A Case Study of the Prevalence and Characteristics of Red Light Runners in Malaysia

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ABSTRACT

Little is known about the prevalence and factors influencing red light running in Malaysia and the relation to the growing number of intersection related crashes. The objective of this study is to examine the prevalence and identify the factors associated with red light running at selected intersections in Malaysia. Four intersections with high rate of accidents were selected as observation sites. Observations were conducted during peak hour (7AM to 9AM) and off-peak (2PM to 4PM) on a randomly selected day of the week excluding the weekends. Traffic volumes, traffic light violations, types of vehicles, time of day and cycle length of the traffic light were recorded. In total, out of 5090 vehicles observed, 12.04% (n=613) violated the red light. It was found that drivers facing short cycle length (less than 120 s) were more likely to run red lights. Intersections with fixed-timed traffic lights recorded 1.5 times more cases of red light running compared to intersections with vehicle-actuated traffic lights. Motorcyclists were 4.32 times more likely to run the red light compared to other drivers. No significant differences were observed in the number of red light running during peak hour and off-peak. To conclude, red light running were significantly related to the cycle length ($p<0.05$), types of traffic light ($p<0.01$) and types of vehicle ($p<0.01$). This study suggests the implementation of suitable engineering countermeasures and automated enforcement to reduce the number of red light running in Malaysia.

Keywords: red light running, traffic light, factors of red light running, observation, volume, violation

1. INTRODUCTION

In Malaysia, traffic crashes contribute to the most significant injuries and death. For the past five years, the number of accidents at signalized intersections in Malaysia has been on upward trend. One of the causes for crashes at intersections is due to red light running. The number of fatalities due to traffic light related accidents has steadily increased, leading to 182 fatalities and 757 injuries in 2009 [1].

Primary cause of crashes at signalized intersection occurred when vehicles entered the intersection on red signal. Drivers often face a problem when reaching a signalized intersection at the onset of amber; whether they have to stop or to proceed. This is the situation where drivers are in an option zone or dilemma zone, in which it is neither possible to proceed straight to clear the stop line nor possible to stop comfortably at the stop line.

Red-light cameras (RLC) can play a significant part in encouraging drivers to stop instead of violating the red light. Studies in two U.S cities – Oxnard, California and Fairfax City, Virginia found that violation rates have decreased by approximately 40 percent during the first year of enforcement of RLC [2]. It was also reported that automated enforcement system are used in 75 countries throughout the world [3]. Reductions of 5 to 60 percent in speeding violations were reported with reduction of 40 to 90 percent in red signal violations and reductions of 15 to 90 percent in crashes [3]. On the contrary, there are a few studies done in overseas that shows otherwise.

Automated Enforcement System is one of the interventions that can help to curb red light running. It is defined as a technical recording device that is triggered automatically when a violation occurs, so that information of the drivers is recorded, making it easier to identify the vehicle for the purpose of sanctioning the owner or driver. Automated enforcement systems on red light running can be an effective safety measure based on literature reviews detailing on its effectiveness. However, there are very limited studies undertaken in this field in Malaysia. For instance, Kulanthayan (2007) evaluated traffic light violation among motorists in Selangor. It was found that traffic light violations were influenced by factors such as day of week (weekday or weekend), types of vehicle (two-wheeled or four-wheeled vehicles), location and types of traffic light (countdown timer or normal) [4]. The study recommended that enforcement cameras should be installed at traffic light intersections to detect violation. Therefore, this study was carried out to examine the prevalence and identify the factors associated with red light running at selected intersections in Malaysia.

2. METHODOLOGY

The Malaysian Institute of Road Safety Research (MIROS) has identified 800 accident prone locations in which 265 locations were identified for RLC installation. The installations were divided into 4 phases. In the 1st phase, 10 locations were evaluated and accepted by AES Committee based on high number of accidents. Out of the 10 locations selected, four were selected for installation of RLC, namely: Banting, Jalan Klang Lama, Sg. Siput and Taiping.

