

Investigating fatigue related motorcycle taxi crashes

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Abstract

Motorcycle taxis are a popular means of transport in many cities, especially in South-East Asia. The recent booming of ride-hailing services has led to a dramatic growth in the fleet of motorcycle taxis, raising concerns about the safety of motorcycle taxi drivers. Like professional car and truck drivers who often have long working hours, motorcycle taxi drivers would similarly be vulnerable to fatigue related crashes. This paper therefore explores self-reported fatigue-related crashes (including falls and other single vehicle crashes) among motorcycle taxi drivers in Hanoi, Vietnam. A survey of motorcycle taxi drivers was conducted in early 2019. Results show that the prevalence of fatigue-related crashes among motorcycle taxi drivers was approximately 16%. Nearly 37% of all self-reported crashes among motorcycle taxi drivers were related to fatigue. Negative binomial regression was used to explore factors influencing the frequency of fatigue related crashes. Regression results indicate that working fulltime, riding hour, delivery trips, and overweight conditions are associated with increasing fatigue-related crashes. Working night shift and passenger trips were found to be negatively associated with fatigue-related crashes. Implications for transport and safety policy are also discussed.

Keywords: motorcycle; taxi; fatigue; crashes

1 Introduction

Motorcycle crashes continue to be a major road safety problem. Among the world's regions, South-East Asia has the highest proportion of motorcycle road deaths, which is 43% (WHO, 2018). In certain countries where the traffic flow is dominated by motorcycles, the proportion of motorcycle road deaths can be substantially higher; e.g. approximately 60% and 74% for Vietnam and Thailand respectively (Truong et al., 2016a; WHO, 2018). Unsafe riding behaviours among motorcyclists have been widely reported (Chang and Yeh, 2007; Susilo et al., 2015; Truong et al., 2017; Truong et al., 2018, 2019a).

In many cities, especially in South-East Asia, motorcycle taxis are a popular means of travel, given their fast, flexible, and low-cost service (Tuan and Mateo-Babiano, 2013; Sopranzetti, 2014). Motorcycle taxis can effectively operate in urban areas with narrow streets, providing door to door access. They are also a fast travel mode, particularly in peak-hour congested traffic, due to their capability to filter through the traffic. The booming of ride-hailing services, e.g. Grab Bike, has led to a dramatic growth in motorcycle taxi service and associated road safety issues. There is evidence that motorcycle taxi drivers have a higher tendency to engage

in risky riding behaviours, such as red light running and speeding, when compared to non-occupational motorcyclists (Wu and Loo, 2016). Previous research based on self-reported data also showed high prevalence of crashes among motorcycle taxi drivers, with 62% during a 2-year period for all crashes and 29% for hospitalised crashes in Thailand (Khan, 2004), approximately 51% for injury crashes in Nigeria (Akinlade and Brieger, 2003), and 32.6% during a 1-year period for all crashes in Vietnam (Truong and Nguyen, 2019). The safety issues among motorcycle taxi drivers would be further complicated as many motorcycle taxi drivers would also operate as delivery drivers.

Fatigue has been found as a contributing factor to crashes among professional truck drivers and car taxi drivers (Sabbagh-Ehrlich et al., 2005; Li et al., 2019; Wang et al., 2019). There was some evidence that driver fatigue was more prevalent among car taxi drivers than professional truck drivers (Meng et al., 2015). However, little is understood about the fatigue-related crashes among motorcyclists (Haworth and Rowden, 2006; Horberry et al., 2008). A study in Nigeria suggested that 13.8% of hospitalised motorcycle crashes would be attributed to fatigue (Oginni et al., 2009). Like car taxi drivers, motorcycle taxi drivers also tend to have high numbers of working hours per day and working days per week. Fatigue would affect riding abilities, impacting crash risks. Nevertheless, there is a lack of research into fatigue-related crashes among motorcycle taxi drivers.

This paper aims to investigate self-reported fatigue-related crashes among motorcycle taxi drivers, using data from a driver survey in Hanoi, Vietnam. Hanoi is the capital city of Vietnam, which has a population of approximately 7.3 million people and density of nearly 2,200 people per square kilometre (GSO, 2017). The number of road deaths in Hanoi is approximately 550 each year, accounting for around 7% of all road deaths in Vietnam (NTSC, 2019; Truong et al., 2019b). Hanoi is a city with motorcycle-dominated traffic, where motorcycles represent approximately 86% of the traffic flow. Motorcycle taxis are a popular mode of travel in Hanoi. The number of motorcycle taxis in Hanoi was estimated at roughly between 50,000 – 100,000 in 2007 (JICA, 2007).

This paper is structured as follows: the survey data and analysis approach are presented in the next section, followed by a summary of results. Finally, a discussion of the findings and conclusion are presented.

2 Methodology

2.1 Survey

A structured questionnaire survey of motorcycle taxi drivers was conducted in Hanoi, Vietnam between January and March 2019. There were no incentives for participating in the survey. The collected survey data was completely anonymous. Each interview took approximately 10-15 minutes to complete. The survey was part of a wider research project exploring crashes and health conditions among motorcycle taxi drivers in Hanoi (Truong and Nguyen, 2019). The project was approved by La Trobe University Human Ethics Committee. This paper specifically focuses on items related to fatigue-related crashes (including falls and other single vehicle crashes).

