Bicyclist mortality between 2006 and 2010 in China: findings from national Disease Surveillance Points (DSP) data

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ABSTRACT

Context While road traffic mortality has been reported to be seriously undercounted by the police in China, non–police-reported data have not been explored previously to examine vulnerable road user mortality.

Objective To examine changes in bicyclist mortality between 2006 and 2010 in China, using the Disease Surveillance Points (DSP) data of China.

Design, setting and data source Mortality data of 2006–2010 from DSP data, covering 73 million population, was analysed. Poisson regression was used to examine the significance of year after controlling for sex, age and urban/rural location.

Main outcome measure(s) Mortality rate and mortality rate ratio (MRR).

Results Between 2006 and 2010, the mortality rate for bicyclists increased from 1.1 to 1.6 per 100 000 population according to DSP data. Between 2006 and 2010, more than 90% of bicyclist deaths were undercounted by the police compared to the findings from DSP data. Contrary to the 34% increase between 2006 and 2010 reflected by DSP data (adjusted MRR: 1.34, 95% CI 1.23 to 1.46), police data revealed a 64% decrease in bicyclist mortality (unadjusted MRR: 0.36, 95% CI 0.32 to 0.40) in the study time period.

Conclusions Health data should be used to assess the road traffic injuries in China. The recent increase in bicyclist mortality merits attention from policy makers and researchers.

INTRODUCTION

Bicycling is a common transportation mode in China. On average, 28 out of 100 households in urban areas had electric bicycles and 96 out of 100 households in rural areas had bicycles in 2010.[1] Bicyclists are one of the most vulnerable road users since they have little or no external protective shield that would absorb energy in a road traffic collision.[2] Use of helmets is not required by law, and helmets are not used by most bicyclists. According to police data, the bicyclist mortality rate has been decreasing sharply in China since 2002.[1 3 4] The reported number of bicyclist deaths decreased from 3856 in 2001 to 447 in 2010.[1 3]

However, recent studies show considerable under-reporting of police-reported road traffic mortality rates compared to the Ministry of Health's Vital Registration data and the Disease Surveillance Points (DSP) data.[5 6] In addition, police-reported statistics indicated that bicyclists accounted for merely <1% of total deaths from road traffic crashes in China,[1] much lower than the 9–10% in other low-income and middle-income countries.[7]

Although the discrepancy in road traffic injuries between police and health data has been documented in many countries,[8–12] the limitations of police data has not been well recognised in China partly due to the lack of evidence. So far, bicyclist mortality has not been reported using health sector (non-police) data in China. The comparison of overall road traffic mortality between police data and health data[5 6] indicates that the bicyclist mortality may be seriously undercounted by police data. Since police statistics are often regarded as the official data source for bicyclist injury and they may suffer from undercounts, it is important to use health sector data to estimate recent bicyclist mortality.

The government of China founded the DSP system in 1978.[6 13] Between 2004 and 2006, substantial adjustments were made to the DSP system to raise the national representativeness by enhancing sampling points in the system; and the sample has been maintained stable since 2006.[14] The primary objective of this study was to examine the trend in bicyclist mortality between 2006 and 2010 using DSP data.

METHODS

Data source

The DSP is one of two national cause-of-death data systems in China. The DSP was built by the central government of China in 1978. Two substantial adjustments were made to DSP in 1989 and in 2004–2006 to enhance its national representativeness.[14 15] Since it was established, the DSP has been under the charge of national Centers for Disease Control and Prevention (CDC) of China and has been looked on as a major health data source of China. At present, it includes 161 surveillance points nationwide and it covers 6% of the total population (73 million population).[15]

DSP reports causes of death using a mix of verbal autopsy and medical certification. When inhabitants die at home, village doctors are requested to report the death to the Division of Prevention and Care in town hospitals and then doctors from town hospitals will visit the family to fill out the death certificate. When inhabitants die in town hospitals, the death certificate will be filled out directly. And when the inhabitants die at other hospitals, a family member is requested to send the death certificate to the town hospital to get permission for cremation or burial.[16] All death certificates are gathered at the town hospital and then are

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reported to local offices of the CDC.[16] The data are coded using the 10th International Classification of Diseases (ICD-10).[16]

Based on a 2009 independent, face-to-face interview that revealed an under-reporting rate of 17% of unintentional injury deaths in DSP data, we adjusted the DSP data using compartment adjustment method and propensity score method. Because the face-to-face interview did not specify the bicyclist deaths, we used the overall under-reporting rate of 17% for overall unintentional injury deaths to adjust the bicyclist mortality. When the data are not missing at random, the estimates from the observed data are biased and inconsistent.[17]

Compartment Method: using the household survey data as golden standard, under-reporting rates for 18 compartments defined by 3 age groups × 2 sexes × 3 regions. Then the counts in each compartment were inflated by the inverse of the under-reporting rates.

