were civilians.

Chinese military hospitals have the most unified and complete national inpatient information registration system and the strictest reporting system. The quantity, scope, accuracy, and integrity of information acquisition of medical records are the best in China. These abilities, levels, and quantities of treating injuries, including traffic injuries, of these hospitals are all at China's middle and upper level and represent China's level and ability of treating injuries. We collected all of the medical record information on injured inpatients treated from 2001 to 2007, based on records of external causes of injuries and poisonings in medical records, classified external causes of injuries and poisonings as E810.000–E819.901 according to *The International Classification of Diseases*, Ninth Revision, Clinical Modification coding guidelines (Liu and He 2002). We selected injuries caused by road traffic crashes and included variables such as admission time, discharge time, admitting diagnosis, discharge diagnosis, surgical treatment, period of hospitalization, and so on.

Though not a random sample of all crashes in China, we believe that the data from the 210 hospitals provide a reasonable representation of conditions overall in China. Even if there were selection biases, these would be unlikely to affect the time trends that are the focus of this investigation.

City Study Using In-depth Original Police Data from City of Chongqing

We aim to compare data in original paper reports produced by police in one city with data later released. Chinese law requires that all crashes reported to the police must have a complete legal file establish. These in-depth original reports (police-reported data) include data such as number of casualties, severity of injuries, crash time, crash location, types of crashed vehicles, damage to crashed vehicles, causes of crash, etc.

Chongqing is a major city in China and was capital of China during World War II from 1937 to 1946. It is the largest of the 4 municipalities in China, with an area 2.39 times the combined area of the other 3 (Beijing, Tianjin, and Shanghai) and 2.0 times that of Switzerland. Chongqing has 32 million people and 38 counties, including a large city and large rural areas.

Examining original paper records is so laborious and time consuming that it was infeasible to do so for all of Chongqing. Instead, we selected 2000 thru 2006 reports for 3 representative counties with the following properties: (1) an urban area with an area of 274 km^2 and 460,000 people, with 1,679 people/km^2; (2) a rural–urban fringe zone with an area of 1,452 km^2 and 800,000 people, with 551 people/km^2; and (3) a rural area with an area of 3,200 km^2 and 1,460,000 people, with 456 people/km^2. Each of these counties had a separate police traffic management branch. All records in each of the 3 counties were included in the study.

All data were input into the road traffic accident and traffic injury database for storage and management. Trained qualified full-time staff collected and input the data (Qiu et al. 2011). Quality control personnel tracked and verified the quality of data acquisition and recording. Data not meeting the standard for traffic crash were excluded. We call the resulting data the *original police data*.

Also obtained from the same 3 police traffic management branches were the number of traffic crashes, injuries, and fatalities released to the public. We call these data the *reported data*.

Table 1. Traffic fatality and injury data from 210 hospitals

Year	Fatalities	Injuries (traffic)	Injuries (all causes)	Percentage of all injuries from traffic accidents	Ratio of traffic injuries to fatalities
2001	1,048	55,883	167,783	33.3	53.3
2002	1,118	62,182	181,403	34.3	55.6
2003	1,159	64,324	190,697	33.7	55.5
2004	1,105	63,434	182,587	34.7	57.4
2005	1,078	62,450	189,627	32.9	57.9
2006	1,236	69,208	208,735	33.2	56.0
2007	1,393	76,720	226,185	33.9	55.1
Total	8,137	454,201	1,347,017	33.7	55.8

Results

Hospital Study

The data from the 210 Chinese hospitals (Table 1) show no decrease in injuries or fatalities, unlike the decreases in the police-reported data (Figure 1). For example, Table 1 shows that fatalities in 2007 were 1,393 compared to 1,118 in 2002. That is a 24.6% increase, in stark contrast to the 25.4% decrease inferred above from the police-reported data.

