



Analyzing fault and severity in pedestrian–motor vehicle accidents in China



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ARTICLE INFO

Article history:

Received 3 April 2014

Received in revised form 19 August 2014

Accepted 27 August 2014

Available online xxx

Keywords:

Pedestrian–motor vehicle accident

Pedestrian/driver liability

Accident severity

Policy

implications

ABSTRACT

The number of pedestrian–motor vehicle accidents and pedestrian deaths in China surged in recent years. However, a large scale empirical research on pedestrian traffic crashes in China is lacking. In this study, we identify significant risk factors associated with fault and severity in pedestrian–motor vehicle accidents. Risk factors in several different dimensions, including pedestrian, driver, vehicle, road and environmental factors, are considered. We analyze 6967 pedestrian traffic accident reports for the period 2006–2010 in Guangdong Province, China. These data, obtained from the Guangdong Provincial Security Department, are extracted from the Traffic Management Sector-Specific Incident Case Data Report. Pedestrian traffic crashes have a unique inevitability and particular high risk, due to pedestrians' fragility, slow movement and lack of lighting equipment. The empirical analysis of the present study has the following policy implications. First, traffic crashes in which pedestrians are at fault are more likely to cause serious injuries or death, suggesting that relevant agencies should pay attention to measures that prevent pedestrians from violating traffic rules. Second, both the attention to elderly pedestrians, male and experienced drivers, the penalty to drunk driving, speeding, driving without a driver's license and other violation behaviors should be strengthened. Third, vehicle safety inspections and safety training sessions for truck drivers should be reinforced. Fourth, improving the road conditions and road lighting at night are important measures in reducing the probability of accident casualties. Fifth, specific road safety campaigns in rural areas, and education programs especially for young children and teens should be developed and promoted. Moreover, we reveal a country-specific factor, *hukou*, which has significant effect on the severity in pedestrian accidents due to the discrepancy in the level of social insurance/security, suggesting that equal social security level among urban and rural people should be set up. In addition, establishing a comprehensive liability distribution system for non-urban areas and roadways will be conducive to both pedestrians' and drivers' voluntary compliance with traffic rules.

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1. Introduction

Due to the increasing number of traffic accidents globally, traffic safety has become a major public health issue. In 2010, the worldwide number of deaths due to traffic accidents reached 1.23 million (WHO, 2013). As the simplest and most basic way of transportation, walking as a pedestrian has become increasingly dangerous due to the large number of traffic crashes that cause pedestrian fatalities and serious injuries each year. In 2010,

pedestrian deaths accounted for 22% of the traffic crash deaths worldwide and as high as 25% of those in China (WHO, 2013). Traffic crashes cause not only pedestrian death and injury but also substantial economic losses. It was estimated that in year 2000, the economic loss associated with each fatality cost as high as US \$3 million in the United States (Blincoe et al., 2002). Although the corresponding numeric value of the monetary cost varies by country, the overall economic burden due to pedestrian fatalities worldwide is alarming.

Pedestrian traffic crashes have a unique inevitability and particular high risk. Due to pedestrians' fragility, slow movement and lack of lighting equipment, they are at higher risk than the driver and passenger in a traffic accident (Moudon et al., 2011). Therefore, the high frequency of pedestrian traffic crashes is not

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merely a coincidence. The study of risk factors for pedestrian traffic crashes will help develop preventive measures and hence reduce pedestrian traffic crash rate.

It is interesting to note that the number of pedestrian traffic crashes is not necessarily proportional to the number of motor vehicles. In particular, pedestrian accidents are more severe in developing countries than in developed countries. For example, although 80% of vehicles in the world are owned by 15% of the world's population in North America, Japan and Western Europe, more than 85% of traffic fatalities and 90% of disabilities occur in developing countries (Asiamah et al., 2002; Nantulya and Reich, 2002; Mock et al., 2003, 2005; Peden et al., 2004; Mabunda et al., 2008). Pedestrian traffic fatalities are significantly higher in developing countries than in developed countries. For instance, the pedestrian traffic fatality rate is 11% in the United States (Retting, 2003; Zhu et al., 2008), whereas it is 65% in the Kenyan capital Nairobi (Khayesi, 1997), 54% in Latin America (Donroe et al., 2008) and 60% in Ghana city (Afukaar et al., 2008). Even so, most developing countries do not consider pedestrian safety to be an important issue (Khayesi, 1997; Kwakye et al., 1997). One survey finds that 82% of Mexicans and 78% of urban residents in Uganda do not feel safe when using public transportation and walking on streets (Mutto et al., 2002; Zhu et al., 2008).

Due to rapid socio-economic development and accelerating process of motorization, China becomes one of the countries with high number of traffic fatalities in the world. Furthermore, traffic accidents have become the number one “killer” that threatens people's lives and property in China¹. For instance, 210,812 road traffic accidents occurred in China in 2011, resulting in a total of 62,387 deaths and 230,000 injuries. Overall, one traffic accident occurred every four minutes in China, resulting in approximately 160 traffic fatalities per day². For these reasons, the United Nation Decade of Action for road safety was officially launched in China in 2011. In addition, the State Council clearly stated a target of more than a 36% decrease in traffic fatality in the “Twelve Five” period³ and set December 2, 2012 as the first “National Traffic Safety Day”.

