

CHANGE OF MOTORCYCLE SPEED UNDER SPEED ENFORCEMENT CAMERA ON URBAN ARTERIAL IN KHON KAEN CITY, THAILAND

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ABSTRACT: Road traffic injuries tend to become more serious all over the world as well as the number of road fatalities, serious injuries that lead to disabilities, which is also increasing. Speeding is one of the top causes of death and injury. At present, Thai law has limited the speed in urban areas at 80 km/h for passenger cars and motorcycles. This speed limit is too high for motorcyclists to prevent injury and fatality in case of an accident. The objective of this study is to explore the change of speed of motorcycles after the installation of speed enforcement cameras. The speeds of motorcycles before and after the installation of speed enforcement cameras were collected by applying spot speed method at 28 points along the project corridor. The change of speeds was analyzed using t-test at 95% confidence level. As a result, the 85th percentile speed of motorcycles significantly decreased after the installation of a speed enforcement camera, whereas the mean speed of motorcycles was constant.

Keywords: Speed, Motorcycle, Speed enforcement cameras, Urban arterial

1. INTRODUCTION

Traffic injuries tend to become increasingly serious all over the world as well as the number of road fatalities and disabilities that is becoming a problem. According to Global Road Safety statistics of 2010 [1], approximately 1.27 million deaths worldwide were caused by road accidents (3,479 people per day). If old defensive measures were still used, within 20 years, road accidents could be the leading cause of deaths globally, and road safety problems are predicted to expand dramatically. By 2030, the road fatalities may rise up to 2.4 million deaths, with a possible increase from injury rates. As a result, road accidents will become the major cause of deaths, together with disabilities, and its rank will change from the ninth (in 1990) to the third by WHO report [1].

Thailand has the highest rate of traffic accident fatalities and the highest rate of motorized 2-or 3-wheelers deaths [2-9]. Speeding is one of the highest causes of a road accident in Thailand [10]. Prior to the speed study in Thailand, Bunjaweht and Sutiwipakorn [11] stated that traffic accidents cause a mass of casualties and damage to citizens' properties each year and can be considered as the underlying causes of deaths. Among the many factors of traffic accidents was the speed of vehicles. Higher speeds of vehicles increase the risks of accidents. Fast speed increases the injuries and damage. In a pedestrian versus car accident, if a pedestrian is hit by a car at 64 km/h, the likelihood of death is 90%, while a hitting car at 32 km/h causes only a 5% chance of the death.

Khon Kaen City is a province of Thailand where there are many educational institutions, department stores, and residences. These result in a lot of traffics, especially along an urban section of Mittraphap Highway passing the Khon Kaen City. The cross-section of this urban arterial is shown in Fig. 1. Its physical characteristic is presented in Table 1. Previously, the speed limit was set at 90 km/h for both passenger cars and motorcycles along this urban corridor. The speed law enforcement by police was not efficient. Kumphong [12] conducted a study of the speed of motorcycles and passenger cars at 28 spots in Khon Kaen City, Thailand in 2016 (before installation of speed enforcing cameras). The results are shown in Table 2. The mean speed and the 85th percentile speed of motorcycles were 54 and 67 km/h, respectively. The mean speed and 85th percentile speed of passenger cars were 77 and 89 km/h, respectively. Table 3 shows the analyzed results of difference between speeds of passenger cars and motorcycles. The difference in 85th percentile speed between passenger cars and motorcycles was 22.4 km/h. The difference in mean speed between passenger cars and motorcycles was 22.8 km/h. The 85th percentile speeds and mean speeds of passenger cars and motorcycles were significantly different. It may cause serious injury of the accident. The speeding and drunk driving caused a lot of accidents [15-16].

Road Safety Committee of Khon Kaen Province has set the speed limits for this 14-km urban corridor to decrease the traffic accident since November 2016. The new speed limit map is displayed in Fig. 2. The urban speed limit has been

set along the urban section of Mittraphap Highway passing the Khon Kaen City [13]. The urban speed limits of motorcycles and passenger cars have been changed from 90 km/h to 80 km/h as displayed in Fig. 3. The mobile speed camera has been replaced by automatic speed enforcing cameras. The installing locations are displayed in Fig 4. However, the urban speed limit that has been established is somehow high when compared with the 85th percentage and mean speeds of motorcycles. The speed enforcing cameras may not influence speeding behavior of motorcyclists.



Fig. 1 Cross section of Mittraphap Road passing through Khon Kaen city

Table 1 Physical Characteristics of Mittraphap Road passing through Khon Kaen City

Characteristics	Mean
Number of lanes	3.3
Roadway width (m)	13
Lane width (m)	3.8
Left shoulder width (m)	1.1
Right shoulder width (m)	0.9
Conflict point (per 1000 m)	3.5

Table 2 Speeds of motorcycles and passenger cars in 2016 (before installation of speed enforcing cameras)

Speeds of passenger cars	km/h
85 th percentage speed _c	89
Mean speed _c	77
Speeds of motorcycles	km/h
85 th percentage speed _{MC}	67
Mean speed _{MC}	54

Table 3 Speed differences between passenger cars and motorcycles in 2016 (before installation of speed enforcing cameras)

	Difference		t
	Mean	S.D.	
85 th percentage speed _{PC} - 85 th percentage speed _{MC}	22.4	10.2	11.6***
Mean speed _{PC} - Mean speed _{MC}	22.8	8.8	13.7***

Note: *Significant at 90% confidence level
 **Significant at 95% confidence level
 ***Significant at 99% confidence level

