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Traffic accidents involving fatigue driving and their extent of casualties

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ABSTRACT

The rapid progress of motorization has increased the number of traffic-related casualties. Although fatigue driving is a major cause of traffic accidents, the public remains not rather aware of its potential harmfulness. Fatigue driving has been termed as a "silent killer." Thus, a thorough study of traffic accidents and the risk factors associated with fatigue-related casualties is of utmost importance. In this study, we analyze traffic accident data for the period 2006–2010 in Guangdong Province, China. The study data were extracted from the traffic accident database of China's Public Security Department. A logistic regression model is used to assess the effect of driver characteristics, type of vehicles, road conditions, and environmental factors on fatigue-related traffic accident occurrence and severity. On the one hand, male drivers, trucks, driving during midnight to dawn, and morning rush hours are identified as risk factors of fatigue-related crashes but do not necessarily result in severe casualties. Driving at night without street-lights contributes to fatigue-related crashes and severe casualties. On the other hand, while factors such as less experienced drivers, unsafe vehicle status, slippery roads, driving at night with street-lights, and weekends do not have significant effect on fatigue-related crashes, yet accidents associated with these factors are likely to have severe casualties. The empirical results of the present study have important policy implications on the reduction of fatigue-related crashes as well as their severity.

1. Introduction

The rapid progress of motorization has increased the number of severe traffic-related casualties. Fatigue driving has already become a major cause of traffic accidents. Approximately 32% of drivers in the US drive while fatigued at least once a month (National Sleep Foundation, 2008). Moreover, 16.5% of fatal traffic accidents and 12.5% of collisions that lead to injuries in the US are related to fatigue driving (American Automobile Association Foundation for Traffic Safety, 2010). Additionally, 14.5% of drivers in the US have fallen half-asleep while driving, and nearly 2% of them have been involved in fatigue- or drowsiness-related crashes in the past year (Vanlaar et al., 2008). According to a country-wide poll, the Traffic Injury Research Foundation of Canada found that more than 50% of drivers have driven under fatigue condition and that 20% (4.1 million Canadian drivers) have fallen half-asleep while driving in the past year (Beirness et al., 2005). Approximately 20% of all traffic accidents worldwide are related to fatigue driving (MacLean et al., 2003; Fernandes et al., 2010).

Drivers in developing countries are more likely to drive while fatigue for economic/financial reasons and meeting work schedule, especially commercial vehicle drivers. Surveys of commercial and public road transport in developing countries have revealed that transport owners, in pursuit of increased profits, frequently force their drivers to drive at excessive speeds, to work unduly long hours and to work when exhausted (WHO, 2004) as well as ignoring speed limits and other safety regulations (Nantulya and Muli-Musiime, 2001; Mock et al., 2004).

However, the potential harmfulness of fatigue driving has not been investigated thoroughly. Research from the US (National Sleep Foundation, 2008), Australia (Smith et al., 2005), and Norway (Nordbakke and Sagberg, 2007) has found that many people still drive when they feel fatigue. The public knows not much about the nature and universality of fatigue driving, and the effect of fatigue in traffic accidents have not been attended sufficiently. Although people may adopt measures such as opening windows or listening to music to avoid or ease their fatigue while driving, few of these

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measures are effective. Therefore, fatigue driving is called a "silent killer."

Traffic accident has become a major cause of death for people between the ages of 14 and 44 in China (WHO, 2013). In 2011, 4.22 million road traffic accidents in China caused 62,387 deaths, 237,421 injuries, and over 1.08 billion RMB property losses. Among these accidents, 1755 were caused by fatigue driving, with 1003 people being killed, 2124 people injured, and accordingly over RMB 43 million in property losses. Moreover, 887 (9.26%) of all highway accidents were caused by fatigue driving, resulting in 520 (8.1%) deaths and over RMB 37 million (10.82%) in property losses (Traffic Management Bureau, Ministry of Public Security, PRC, 2011). This research studies the role of fatigue driving using a database of 16,459 traffic accidents reported from 21 cities in Guangdong from 2006 to 2010 and contrasts the severity of such accidents based on the characteristics of the driver, the type of vehicle, road conditions, and environmental factors using a logistic regression model. By examining the risk factors related to fatigue driving, appropriate measures can be derived to reduce the incidence and severity of such kind of traffic accidents.

The rest of this paper is arranged as follows. In Section 2, we review related literature to identify the key issues and summarize the experiences from various studies in different countries about the topic. In Section 3, we describe the data, the methodology and present related descriptive statistics. In Section 4, risk factors associated with fatigue driving and/or the severity of fatigue-related crashes are reported. Discussion of results is given in Section 5. Some policy implications and further remarks are provided in Section 6.