In order to avoid influences such as changes in inpatient structure caused by the development of hospitals, the data for patients injured in traffic accidents were compared to all those injured (Table 1). In 2001–2007, the number of the injured inpatients also tended to increase year by year and only dropped slightly in 2004 and 2005; the proportion of traffic injury patients to all of the injured patients basically remained between 32.9 and 33.9% without obvious changes and fluctuations; that is, the structure of inpatients was relatively stable without obvious decreases.

City Study—Original In-depth Police Records

Though the original police data (Table 2) do not show any prominent trends, it is clear that they do not support any claim of large decreasing trends in deaths or crashes.

What is unmistakably clear from Table 3 is that the original police data include far more fatalities and injuries than reported to the Traffic Management Bureau of the Ministry of Public Security of China (the reported data in Table 3).

A convenient way to quantify the difference between the original numbers (N_o) and those reported (N_r) is the ratio, R, defined as

$$R = N_o / N_r .$$

The standard error in R[1] is given by

$$\Delta R = R\sqrt{(1/N_o + 1/N_r)}.$$

In all cases in Table 3 the value of R exceeds 1.0 by far more than 2 standard errors, equivalent to the 5% confident level that there is a difference between N_o and N_r. We can therefore conclude that in all cases $N_o >>> N_r$. For convenience we consider the symmetric errors around R rather than the more strictly correct symmetric errors around the logarithm of R. For the small errors here the distinction is inconsequential.

For all years summed in Table 3, the original data show 3.09 times as many fatalities as the reported data. Another way to express this is the percentage of the original data lost, L, where

$$L = 100(N_o - N_r)/N_o$$

with an associated standard error

$$\Delta L = 100(N_r/N_o)\sqrt{(1/N_o + 1/N_r)}.$$

For this measure we find a data loss of 67.6% for total fatalities.

For injuries there are even greater differences between the original and reported data. For all years summed in Table 3 there are 5.59 times as many injuries in the original as in the reported data. This is equivalent to a data loss of 82.1%. These differences between reported data and other estimates are much larger than those found for other countries (Amoros et al. 2006; Broughton et al. 2010; Dandona et al. 2008; Lopez et al. 2000; Peden et al. 2004).

Table 4 shows the data disaggregated into the 3 regions. Data loss is systematically higher in the rural–urban fringe zone than in either the urban zone or the rural zone. Differences between the zones are remarkably consistent over the years, as is the much greater loss of injury than fatality data.

Time Between Crash and Death for Hospital Fatalities

Of the 8,137 traffic fatalities documented in the hospital data, 73.3% died within 7 days of the crash. An additional

Table 2. Road traffic crashes and casualties from the *original* police data for the 3 representative counties

Year	Crashes	Fatalities	Injuries	Injuries/fatalities
2000	4,398	219	6,153	28.1
2001	4,633	278	7,933	28.5
2002	4,679	277	7,916	28.6
2003	4,372	283	7,585	26.8
2004	4,838	262	7,541	28.8
2005	5,048	267	7,193	26.9
2006	4,673	230	5,910	25.7
total	31,641	1,816	50,231	27.7

Table 3. Traffic fatality and injury data from *original* police reports and as reported for the 3 representative counties[a]

	Fatalities				Injuries			
Year	Original	Reported	$R \pm \Delta R$	$L \pm \Delta L$ (%)	Original	Reported	$R \pm \Delta R$	$L \pm \Delta L$ (%)
2000	123[b]	77[b]	1.60 ± 0.23	(37.4 ± 9.1)	3,297[b]	746[b]	4.42 ± 0.18	(77.4 ± 0.9)
2001	278	62	4.48 ± 0.63	(77.7 ± 3.1)	7,933	1,248	6.36 ± 0.19	(84.3 ± 0.5)
2002	277	63	4.40 ± 0.61	(77.3 ± 3.2)	7,916	1,411	5.61 ± 0.16	(82.2 ± 0.5)
2003	283	61	4.64 ± 0.65	(78.4 ± 3.0)	7,585	1,031	7.36 ± 0.24	(86.4 ± 0.5)
2004	262	117	2.24 ± 0.25	(55.3 ± 5.0)	7,541	1,307	5.77 ± 0.17	(82.7 ± 0.5)
2005	267	88	3.03 ± 0.37	(67.0 ± 4.1)	7,193	1,413	5.09 ± 0.15	(80.4 ± 0.6)
2006	230	89	2.58 ± 0.32	(61.3 ± 4.8)	5,910	1,324	4.46 ± 0.14	(77.6 ± 0.7)
Total	1,720	557	3.09 ± 0.15	(67.6 ± 1.6)	47,375	8,480	5.59 ± 0.07	(82.1 ± 0.2)