Motorcycle taxi drivers' information regarding age, gender, weight, height, education, income, motorcycle licence, motorcycle insurance, and alcohol consumption were recorded in the survey. They were asked to clarify whether they are traditional, ride-hailing, or hybrid taxi drivers (i.e. who operate as either traditional and ride-hailing taxi drivers - often at different times of day). They were also asked to provide the number of years working as a motorcycle taxi driver, the average numbers of passenger trips and delivery trips per day, the average number of working days per week, working conditions (i.e. fulltime or part-time/casual; and worked night shift or not), average distance travelled for working per week, and the average working hours (i.e. including waiting time) and riding hours per day. Based on the self-reported

weight and height, the BMI was calculated. Underweight, normal-weight, and overweight/obese conditions were then determined using WHO classifications.

Motorcycle taxi drivers were asked to indicate the frequencies of crashes (including falls and other single vehicle crashes) and fatigue-related crashes that they had been involved in while riding a motorcycle taxi in the last 12 months. They were also asked to indicate whether they suffered from fatigue as a health condition.

2.2 Analysis

Since crash frequencies are non-negative integers, negative binomial regression was utilised to explore factors contributing to the frequency of fatigue-related crashes. Let y_i denote the reported number of fatigue-related crashes for motorcycle taxi driver i , X_{ik} is the k^{th} explanatory variable for driver i , β_0 is the intercept, β_k is the coefficient, p is the number of variables. The negative binomial model is presented as follows:

$$y_i \sim \text{Poisson}(\lambda_i) \tag{1}$$

$$\ln(\lambda_i) = \beta_0 + \sum_{k=1}^p \beta_k X_{ik} + \varepsilon_i \tag{2}$$

where λ_i is the expected number of fatigue related crashes for motorcycle taxi driver i , $\exp(\varepsilon_i)$ is a gamma-distributed error term with mean one and variance $1/\theta$, where θ is the dispersion parameter.

To select a set of contributing factors that provide the best-fitted model, the Akaike Information Criterion (AIC) was utilised. Multicollinearity was evaluated using the Generalized Variance Inflation Factor (GVIF). In the modelling, all standard error components were computed using the sandwich estimator that is often called the robust covariance matrix estimator. Data was analysed using R. Negative binomial regression was estimated using *MASS* package and GVIF was computed using *car* package in R.

3 Results

There was a total of 549 survey respondents, in which 362 had at least one year of motorcycle taxi experience. Given that survey respondents were asked about their crash frequencies in the last 12 months, the analyses in this paper were based on these 362 motorcycle taxi drivers. Results of the best-fitted negative binomial regression model are presented in Table 1.

Table 1 Results of negative binomial model for fatigue-related crash frequency

Variables	Estimate	Std. Error	
Intercept	-1.957	0.476	***
Full time (binary)	0.990	0.331	**
Daily riding hours	0.149	0.074	*
Weekly passenger trips	-0.017	0.004	***
Weekly delivery trips	0.018	0.005	***
Night shift (binary)	-0.621	0.302	*
Fatigue (binary)	0.562	0.291	^a
Overweight/obese (binary)	0.871	0.298	**
Underweight (binary)	1.566	0.537	**
Dispersion parameter	0.524	0.156	***
AIC	410.230		
Log likelihood (restricted)	-222.545		
Log likelihood	-195.116		
Number of observations	362		

Note: ^a $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

The model was statistically significant at $p < 0.001$ (Chi square = 54.86, $df = 8$). The dispersion parameters were also significant, indicating that negative binomial regression was preferred to the Poisson regression. GVIF scores indicated no multicollinearity issues.

4 Discussion and conclusions

Survey results indicated that the prevalence of fatigue-related crashes among motorcycle taxi drivers was approximately 16%. Based on crash frequencies, nearly 37% of all self-reported crashes were related to fatigue. These results suggest a significant issue of fatigue-related crashes among motorcycle taxi drivers. Results also showed that the proportion of motorcycle taxi drivers suffering from fatigue was approximately 24%. A relatively stressful working environment associated with Hanoi's congested and heterogeneous traffic would be the key reason for the high level of fatigue among motorcycle taxi drivers. Overall, immediate interventions should be implemented by the authorities to address this significant issue of fatigue-related crashes among motorcycle taxi drivers. Publicity campaigns should be developed to increase awareness about fatigue and fatigue-related crashes. For ride-hailing motorcycle taxi drivers, a warning of riding hours exceeding certain thresholds should be sent by the service providers.

It was found that increasing delivery trips among motorcycle taxi drivers were associated with more fatigue-related crashes. In contrast, increasing passenger trips were associated with fewer fatigue related crashes. A possible explanation is that motorcycle taxi drivers who carry a passenger would be more cautious. In addition, potential conversations between motorcycle taxi drivers and passengers would reduce sleepiness while riding. This finding is in alignment with previous research. For example, motorcyclists who carried a passenger would be less likely to engage in risky behaviours (Truong et al., 2016b). Nevertheless, the safety issue around delivery trips among motorcycle taxi drivers was noticeable.

Results showed that overweight and obese motorcycle taxi drivers were more likely to be involved in a fatigue-related crash, when compared to normal-weight drivers. Obesity-related health conditions, such as obstructive sleep apnea, would increase the risk of falling asleep or reduced vigilance while riding, particularly with long working and riding hours among motorcycle taxi drivers. Similarly, underweight motorcycle taxi drivers were also more likely to be involved in a fatigue-related crash, when compared to normal-weight drivers.

Overall, this paper has highlighted the issue of fatigue-related crashes, i.e. high prevalence and high proportion among all self-reported crashes, among motorcycle taxi drivers in Hanoi, Vietnam. New and important factors influencing fatigue related crashes, including delivery trips and overweight conditions, were identified. Immediate interventions via publicity or educational campaigns should be considered by authorities to address this important issue.

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