Propensity Score (PS) Method: First, coded the individuals in the household survey as '0' if he/she was missed in the DSP survey; otherwise, the code was '1'. Next, a logistic model was fitted based on the household survey data using independent variables like age, place, sex and their interactions. The estimated coefficients were applied to the DSP data to yield the probability of individuals being missed. At last, the inverse of probabilities of being missed was used as a weight to make unbiased and consistent estimates.[18]

Both methods obtained essentially identical adjusted mortality rates that were consistent with estimates by WHO in terms of key health indicators, such as infant mortality and under-5-year mortality. The details of adjustment have reported in another paper by Li *et al*.[19 20]

Statistical methods

The mortality rate was calculated using bicyclist deaths from external cause of injury mortality matrix for ICD-10 that was developed by the US CDC.[21] The ICD-10 codes for bicyclist deaths include: (V12–V14)(0.3–0.9) and V19(0.4–0.6).[21] We used Poisson regression to examine the significance of sex, age, urban/rural location and year. Mortality rate ratio (MRR) was used to quantify the impact of independent variables.

RESULTS

Between 2006 and 2010, the DSP system of China captured 5560 bicyclist deaths caused by road traffic crashes. The overall mortality was 1.5 per 100 000 population in the study time period. The crude bicyclist mortality rate increased from 1.1 per 100 000 population in 2006 to 1.6 per 100 000 population in 2010 (figure 1) (unadjusted MRR: 1.37, 95% CI 1.25 to 1.49). After controlling for sex, place and age, bicyclist mortality increased by 34% between 2006 and 2010 (adjusted MRR: 1.34, 95% CI 1.23 to 1.46) (table 1).

The crude bicyclist mortality rates based on police data were merely 3–9% of those based on DSP data for the same years (figure 1). Contrary to the recent increase reflected by DSP data, a 64% decrease was observed in bicyclist mortality for police data in the study time period (unadjusted MRR: 0.36, 95% CI 0.32 to 0.40). Adjusted analysis was omitted for police data due to the lack of information of sex, place and age.

DISCUSSION

This study reports for the first time on the most recent bicyclist mortality in China using DSP data. Between 2006 and 2010, more than 90% of bicyclist deaths were undercounted by the police compared to the findings from DSP data. DSP data and police data displayed contradictory trends in bicyclist mortality rates.

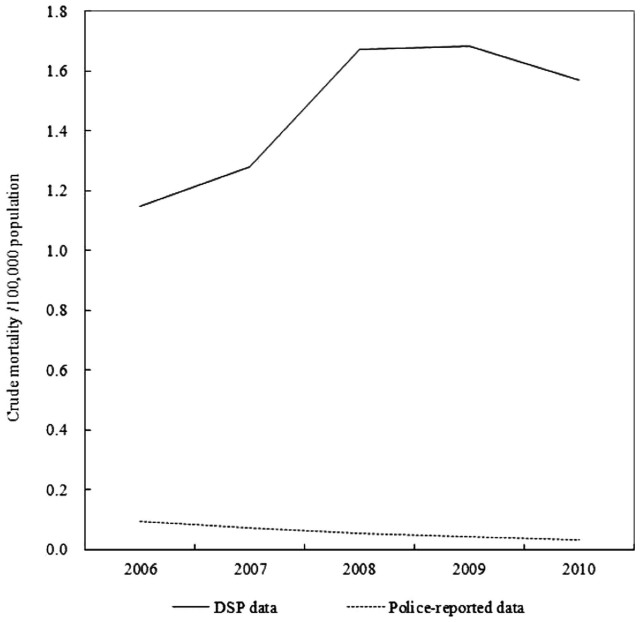

Figure 1 Crude bicyclist mortality per 100 100 population (China, 2006–2010).

First, the large gap between DSP data and police data suggests substantial undercounting within police data for bicyclist deaths and underlines the important and urgent need to improve police reports in China. Serious undercounting of police-reported bicyclist crashes was also reported in Germany. Juhra et al reported that the number of bicycle accidents based on the Münster Bicycle Study exceeded police-reported number by nearly two times in a large German city.[22] Low crash reports of police data can be attributed to different definitions[5] and misplaced incentives in local police bureaus by the national

Table 1 Adjusted mortality rate ratio (MRR) for bicyclists (China, 2006–2010)

Variables	MRR	Std. Err.	*Z*	p Value	95% CI of MRR	
Sex						
Male	2.36	0.07	29.16	<0.01**	2.23	2.50
Female (reference)						
Urban/rural						
Urban (reference)						
Rural	1.64	0.05	16.41	<0.01**	1.55	1.74
Age group						
0–4 years (reference)						
5–14 years	1.20	0.18	1.25	0.21	0.90	1.60
15–24 years	2.68	0.36	7.42	<0.01**	2.07	3.48
25–59 years	5.62	0.71	13.67	<0.01**	4.39	7.19
60 years and over	13.07	1.67	20.18	<0.01**	10.18	16.78
Year						
2006 (reference)						
2007	1.11	0.05	2.14	0.032*	1.01	1.21
2008	1.44	0.06	8.14	<0.01**	1.32	1.57
2009	1.44	0.06	8.27	<0.01**	1.32	1.57
2010	1.34	0.06	6.52	<0.01**	1.23	1.46

*p<0.05; **p<0.01.
Data source: the Disease Surveillance Points (DSP) data of China.

government[23] in China. Our findings emphasise: (1) non-police data like health data should be used to complement the reporting of traffic bicyclist injuries; and (2) specific actions should be taken to improve the collection and quality of police data.