Some research studies reported that developing countries, including China, with high density of population and rapid urbanization, have experienced sky-rocketing increase in the number of accidents involving pedestrians (Khan et al., 1999; Hamed, 2001; Yang et al., 2006). In general, pedestrians in developing countries, due to the lack of road safety awareness and strict traffic laws enforcement, tend to cross roads haphazardly. In China, the proportion of walking in the total egression comes to 40% in big cities, and it must be even higher in small cities or in towns. Furthermore, a high proportion of pedestrians took dangerous action while crossing streets and most pedestrians habitually did not pay attention to the traffic light signals, indicating that the pedestrians' violation was popular and the level of traffic safety culture was still at a low level (Yang et al., 2006; Zhou et al., 2009). In 2007, such road crossing behavior resulted in 11,383 accidents, accounting for 83.25% of the total numbers of pedestrian-related traffic accidents. Nevertheless, a large scale empirical research on pedestrian traffic crashes in China is lacking. Therefore, in the current situation of increasingly harsh traffic conditions, it is particularly urgent and important to study pedestrian traffic violations and factors that affect accident severity. In the current paper, traffic accidents in China and the

risk factors for severe injuries are empirically studied using a logistic regression analysis based on the 6967 pedestrian traffic accident reports in the 2006–2010 Chinese Ministry of Public Security Traffic Accident Database. Risk factors for pedestrian–motor vehicle traffic accident fault and severity, including individual, vehicle, road and environmental characteristics, are investigated.

The remainder of the paper is organized as follows. The second section provides a review of the literature on pedestrian traffic safety. The third section describes the study data and hypotheses, and presents the descriptive statistics. The fourth section provides the results of the empirical data analysis by applying the stepwise logistic regression model. Finally, the fifth section discusses the implications of the effect of the identified risk factors for pedestrian–motor vehicle accident fault and severity.

2. Literature review

2.1. Risk factors for the occurrence of pedestrian–motor vehicle accidents

In the literature, the risk factors for pedestrian–motor vehicle accidents are mainly studied from the aspects of the pedestrian's characteristics, driver's behavior, vehicle type, road conditions and environment surrounding the accident site. Male and old pedestrians are more prone to pedestrian–motor vehicle accidents (Nantulya and Reich, 2002; Odero et al., 2003; Peden et al., 2004; Yee et al., 2006; Wier et al., 2009). Speeding and drunk driving are important factors that cause pedestrian accidents (Stutts et al., 1996). Vehicle types and characteristics also have certain influence (Zajac and Ivan, 2003; Ballesteros et al., 2004; Lefler and Gabler, 2004; Matsui, 2005). Road conditions, such as road network design and center turning lane settings (Shankar et al., 2003), the number of traffic lanes (Hess et al., 2004) and road demarcation (Donroe et al., 2008), are also important risk factors for the occurrence of pedestrian accidents. In addition, environmental factors, such as location, traffic volume, road lighting and time of the day, also significantly affect the likelihood of pedestrian accidents (Christie, 1995; Shankar et al., 2003; Hess et al., 2004; Harwood et al., 2008; Wier et al., 2009; Brüde and Larsson, 1993; Dissanayake et al., 2009; Moudon et al., 2011; Griswold et al., 2011; Lyon and Persaud, 2002; Miranda-Moreno et al., 2011).

2.2. Risk factors for pedestrians' liability in pedestrian–motor vehicle accidents

In most pedestrian–motor vehicle accidents, either the pedestrian, the driver or both was/were liable (Ulfarsson et al., 2010). The factors that impact pedestrian liability include pedestrian characteristics, behavior, road conditions and environmental factors, among which participants' age and gender are the most significant factors that relate to pedestrian liability (Zhou et al., 2009; Tom and Granie, 2011; Prato et al., 2012; Zhuang and Wu, 2011).

The pedestrian behaviors that result in traffic crashes include distractibility, ignoring traffic signals, and crossing the street while drunk. For example, Bungum et al. (2005) and Oxley et al. (2005) found that pedestrians who were negligent or distracted were prone to traffic crashes. Damsere-Derry et al. (2010) reported that ‘crossing the road’ explained 70% of the 812 pedestrian accidents in Ghana. Kim et al. (2008a) found that a jaywalking drunken male pedestrian was more likely to be liable in a pedestrian accident than in other cases. Ulfarsson et al. (2010) also identified that pedestrians' alcohol consumption significantly affected the pedestrian accident rate. Statistics in the United States showed that 55% of the pedestrians who were over 16 years old and fatally injured in

¹ Jun Liu: “Traffic Accidents Have Become the No. 1 ‘Killer’”, People's Daily, 08/05/2010.

² Traffic Management Research Institute, Ministry of Public Safety: “2012 White Paper on Road Traffic Accidents”, 2012.

³ Xinhua News Agency: “Strive to reduce the mortality rate of 100 million yuan GDP accidents by over 36% in China”, 01/13/2011.

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