Accident Analysis and Prevention 91 (2016) 208–215

Contents lists available at ScienceDirect

Accident Analysis and Prevention

journal homepage: www.elsevier.com/locate/aap

Mobile phone use among motorcyclists and electric bike riders: A case study of Hanoi, Vietnam

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ARTICLE INFO

Article history:
Received 13 December 2015
Received in revised form 2 February 2016
Accepted 11 March 2016
Available online 22 March 2016

Keywords:
Motorcyclists
Electric bike riders
Mobile phone use
Cell phone
Vietnam

ABSTRACT

Motorcyclist injuries and fatalities are a major concern of many developing countries. In Vietnam, motorcycles are involved in more than 70% of all road traffic crashes. This paper aims to explore the prevalence and factors associated with mobile phone use among motorcyclists and electric bike riders, using a case study of Hanoi, Vietnam. A cross-sectional observation survey was undertaken at 12 sites, in which each site was surveyed during a two-hour peak period from 16:30 to 18:30 for two weekdays and one weekend day. A total of 26,360 riders were observed, consisting of 24,759 motorcyclists and 1601 electric bike riders. The overall prevalence of mobile phone use while riding was 8.4% (95% CI: 8.06–8.74%) with calling having higher prevalence than screen operation: 4.64% (95% CI: 4.39–4.90%) vs. 3.76% (95% CI: 3.52–3.99%) respectively. Moreover, the prevalence of mobile phone use was higher among motorcyclists than electric bike riders: 8.66% (95%CI: 8.30–9.01%) vs. 4.43% (95% CI: 3.40–5.47%) respectively. Logistic regression analyses revealed that mobile phone use while riding was associated with vehicle type, age, gender, riding alone, weather, day of week, proximity to city centre, number of lanes, separate car lanes, red traffic light duration, and police presence. Combining greater enforcement of existing legislations with extensive education and publicity programs is recommended to reduce potential deaths and injuries related to the use of mobile phones while riding.

1. Introduction

Research literature has highlighted crash risks associated with deteriorated driving performance resulting from mobile phone use while driving. For example, using a mobile phone while driving increases the chance of failing to perceive and process traffic signs and hazards on roads (McKnight and McKnight, 1993); it can also affect reaction times (Caird et al., 2008). As a result, the risk for drivers being involved in road traffic crashes is increased significantly by either using a mobile phone or a hands-free device (McEvoy et al., 2005). It has been reported that mobile phone use while driving is associated with 0.4% of fatal crashes in Nigeria, 1.2% of fatal crashes in the US, and 10% of injury crashes in France (OECD/ITF, 2014). Effects of mobile phone use while riding a bicycle have also been investigated in previous research. For example, cyclists have been found to make less head movements at intersections if they are using a mobile phone (de Waard et al., 2015). According to a study in the Netherlands, 10% of cyclists' self-reported injury crashes occurred when they were using electronic devices, including mobile phones (Goldenbeld et al., 2012). As a result, in most countries, the use of hands-free devices is tolerated whereas it is illegal to use a mobile phone while driving a car or riding a motorcycle (OECD/ITF, 2014).

Rapid economic growth has been accompanied by an increasing level of motorisation and road traffic crashes (WHO, 2015). Due to their affordability, the number of motorcycles in many developing countries is high and expected to increase. For example, motorcycles account for 52% of the fleet of vehicles in Nigeria, 53% in Tanzania, 59% in Thailand, and 83% in Indonesia (WHO, 2015). However, motorcyclist deaths account for 23% of all road traffic deaths worldwide with South East Asia being the most vulnerable region at 34% (WHO, 2015).

Road traffic crashes are one of the leading causes of deaths and disabilities in Vietnam (Nguyen et al., 2012). In 2013, over 9000 people were killed in more than 29,000 road traffic crashes in Vietnam (WHO, 2015). The social cost of road traffic crashes was estimated at 2.9% of the country's GDP (JICA, 2009). Motorcycles are the dominating transport mode in Vietnam, accounting for around 95% of

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http://dx.doi.org/10.1016/j.aap.2016.03.007
0001-4575/

40.8 million registered vehicles by 2013. Motorcyclists are the most vulnerable road users as they were involved in more than 70% of road traffic crashes (Hung et al., 2008; La et al., 2013). A study using a sample mortality surveillance system in 16 provinces suggested that motorcycle users accounted for 58% of road fatalities (Ngo et al., 2012). The use of mobile phones and portable music devices while driving and cycling is forbidden by road traffic laws. However, there is no available information about its compliance level in Vietnam.

Hanoi, the capital city of Vietnam, has a population of 7.1 million people with a density of 2134 people per square kilometre (GSO, 2015). Between 2006 and 2011, the number of motorcycles increased to around 4 million with an annual growth rate of 13.1% while the number of cars increased to around 235,000 with an annual growth rate of 22.8%. It is estimated that motorcycle ownership will remain high despite a greater increase in car ownership. Electric bikes are an emerging alternative transport mode, particularly for teenagers, as riding them does not require a licence. In Hanoi, motorcycles represent around 86% of the traffic flow (Bray and Holyoak, 2015) and generate about 65% of all vehicular trips (World Bank, 2006).

