



Influences of motorcycle rider and driver characteristics and road environment on red light running behavior at signalized intersections

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ABSTRACT

In Thailand, red light running is considered as one of the most dangerous behaviors at intersection. Red light running (RLR) behavior is the failure to obey the traffic control signal. However, motorcycle riders and car drivers who are running through red lights could be influenced by human factors or road environment at intersection. RLR could be advertent or inadvertent behavior influenced by many factors. Little research study has been done to evaluate the contributing factors influencing the red-light violation behavior. This study aims to determine the factors influencing the red light running behavior including human characteristics, physical condition of intersection, traffic signal operation, and traffic condition. A total of 92 intersections were observed in Chiang Mai, Nakhon Ratchasima, and Chonburi, the major provinces in each region of Thailand. In addition, the socio-economic characteristics of red light runners were obtained from self-reported questionnaire survey. The Binary Logistic Regression and the Multiple Linear Regression models were used to determine the characteristics of red light runners and the factors influencing rates of red light running respectively. The results from this study can help to understand the characteristics of red light runners and factors affecting them to run red lights. For motorcycle riders and car drivers, age, gender, occupation, driving license, helmet/seatbelt use, and the probability to be penalized when running the red light significantly affect RLR behavior. In addition, the results indicated that vehicle travelling direction, time of day, existence of turning lane, number of lanes, lane width, intersection sight distance, type of traffic signal pole, type of traffic signal operation, length of yellow time interval, approaching speed, distance from intersection warning sign to stop line, and pavement roughness significantly affect RLR rates.

1. Introduction

Red light running (RLR) is one of the serious traffic law violation behaviors at the signalized intersection. In Thailand, although RLR is considered as one of the most dangerous behaviors on roadways, the penalty of RLR is not severe (only \$30 fine), and there has been no effort to alleviate the problem. According to the National Statistics of Traffic Accident in Thailand 2015 (Kanitpong et al., 2015), 1702 red light running crashes at the intersection were reported, or 1.96% of all police-reported crashes were caused by drivers violating the red light. Based on Fig. 1, even though the road crashes caused by red light running shows smaller number when compared to other causes, it is considered as serious problem because most of the crashes due to red light running at intersection are always serious injured or fatal crashes.

Red light running (RLR) of motorcycle riders and car drivers is a complex problem that could result from various factors. Some drivers advertently run red lights because they are in a hurry or they are sometimes impatient to wait for the signal. In Thailand, some drivers

always “speed up” when the signal turning to yellow, instead of “slow down” and “prepare to stop”. It is observed that RLR behavior is becoming a habit because if drivers run red light for one time, it is likely that they will do it again if they have a chance. However, some drivers could inadvertently run red lights due to other factors influenced by road environment at intersection; for example, inappropriate traffic signal operation and traffic signal installation, poor intersection sight distance, and etc. (Wu et al., 2013). Not only the driver habit itself that influences RLR behavior, but also other contributing factors that influence RLR such as the driver characteristics (Retting et al., 1999b; Wang et al., 2016), the geometry of intersection, traffic signal operation (Wang et al., 2016), traffic condition, vehicle types, and road environment. Therefore, this study aims to determine the factors influencing the RLR behavior including the factors related to driver characteristics, vehicle characteristics, and geometry of intersection.

Motorcycle has been very popular and there were about 20 million motorcycles registered in Thailand or about 60% of all registered vehicles. However, motorcycles are found to be the highest risk group of

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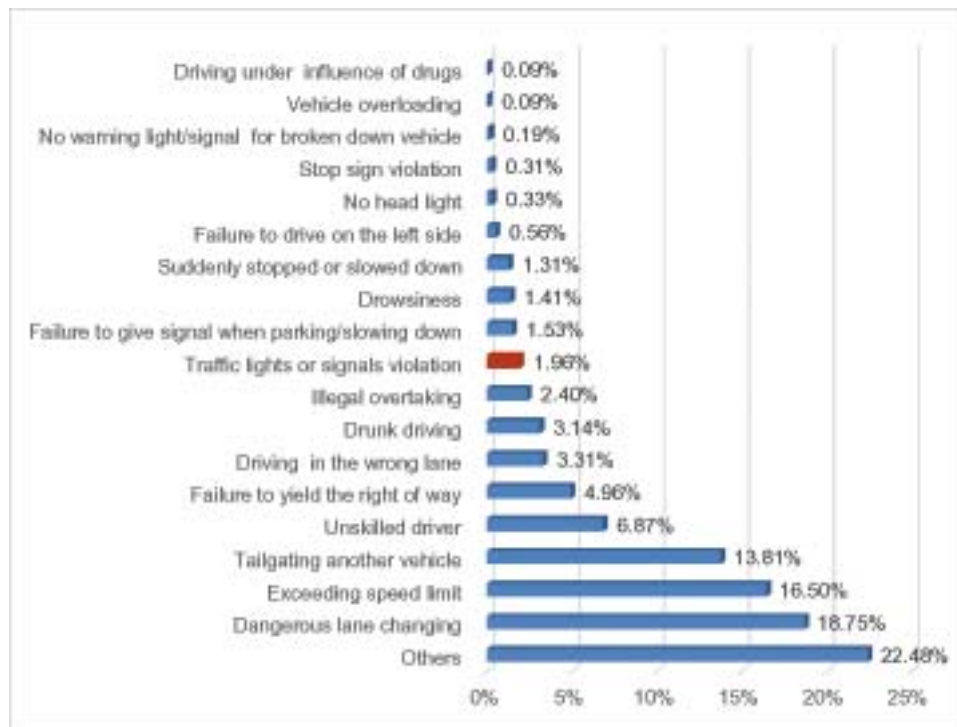