These four locations were divided into two zones; Zone A consists of Sg Siput (Route F0001) and Taiping (Route A0007) while Zone B consists of Banting (Route F0005) and Jalan Klang Lama (Route Z0089). All four junctions chosen were three legged junction.

In this study, two types of route were taken into consideration: major and minor. Four enumerators were tasked to take note of the route particulars; i.e date, time, weather; signal timing, traffic volume and violations. Enumerators were placed unobtrusively, so that the drivers were not aware that their driving behaviour was being observed. Data were recorded for two hours during peak (7AM to 9AM) and two hours off – peak period (2PM to 4PM); considering different levels of traffic congestion on a randomly selected day of the week excluding weekends. During the time of data collection, all the sites are yet to be installed with RLC.

The following information was collected for this study:

1) Types of route (major and minor). Route types were determined during site verification.

2) Particulars of the site; the date, time, weather and location of the site were noted. Site locations were Taiping, Jln Klang Lama, Sg. Siput or Banting.

3) Layout of the site; site layout were done to ease in identification of observation spot.

4) Signal timing; signal timing in which consist of green, amber and red signal were recorded.

5) Traffic volume and violation; both traffic volume and violations were recorded for all direction which consist of right/left turn and through traffic. Traffic volume and violations were also separated by vehicle types.

Violation as defined by Kulanthayan (2007) is when the front wheel(s) of a vehicle entered the defining boundary of an intersection after traffic light has changed to red and the vehicle proceeded through the intersection [4]. The data collected was analysed using Statistical Package for the Social Sciences (SPSS) by employing chi square and odds ratio technique.

3. RESULTS

3.1 Violation Level

In total, an average volume of 5090 vehicles were observed comprising of 29.5% (1502) motorcycle, 53.7% (2731) cars, and 16.8% (857) others. Banting has the highest violations with 18.8%, followed by Jalan Klang Lama (11.7%), Taiping (10.5%) and Sg. Siput with 8.3%. On average, the overall violations for the four sites are 12.04% (2451) while percentage of compliance is 87.96 (17907).

Table 1 Summary of Violation level

Average Data Collection				
Vehicle Type				
	M/C	Cars	Others	Total
Volume	1502	2731	857	5090
(%)	29.5	53.7	16.8	100.0

	Violate	**%**	**Comply**	**%**	**Total**
Jln Klang Lama	819	11.7	6193	88.3	7012
Taiping	555	10.5	4741	89.5	5296
Sg. Siput	348	8.3	3837	91.7	4185
Banting	729	18.8	3136	81.1	3865

	Violate	**%**	**Comply**	**%**
Overall	2451	12.04	17907	87.96

3.2 Cycle Length

Table 2 Traffic Violation by Cycle Length (n = 5090)

Cycle Length	**Violate**	**(%)**	**Comply**	**(%)**	**Odds**
Short (≤120s)	310	13.2	2039	86.8	0.15
Long (>120s)	303	11.1	2438	88.9	0.12
Total	613	12.0	4477	88.0	

Variable	**Co-efficient**	**Standard Error**	**95% Significance**	**95% Confidence Interval**	**Odds Ratio**
Cycle Time	0.20	0.09	0.02	1.03 - 1.45	1.22

Table 2 shows traffic light violation by cycle length at traffic light junction. In short cycle length, 13.2% (310) of the vehicles violated the traffic lights while 86.8% (2039)

complied. Nonetheless, in long cycle length 11.1% (303) violated and 88.9% (2438) complied. Cycle length was found to be significant factor ($p<0.05$) in violation rates. The violation rates during short cycle length slightly higher than during long cycle length. Result also shows that drivers facing short cycle length are 1.22 times more likely to beat the red light than drivers facing long cycle length.

3.3 Peak – Off Peak Hour

Table 3 Traffic Violation by Peak – Off Peak Day Hour (n = 5090)

Peak – Off Peak Hour	Violate	(%)	Comply	(%)	Odds
Peak	300	12.1	2177	87.9	0.14
Off Peak	313	12.0	2300	88.0	0.14
Total	613	12.0	4477	88.0	

Variable	Co-efficient	Standard Error	95% Significance	95% Confidence Interval	Odds Ratio
Time of Day	0.02	0.09	0.88	0.86 - 1.20	1.01

Table 3 demonstrates the traffic violation by peak – off peak hour. Not much difference in percentage of violation can be observed between peak (12.1%) and off peak (12.0%). As such, traffic light violation was found not significant ($p = 0.88$) with time of day. This suggests that there is no difference in violation between daytime peak and daytime off peak hour.