The prevalence of mobile phone use among motorcyclists and electric bike riders has been reported in very few studies. For example, a study in Guadalajara-Zapopan, León, and Cuernavaca in Mexico showed that 0.64% of motorcyclists were using a mobile phone while riding (Pérez-Núñez et al., 2013). In another study in Suzhou, China, 0.4% of electric bike riders were observed to use a mobile phone (Du et al., 2013). These studies however focused on observation at intersections with traffic lights where there is a temptation to use a mobile phone during the red traffic light phase (Huth et al., 2015). Hence investigating mobile phone use at other locations such as mid-blocks is important for gaining a better understanding of the extent of mobile phone use. In addition, little is known about mobile phone use patterns among motorcyclists and electric bike riders, i.e. calling and screen operation, and influencing factors. To our knowledge, there is no study dedicated to understanding the prevalence of mobile phone use among motorcyclists in a motorcycle-dominated city. This paper aims to explore the prevalence and factor associated with mobile phone use among motorcyclists and electric bike riders, using a case study of Hanoi, Vietnam.

2. Study design and methods

2.1. Study design

A cross-sectional observation survey was undertaken in Hanoi during October to November 2015. An important factor considered in the selection of observation sites was the inclusion of both intersection and mid-block locations. Another factor was the number of lanes since previous studies have reported that mobile phone use and helmet use among motorcyclists might be different depending on road types (Hung et al., 2006; Pérez-Núñez et al., 2013). Roads with different numbers of lanes, e.g. one lane, two lanes, and three lanes, were considered. In Hanoi, separate lanes for cars and non-car traffic such as motorcycles and electric bikes can be provided on three-lane roads as a measure for improving safety and reducing traffic congestion. Thus it is important to investigate the impacts of separate lanes in this study. Therefore, a stratified random sampling approach was used to incorporate these factors. A list of potential corridors was first developed based on preliminary observations by considering safety for surveyors and visibility for collecting data. Six corridors, including two one-lane corridors, two two-lane corridors, one three-lane corridor with separate lanes and one three-lane corridor without separate lanes, were then randomly selected from the list. This random selection process was repeated until selected corridors were widely distributed, both inside and outside the city centre. On each selected corridor, an intersection site was randomly chosen, followed by a mid-block site. This aimed to examine the effect of intersection/mid-block locations on mobile phone use. To avoid repeated observations, data were collected at intersection and mid-block sites on different days. A total of 12 observation sites were selected, which were distributed over five urban districts of Hanoi, including two districts in the city centre area.

A summary of observation site characteristics is presented in Table 1. Information about the presence of police and whether the site is located within the city centre is also included given their impacts on motorcyclists' helmet use suggested in previous studies (Kulanthayan et al., 2001; Akaateba et al., 2014). Red light duration indicated by signal countdown timers are also included for sites at signalised intersections.

Each site was surveyed during a two-hour peak period from 16:30 to 18:30 for two weekdays and one weekend day. At each site, two trained surveyors observed one direction of traffic and recorded information. To avoid repeated observations, one surveyor was focused on motorcycles and electric bikes with only drivers while the other was focused on those with passengers. Since the volume of motorcycles in Hanoi is high, it was not possible to record all motorcyclists at the site during the survey periods. To avoid any bias towards mobile phone use, surveyors were instructed to capture information from the first (nearest) motorcyclist and electric bike rider they could see; after finishing recording that information, they picked the next nearest motorcyclist and electric bike rider in their line of sight. Collected data include information about riders (mobile phone use, age estimate, and gender), vehicles (vehicle type and presence of passengers), traffic light status (red/green lights for sites at signalised intersections), and observation sites (date, location type, presence of police, number of lanes, presence of separate car lanes, red light duration for sites at signalised intersections). Motorcyclists and electric bike riders observed calling (holding the phone to their ear or speaking into their hands-free device) or operating a mobile phone screen (sending text messages or reading from the screen) were recorded as using a mobile phone.

2.2. Data analysis

Using descriptive statistics, the prevalence of mobile phone use with 95% confidence intervals was determined by different variables such as gender, road type, and vehicle type. Factors associated with mobile phone use were then explored by using a binary logistic regression model. A more detailed investigation of mobile phone use (i.e. calling, screen operation, or not using a mobile phone) was then conducted using a multinomial logistic regression model. A binary logistic model can be described as follows:

$$log\left(\frac{P(Y=1)}{P(Y=0)}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_N X_N \quad (1)$$

where P denotes probability, Y is the binary outcome variable, $\beta_0, \beta_1, \ldots, \beta_N$ are coefficients, and $X_1, X_2, \ldots, X_N$ are predictors. A multinomial logistic model with p possible outcomes can be similarly expressed as $p-1$ binary logistic models.

Choosing a subset of independent variables is a fundamental task of developing a regression model. To this end, the stepwise strategy is the most widely-used approach for variable selection. However, this strategy ignores the uncertainty in model selection, which can lead to limited predictability (Raftery, 1995; Raftery et al., 1997; Wang et al., 2004). A Bayesian Model Averaging (BMA) approach can be used to overcome this limitation by averaging information on all or a subset of possible models and using the