Second, the inconsistent trends by these two kinds of data sources also indicate that fatal bicyclist injuries have become increasingly serious with the rapid motorisation in both urban and rural areas of China. Fifteen years ago, Li and Baker[24] reported that none of the bicyclists who died in road traffic crashes wore a helmet at the time of injury in Wuhan, China. Unfortunately, little has changed for helmet use among bicyclists in China in the last two decades. Currently, bicycling has become increasingly risky because bicyclists often have to share the road with more automobiles and motorcycles especially in rural areas where cycle tracks are lacking.

The increase in bicyclist mortality between 2006 and 2010, especially the large jump between 2007 and 2008 according to health data (shown in in figure 1), however, merits further analysis and should be cautiously explained because it may reflect the change in data collection or the effects of interventions.

Clearly, it is time for China to reconsider its road policies and introduce interventions of proven effectiveness in other countries to protect vulnerable road users like pedestrians and bicyclists. These might include legislation and enforcement to promote helmet use, zero-tolerance drink driving laws, mass media campaign against alcohol-impaired driving, speed cameras, and red light cameras.[25] In rural areas, infrastructural investment to improve road traffic safety measures like traffic lights, sidewalk, cycle tracks, speed cameras and red light traffic light cameras may prevent unwanted bicyclist deaths.

In addition, our findings identified males, rural residents, and old persons as high-risk groups for bicyclist deaths in China. Successful experiences could be learned from developed countries to protect the safety of high-risk bicyclists.[26]

This study was primarily limited by the restricted covariate information in the DSP data. For example, the DSP system is not set up for road traffic injury surveillance, and therefore, lacks information such as alcohol use, driving speed, characteristics of crash location and motor vehicles, personal behaviours and helmet use of road users being involved. Second, the inaccessibility of non-fatal bicyclist injury data limits the application of our findings to some extent, because the morbidity data may reveal different epidemiologic characteristics compared to mortality data. In addition, other factors like quality of coding may limit the findings of this study, though we do not have an estimate of such potential miscoding. Furthermore, the quality of coding might be uneven across rural and urban hospitals, resulting in some biased estimates.

Our findings have several policy implications. First, health (non-police) data should be utilised to improve the quality of bicyclist injury data. Second, actions should be taken to curb the recent increasing bicyclist mortality, such as promoting helmet use, improving rural road traffic infrastructure (traffic light, speed camera, red light camera, sidewalk and cycle track), mass media campaigns and legislation.

What is already known on this topic

- Bicyclists are vulnerable road users worldwide.
- Bicyclist mortality was reported to continue to decrease substantially in China according to police data.
- Road traffic mortality was seriously undercounted by the police.

What this study adds

- Compared to DSP data, the police data only reported 3–9% of bicyclist mortality for the same years.
- In contrast to decreasing trend based on police data, the DSP data displayed rising bicyclist mortality between 2006 and 2010 in China.

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Competing interests None.

Ethics approval The Ethics Committee of Central South University, School of Public Health granted this study exemption because the aggregated data that we have used involves no private information.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement The DSP data is not available for free access. Any request for it should be sent to the national CDC of China according to the health data management regulation.

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Canada Throne Speech mentions injury prevention

The federal government has said it will 'collaborate with injury prevention organisations, to reduce the injury rate in Canada'. Some view this as a significant milestone for Canada, and for the injury prevention community. *Editor's comment*: 'I am not convinced that it comes even close to the leadership needed to make real progress'.

Violence is contagious

A study described in *The Atlantic* addresses how conflict has affected adolescents in southern Israel. Those exposed to rocket attacks and terrorism weren't much more anxious or depressed than their peers but they were more violent: for each point a teen scored on a scale measuring exposure to such attacks, he or she was about twice as likely to commit violence later on.

The cost of gun violence in the USA

Thirty-six thousand victims of firearm assaults went to an emergency room, and 25 000 were admitted to hospital in 2010. The cost of treatment came to US$630 million. About half of those costs are for people with publicly funded health insurance, and another 28% went to the uninsured. Thus, taxpayers pay the largest share of these costs. *Editor's comment*: 'The author of this article in *The Atlantic* suggests that the data point to the prevention of gun violence as a way to lower health costs for taxpayers'.

Compulsory lifejackets for children

The Injury Prevention Network in New Zealand (NZ) is supporting a call from a member of parliament to make lifejackets compulsory for children on boats up to 6 m long. It is noted that almost one-quarter of New Zealanders own or use a boat, and given that all boats are required to carry a lifejacket for each person, it is reasonable to oblige children to wear one at all times.