2. Literature review

Many studies have investigated the effect of fatigue driving by examining individual factors, such as the gender or age of the driver. Horne and Reyner (1995a) found that 50% of drivers in southwest England and the midlands who drive under fatigue are male and under the age of 30. The peak time of fatigue driving varies with age. Young drivers are likely to be fatigued in the morning, while older drivers are more likely to be fatigued in the afternoon (Brown, 1997). Given their habits, young drivers are more likely to drive at night according to a roadside survey conducted in Copenhagen (Corfitsen, 1994) and are enthusiastic when embarking on a road trip in Australia (Turner et al., 2004; Fernandes et al., 2010). The New South Wales Risk Management Research Center of Australia found that 50% of fatigued young drivers insist on driving despite the presence of their fatigue condition (Hatfield et al., 2005).

The years of driving experience also affects fatigue driving behaviors. Drivers with little driving experience indiscriminately accept, read, and process large amounts of information while driving because of their limited experience. In China, these drivers consume a tremendous amount of energy and become fatigued within a short period of time (Li et al., 2010). By investigating the driving habits of taxi drivers in Shanghai, Ren et al. (2007) found that fatigue-related crashes are associated with the experience of drivers. People with limited driving experience are at high risk of causing traffic accidents. However, drivers with extensive driving experience tend to overestimate their ability when dealing with emergencies. Their overconfidence may lead to more involvement in accidents (Li et al., 2010). Liu et al. (2008) found that Chinese drivers who have driven for either less than 3 years or approximately 10 years have the highest probability of causing traffic accidents.

Most of these studies assert that fatigue driving is closely related to work and lifestyle of driver. The National Highway Traffic Safety Administration identified three dangerous groups of drivers in the US: male drivers with age between 16 and 29, drivers working irregular shifts, and drivers with sleeping problems (NHTSA, 1998). Fatigue driving behaviors are also commonly observed in people who drive frequently and work for long hours in the US (Novak and Auvil-Novak, 1996). Approximately 25% of fatal crashes in the US (Toscano and Windau, 1994) and more than 20% of such accidents in Denmark, Finland, and Norway are related to occupations with these conditions (Charbotel et al., 2001). Professional drivers are at high risk of causing traffic accidents in Turkey (Öz et al., 2010). Gnardellis et al. (2008) found that the lifestyle and factors related to sleep also influence rural traffic accidents in cities of Greece. The combination of fatigue and alcohol or drugs increases the probability for drivers to cause traffic accidents (Horne et al., 2003; Roehrs and Roth, 2001).

Use of drugs can cause tiredness, in addition to their other impairment effects (NHTSA, 1998) and tends to have a larger effect on the risk of fatal and serious injury accidents than on the risk of less serious accidents (usually property-damage-only accidents) (Elvik, 2013). Findings indicated that illicit drugs and driving behavior is common among out-of-treatment drug users (Albery et al., 2000). Driving performance can be impaired by a wide array of illicit and prescription drugs. Evidence showed that use of marijuana impairs cognitive functions and driving performance, such as psychomotor skills, divided attention, and lane tracking (Battistella et al., 2013; Hartman and Huestis, 2013), and doubles the risk of being involved in a motor vehicle crash (Asbridge et al., 2012). Use of stimulants, in high doses, or in combination with alcohol or other drugs or with lack of sleep, can pose a threat to driving safety (Bogstrand et al., 2012; Walsh et al., 2004).

About 4% of Chinese aged 30 or over suffer from sleep apnea syndrome.[1] In general, patients with obstructive sleep apnea often report falling asleep while driving (Findley et al., 1988). Sleep disorders directly or indirectly affect the quality and quantity of one's sleep or otherwise cause excessive daytime fatigue (Smolensky et al., 2011). Epidemiological studies showed that fatigue and sleep-related accidents represent up to 20% of all traffic accidents in industrial societies (Horne and Reyner, 1995a; Philip et al., 2001; Connor et al., 2002; Nabi et al., 2006). Powell et al. (2007) investigated the risk of driving and found that patients suffering from sleep disorders had more sleep-related accidents. Sleep disorders are common in the adult general population. Research showed that insomnia concerns one adult out of five for the general population of the US, France, Germany, Italy, Spain, the UK and Japan (Leger et al., 2007; Leger and Poursain, 2005) and sleep apnea 5–10% in Spain (Marin et al., 1997; Young et al., 1997). Many drivers are also patients affected by sleep disorders who must face altered driving habits (Sagaspe et al., 2007). Sleep disorders can affect driving skills (Philip et al., 2010). In regular highway drivers, sleepiness at the wheel or sleep disorders are responsible for traffic accidents independent of age, sex, marital status or socioprofessional categories (Philip et al., 2010).

Road facilities and conditions also affect fatigue driving. Many researchers believe that a complicated, dynamic environment increases the chance of fatigue for drivers. By examining the effect of different road conditions on driving and cognitive behavior of Chinese drivers, Liu and Wu (2009) found that the change of road conditions from complicated to simple exacerbates driver fatigue. Different road facilities also affect fatigue driving. Several researchers have found that 59% of fatigue driving behaviors occur in multi-lane interstate highways in the US at the speed above 55 miles/h, 23% of fatigue driving behaviors occur in two-lane public roads at the speed above 45 miles/h, while only 8% of

[1] Doctor Warns Chinese of Sleep Apnea Syndrome: http://www.china.org.cn/english/scitech/50632.htm.