3.4 Types of Traffic Light

Table 4 Traffic Violation by Types of Traffic Light (n = 5090)

Types of Traffic Light	Violate	(%)	Comply	(%)	Odds
Fixed Timed	387	14.2	2332	85.8	0.17
Vehicle Actuated	226	9.5	2145	90.5	0.11
Total	613	12.0	4477	88.0	

Variable	Co-efficient	Standard Error	95% Significance	95% Confidence Interval	Odds Ratio
Types of Traffic Light	0.45	0.09	0.00	1.32 - 1.87	1.58

Table 4 shows correlation between traffic light violations and types of traffic light. From a total of 5090 samples, 14.2% violated the red light while 85.8% complied. Chi square test done indicates the significance of this variable ($p<0.05$). Apart from that, the odds ratio stated that drivers at fixed- timed traffic light are 1.58 times more likely to violate

than drivers at vehicle-actuated traffic light. Therefore, the results show that types of traffic light is one of the factors affecting red light running.

3.5 Vehicle Types

Table 5 Traffic Violation by Vehicle Types (n = 5090)

Vehicle Types	Violate	(%)	Comply	(%)	Odds
2 wheeler	365	24.3	1138	75.7	0.32
4 wheeler	248	6.9	3339	93.1	0.07
Total	613	12.0	4477	88.0	

Variable	Co-efficient	Standard Error	95% Significance	95% Confidence Interval	Odds Ratio
Vehicle Types	1.46	0.09	0.00	3.63 - 5.14	4.32

Traffic light violations by vehicle types were differentiated between violations by two (2) wheel and four (4) wheel vehicles. Two wheeled vehicles recorded higher traffic light violations with 24.3% compared to four wheeled vehicle with 6.9% (Table 5). The result of chi square test proves this to be significant ($p<0.05$). Analysis of odds ratio shows that drivers of a 2 - wheeler vehicle are 4.32 times more likely to violate than drivers of a 4 - wheeler. This implies strong association of traffic light violation and types of vehicle.

4. DISCUSSION

The primary aim of this study is to examine the prevalence of red light runners and identify the factors associated with red light running at selected intersections in Malaysia. Factors considered in the study were cycle length, time of day, types of traffic light and vehicle types.

4.1 Cycle Length

Cycle length is defined as the sum of all traffic phases. Timing of several signal phases is based on the characteristics of the individual approach as well as the intersection. Poor signal timing may cause drivers to lose patience and violate the red light. There are beliefs and considerations that shorter or longer cycle lengths will have effect on signal violations. In this study, it was found that drivers have the tendency to violate 1.22 times more during short cycle length than drivers facing long cycle length. Cycle length was also found to be statistically significant ($p<0.05$). These results are on the contrary from the study done by Kulanthayan et al., 2007 [4], who observed more traffic light violations during long signal duration cycles (above 160s). This could be due to the fact that our sample sites are small (2 in Selangor and 2 in Perak) while Kulanthayan only considered Selangor. On the other hand, Che Puan and Ismail [5] found that the rate of red light running was significantly reduced when duration of amber period was longer than the required length. It was also reported in Porter and England [6] that frequent yellow signal caused the increase of red light running.