[a]R = original/reported, $L = 100(1 - 1/R)$, and ΔR and ΔL are standard errors.
[b]Data from rural–urban fringe zone not included in order to achieve consistency with Table 4.

21.0% died after 7 days but before 30 days, 5.5% died after 30 days but before 1 year, and 0.2% died after 1 year. See Figure 2.

The plot shows that 73.3% of those who eventually died did so within 7 days of their crash. Not included are those who died at the crash scene and those not transported to hospital.

For the 1,816 traffic fatalities in the city sample, 86.8% died within 7 days of the crash. The lower value of 73.3% for the hospital data is likely because some victims who are dead at the crash scene are not transported to the hospital.

The "True" Number of Traffic Fatalities Cannot Be Known

The above analyses and other studies cited involve compare results from different data sets. This does not mean that one data set gives the "true" value, because uncertainty is unavoidable. Everybody has some risk of dying at any time even without a traffic crash. So concluding that a death is due to a crash can sometimes require uncertain medical judgments. Suppose a hit-and-run driver strikes a pedestrian, propelling him into a river that sweeps him out to sea. This incident is extremely unlikely to ever be classified as a pedestrian fatality.

Even the best data files in the world have deficiencies. For more than half a century The Netherlands issued annual traffic deaths based on police-reported data. In 1996, a program started to estimate true values by augmenting the police data with cause of death and coroners' records (Institute for Road Safety Research 2013). Discrepancies as large as 21% are noted. It is unfortunate that the improved data set is labeled "true" when "improved" would be a better label.

Table 4. Percentage of data lost, L, between the original data collection and what was reported[a]

		Fatalities			Injuries		
County	Year	Original	Reported	$L \pm \Delta L$ (%)	Original	Reported	$L \pm \Delta L$ (%)
Urban area	2000	39	23	(41.0 ± 15.5)	1,348	415	(69.2 ± 1.7)
	2001	49	25	49.0 ± 12.5	2,493	627	74.8 ± 1.1
	2002	59	26	55.9 ± 10.4	2,150	702	67.3 ± 1.4
	2003	59	19	67.8 ± 8.5	1,122	609	45.7 ± 2.7
	2004	74	53	28.4 ± 12.9	2,212	712	67.8 ± 1.4
	2005	60	47	21.7 ± 15.3	987	766	22.4 ± 3.7
	2006	59	42	28.8 ± 14.4	1,119	771	31.1 ± 3.2
	Total	399	235	41.1 ± 4.8	11,431	4,602	59.7 ± 0.7
Rural–urban fringe zone	2000[b]						
	2001	116	8	93.1 ± 2.5	3,116	107	96.6 ± 0.3
	2002	134	7	94.8 ± 2.0	3,395	222	93.5 ± 0.5
	2003	119	13	89.1 ± 3.2	4,523	184	95.9 ± 0.3
	2004	93	13	86.0 ± 4.1	3,786	165	95.6 ± 0.3
	2005	86	8	90.7 ± 3.4	4,080	134	96.7 ± 0.3
	2006	58	12	79.3 ± 6.6	3,242	133	95.9 ± 0.4
	Total	606	61	89.9 ± 1.4	22,142	945	95.7 ± 0.1
Rural area	2000	84	54	35.7 ± 11.2	1,949	331	83.0 ± 1.0
	2001	113	29	74.3 ± 5.3	2324	514	77.9 ± 1.1
	2002	84	30	64.3 ± 7.6	2,371	487	79.5 ± 1.0
	2003	105	29	72.4 ± 5.8	1,940	238	87.7 ± 0.8
	2004	95	51	46.3 ± 9.3	1,543	430	72.1 ± 1.5
	2005	121	33	72.7 ± 5.4	2,126	513	75.9 ± 1.2
	2006	113	35	69.0 ± 6.0	1,549	420	72.9 ± 1.5
	Total	715	261	63.5 ± 2.6	13,802	2,933	78.7 ± 0.4