Fig. 1. Proportion of road crashes classified by causes of crashes in Thailand.

vehicle types to have accidents. During 2006–2015, the number of fatalities from motorcycle accidents was as high as 75% of the total fatalities from road accidents in Thailand (Kanitpong, 2016). It was believed that the primary causes of fatalities from motorcycle injuries were speed, drunkenness, and violation of traffic laws such as RLR. Therefore, the purpose of this study is to gain insight into the influencing factors leading to RLR behavior for both motorcycle riders and car drivers, in the context of Thailand. Findings from this study have several important implications that could improve the current practices to reduce the RLR behavior at the signalized intersection.

The specific objectives of this study are to:

- 1) Determine the characteristics of RLR motorcycle riders by using the observational survey.
- 2) Determine the socio-economic characteristics of red light runners by using the self-reported questionnaire survey.
- 3) Determine the factors related to the physical condition of intersection, traffic signal operation, and traffic condition affecting rates of RLR by using observational survey.

2. Literature review

Based on previous studies, there are many contributing factors affecting RLR behavior such as driver characteristics, physical condition of intersection, traffic condition, and driving environment. Kraus and Quiroga (2004) reported on RLR trends in Texas and found that older driver accounts for a relatively small portion of RLR crashes compared to young driver. Yang and Najm (2007) found that younger drivers under 30 years old are more likely to run red lights than drivers in other age groups. Other studies also reported in the same way that young drivers are more likely to run the red lights comparing to other age groups (Porter and Berry, 2001) and red-light runners tend to be drivers under 30 years old (Retting et al., 1999a; Retting and Williams, 1996). Gender of driver is also a contributing factor of RLR behavior as male is reported as red-light runners than female (Retting et al., 1999a).

Many research studies consider the occupancy in a vehicle as a factor contributing to RLR behavior. Porter and Berry (2001) concluded

that having passengers on the car can reduce the tendency of driver to run red lights. Moreover, Porter and Berry (1999) reported that the probability of RLR decreases as there are child passengers in the car.

Survey results from previous studies pointed out that RLR is related to other risk behaviors. Drivers who always wear seat belts are less likely to run red lights (Retting and Williams, 1996). The same study also found that the drivers with poor driving records (Retting and Williams, 1996) such as driving with suspended or revoked driver's license (Retting et al., 1999a) or drivers who ever got the ticket (Porter and Berry, 1999) have a high tendency to run the red lights. Other driver's characteristics influencing RLR could be ethnicity, occupation, alcohol consumption, and frustration.

Elmitiny et al. (2010) and Chang et al. (1985) found that as the distance from vehicle to intersection increases, the probability of a vehicle to stop at traffic light increases. Moreover, Chang et al. (1985) found that the width of intersection is another factor affecting the stop and go decision of drivers as most drivers tend to stop at traffic lights at wider intersection rather than at narrower intersection.

Approaching speed was observed as contributing factor to drivers' decision to stop. The probability of driver to stop at traffic light decreases as the approaching speed to the intersection increases (Chang et al., 1985). Elmitiny et al. (2010) found that if operating speed is lower than 50 mph, drivers are more likely to stop at traffic light. Yang and Najm (2007) also reported that about 56% of the red light runners were driving at or below the posted speed limit.

Furthermore, the signal timing, especially yellow timing, has an effect on drivers' decision. A study by Retting et al. (2008) showed that when yellow timing is changed, RLR violations are reduced by 36%. Based on the result from Brewer et al. (2002), it illustrates that the frequency of RLR increases when the yellow interval is less than 3.5 s. However, Elmitiny et al. (2010) observed that when the yellow time is greater than 4.3 s, the RLR violations can occur.

Other factors affecting RLR could be the traffic conditions such as time pressure or approaching traffic volume. Many drivers tend to speed up during yellow light which followed by red light due to the fact that they want to save time (Porter and Berry, 2001). More approaching traffic volume could lead to higher RLR rates. It is reported by Elmitiny

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