4.2 Peak and Off Peak Hour

Time of day is one of the many factors affecting red light running. Drivers often beat the red light when they are in a hurry. Green [7] conducted an extensive analysis using Australian crash data from 1994 to 1998 and found that high number of red light running related crashes was observed during late afternoon and on the weekends, thus suggesting a relation to high alcohol times. Retting et al. [8] also indicated time of day as a factor influencing red light running. They found different characteristics of red light running related crashes during the night as compared to daylight crashes. However, results from our study shows no significance ($p = 0.8843$) between traffic light violation and time of day. Since the study only conducted volume and violation count during daytime, it can be concluded that there is no difference in daytime peak flow and daytime off peak flow. Malaysian is one of the Muslim countries. Being a Muslim country, drinking alcohol is prohibited to its followers. Therefore, the number of drivers driving under the influence of alcohol is considerably low. This explains the difference in results between our study and Green's [7]. Furthermore, a study done by A. Shabadin [8] on driving exposure in Sabak Bernam, Malaysia indicates that there is not much difference in traffic volume for daily morning routine (7.00am- 11.59am) and evening (2.00pm-6.59pm). Volume for motorcycles and cars during those periods are approximately 38% and 61% each. Higher number of approaching vehicles would indicate that there is a possibility of an increment in the number of red light runners.

4.3 Types of Traffic Light

Traffic controllers are signalling devices used to control and regulate competing flows of traffic and are highly useful during peak hour when the traffic volume are reasonably high. However, such devices may expose drivers to accidents because drivers will have to make a choice whether to stop or proceed through the intersection at the onset of amber. As a countermeasure to the dilemma facing by drivers at junctions, engineers have introduced new modifications to the controller such as using vehicle-actuated sensors and countdown timer. Chi square test done in our study indicates the significance between traffic light violations and types of traffic light ($p<0.05$). Drivers facing a fixed traffic light were found to be 1.58 times more likely to violate than drivers facing vehicle actuated traffic light. This finding is concurrent with Che Puan and Ismail [5], who found that the rate of red light running was lower at the intersections with vehicle-actuated signals as compared to fixed-time controller. Bonneson et al. [9] stated that the factor could be interrelated with driver's expectancy. A fully vehicle-actuated traffic light usually let a green light for a group of vehicle to travel through several interconnected signal. Drivers expect the green signal to stay green until they successfully pass through the series of intersections. This could resulted in violations as drivers would assume the yellow phase is long enough for them to drive through the intersections.

4.4 Types of Vehicle

In Malaysia, motorcycles comprise more than 50% of vehicles that share the road and have contributed the highest number of fatalities each year. Motorcyclists are the most vulnerable group to all types of violation as they are smaller in size, move faster and can easily go undetected in between vehicles. In addition, motorcycle moving at high speed is much more difficult to come to a stop compared to cars, particularly in a short distance

at signalized intersection. Retting et al [10] observed that red light runners comprised mostly those who drive small and old vehicles. However, the study classified the vehicles based on the size instead of the number of wheels (i.e., two-wheeler, etc.). Classification were made from three different sizes, namely small (wheelbase ≤ 99 inches), midsize (wheelbase 100 – 109 inches), and large (wheelbase >109 inches). In previous study, higher violations of motorcyclists were observed compared to other type of road users. However in this study, the vehicle types were separated into two i.e. two (2) wheel and four (4) wheel vehicles. Chi square test proves strong relationship between traffic light violation and vehicle types. It was also found that drivers of a two-wheel vehicle are 4.32 times more likely to violate than drivers of a four-wheel vehicles thus suggesting a strong correlation between the two.

5. CONCLUSION

Factors contributing to red light running as discussed in this paper are cycle length, time of day, types of traffic light and vehicle types. Out of these factors, red light violations were independent of peak and off peak period. This might be influenced by Malaysia's socio-demographic factor and lifestyle as previously explained. Red light running were significantly related to the cycle length ($p<0.05$), types of traffic light ($p<0.01$) and types of vehicle ($p<0.01$). However, the sample size of this study is small. Only four locations were considered due to some constraints mentioned earlier. The results only represent the sample size. Further study needs to be conducted in order to come out with a result that can be generalized for drivers in Malaysia. This study suggests the implementation of suitable engineering countermeasures and automated enforcement to reduce the number of red light running in Malaysia. As people tend to violate higher at a fixed timed traffic light, the use of vehicle actuated traffic light is more suitable to solve the issue of red light running. Apart from that, education and enforcement will definitely reduce the tendency to beat the red light especially among motorcyclists.

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