[a]Data loss is given by $L = 100 * (\text{original} - \text{reported})/\text{original}$.
[b]Data not available.

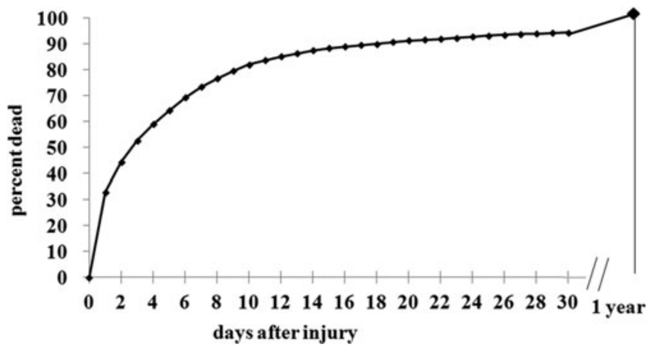

Fig. 2. Combined data for patients in 210 hospitals.

Discussion

Have Chinese Road Traffic Injuries Been Controlled Effectively?

The records from 210 military hospitals show a slow increase in deaths and injuries after 2002, in stark contrast to the sharp declines in the released police-reported data. The city study found 3 times as many fatalities and 5 times as many injuries in original data as finally released. The present findings confirm the conclusion in earlier publications that fatal injuries did not decline and that actual deaths and injuries are more than twice as many as reported.

These findings show less success than previously claimed in controlling traffic harm. However, it should be noted that from 2002 to 2007 the number of vehicles doubled, from 79,757 million to 159,778 million. Using the hospital study data, these values imply that between 2002 and 2007 traffic deaths per million vehicles declined by 37.8% and injuries by 38.4%, equivalent to an average annual reduction of 7.5%. This is more than twice the 3.3% decline recorded over a prolonged period in the United States (Evans 2004). Applying the corresponding calculation to the city data gives yet higher annual declines. Chinese safety programs may have produced substantial safety benefits, even if not as great as claimed earlier.

An increase over time in the probability that a given injury led to hospitalization would increase the steepness of the increase in reported injuries in time. Such an increase (of perhaps a few percent per year) is plausible given China's increasing development and hospital expansion and would strengthen the conclusion that China's safety programs have produced benefits even if not as great as previously reported.

This study, in agreement with earlier research, implies that there are over 200,000 annual traffic deaths in China.

Why Are Police-Reported Data Lower Than In-depth Data?

A number of factors contribute to differences between the original city police records and the data released.

1. Definition of death from road crash. The definition in the released police file is death within 7 days of the crash, including death at the crash scene or before 8 days after the crash. Many deaths still occur after 7 days. Indeed, for U.S. data, an additional 4% die after 30 days but before one year (Evans 2004). Published methods (Alcorn 2011; Peden et al. 2004) include many deaths that are not supposed to be in the police data. For the city data, 13.2% died after 7 days, far higher than the 7% adopted by the World Health Organization (Zhao and Zhou 2011).
   Although the hospital data did not contain the time of the crash, the data still show that the proportion of inpatients who died after 7 days is higher at 26.7%. In the process of investigating each hospital, we also observed that the life of many dying patients with serious road traffic injuries could be maintained for more than 7 days (all police officers expected hospitals to do everything possible to maintain the life of injured persons longer than 7 days). Due to the continuous improvement in technical level of medical intensive care units in recent years, the proportion of injured persons who die after 7 days may increase. Moreover, hospitals may acquiesce in discharging dying and incurable patients in order to maintain low death rates, so the number of deaths after 7 days is may be far lower than the actual data.
2. Limitation of scene of road traffic crashes. A provision in the *Law of The People's Republic of China on Road Traffic Safety* (Beijing Traffic Management Bureau 2014) defines a road traffic accident as caused by vehicles and non-motor vehicles because of faults or accidents on public roads and locations that allow public vehicles and non-motor vehicles. Therefore, many cases are not included in data reported by the public security traffic police because of reasons such as "happening outside of roads," "not roads and locations which allow the traffic of social motor vehicles," and "non-public roads." We expected to know the proportion of these data, but we could not obtain it from the original files or data provided by the police, so it is difficult to evaluate and analyze these data. There are greater differences in this part of the data because of differences of handling standards in different police offices.
3. Among the road traffic data management systems, a part of the data could not be accounted for in the data released by the Ministry of Public Security due to the ownership problem of themanagement system. For example, expressway crashes in Chongqing are assigned to the management of the Expressway Branch of Chongqing Traffic Lawful Administrative Enforcement Team, which is an independent authority outside of the Traffic Management Bureau of Public Security Ministry. Therefore, data on road traffic crashes and casualties that occur on expressways within Chongqing are not accounted for in the national published data. Although the proportion of these data is much lower, it also influences the integrity of data.
   There are a large number of agricultural vehicles, such as agricultural automobiles, tractors, etc., that are governed by the agricultural machinery department in China. Traffic police officers often do not deal with crashes caused by these vehicles because they are not within the scope of traffic police management. There are more than 800 kinds of agricultural vehicles in China now and there were 14,633,456 tractors driven on roads in China in 2010. Therefore, many road traffic crashes involving agricultural

vehicles are ignored, especially crashes on back roads involving agricultural vehicles.

4. The managing mode of traffic police has a great influence on the data statistics. At present, Chinese traffic police mainly adopt a method called “target responsibility system” for traffic crashes and injury management; that is, the quantity of annual crashes must be less than a fixed number, the number of deaths mus be less than a fixed number, and so on. If the index of serious road traffic crashes and injuries cannot meet the required target, not only can year-end rewards and a part of wages be lost but jobs may be lost. Under the pressure of continuously increased and established targets, police officers at all levels inevitably acquiesce in the basic level to eliminate “unqualified” road traffic injury data by various “legal” reasons. “Excellent” performance of management by objectives also creates a good base for position competition.

This is a universal problem prompting Hauer (1989) to make a convincing plea that the functions of evaluation and implementation should be kept separate.

Recommendations

Based on the findings in this article, we recommend that two things be done to improve traffic safety studies in China. First, a government agency should be given the task of creating a comprehensive data file documenting all traffic deaths in China modeled on the U.S. Fatal Accident Report System known as FARS (NHTSA 2014). The primary goals of this effort should be accuracy and completeness. Second, an independent national traffic safety research organization, similar to The Netherlands’ Institute for Road Safety Research (known as SWOV) should be created in China (Institute for Road Safety Research 2013). An independent institute that can conduct unbiased, high-quality traffic research will analyze relevant information from China and beyond to determine how best to reduce harm in the Chinese traffic environment.

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Contributors

J.H. Zhou, J. Qiu, L. Zhou, and Z.G. Wang planned the study. J. Qiu, L. Zhang, D.F. Yuan, G.D. Liu, Y. Yao, J.G. Shi, D.W. Liu, and Z.M. Gao were responsible for investigation and data input. J.H. Zhou, J. Qiu, and L. Evans and were responsible for data interpretation and statistical analysis. The report was written mainly by J.H. Zhou, L. Evans, and J. Qiu.

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