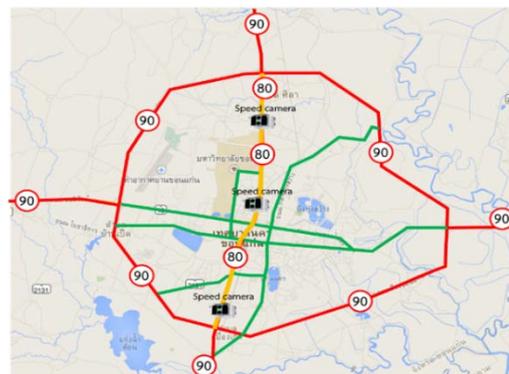


Fig. 2 Map of the speed limit of Khon Kaen city [13]

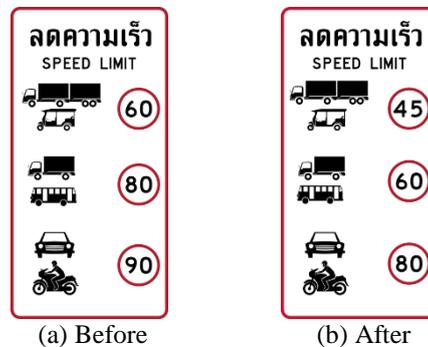


Fig. 3 Speed limits (before-after speed enforcement camera installation)



Fig. 4 Locations of installed speed enforcing cameras

The objective of this study is to explore the change of speed of motorcycles after the installation of speed enforcement cameras along the section of Mittraphap Road passing through the Khon Kaen City.

2. METHODOLOGY

2.1 Data Collection

The speeds of motorcycles before and after installation of speed enforcing cameras were collected and compared. The free flow spot speeds, 6:00 - 7:00 AM, were collected at 28 points along the project corridor as displayed in Fig. 5. The spot speed method was applied to collect the spot speeds of motorcycles by using radar gun as shown in Fig. 6.

The speeds of motorcycles before installation of speed enforcing cameras were collected by the previous study in 2016 [12]. This study collected the speeds of 1,555 motorcycle samples after installation of speed enforcing cameras in 2017.



Fig. 6 Speed observation by a radar gun

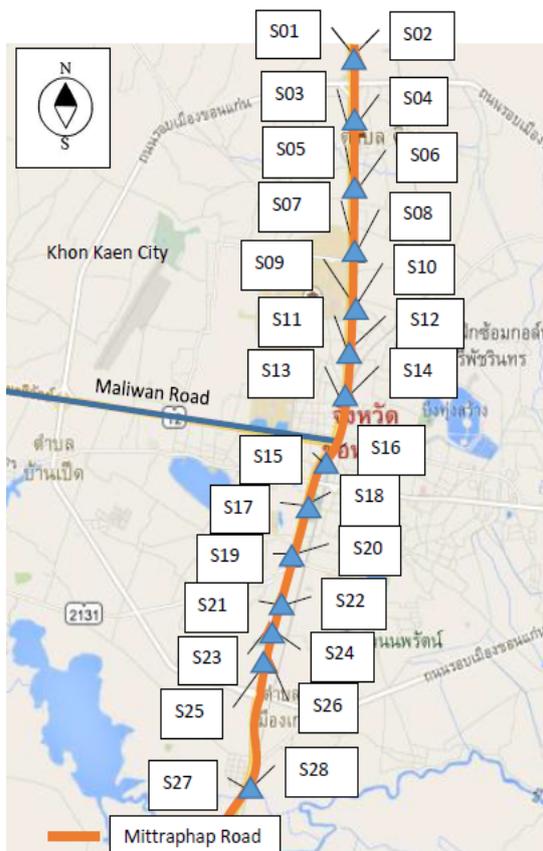


Fig. 5 Locations of spot speed survey

2.2 Statistical Analysis

This study applied SPSS program to analyze the descriptive statistics of collected speeds. The t-test was conducted to find the difference of speeds before and after the installation of speed enforcing cameras at 95% confidence level [17].

3. RESULTS AND DISCUSSIONS

The results of speed collection after speed enforcing camera installation are displayed by location in Fig. 7 and 8. The 85th percentile and mean speed of motorcycles after project implementation at all locations (S1-S28) are quite consistent through the project corridor.

The 85th percentage and mean speeds of motorcycles before and after installation of speed enforcing cameras are presented by location in Table 4. The 85th percentage speed of motorcycles of speed enforcing cameras, whereas the mean speed of motorcycles was constant because the speed limit was set at a high level (80 km / h). There was no law enforcement or any fine by the police on motorcycles.

The results of the comparison of speeds before and after installation of speed enforcing cameras are presented in Table 5. The 85th percentile speeds before and after installation of speed enforcing cameras were significantly different at 95% level confidence ($p < 0.05$) whereas the mean speeds were not significantly different.

However, the speed distribution in Fig. 9 shows that before speed enforcing camera installation, approximate 7.1% of motorcycles, sped up over 59 km/h. After speed enforcing camera installation, no motorcycle was found using speed over 59 km/h during the surveying period. The speeds of most riders, 92.9%, ranged from 50 to 59 km/h.

After installation of speed enforcing cameras, the 85th percentage speed of motorcycles was 64 km/h and the mean speed of motorcycles was 53 km/h., which is the speed range difference that is higher than the studies in Vientiane, Lao PDR and Phnom Penh, Cambodia where the means speeds were 36 Km/h and 35 Km/h, respectively [12]. The high speed of motorcycle riding may cause a lot of motorcycle accidents in Thailand [5].

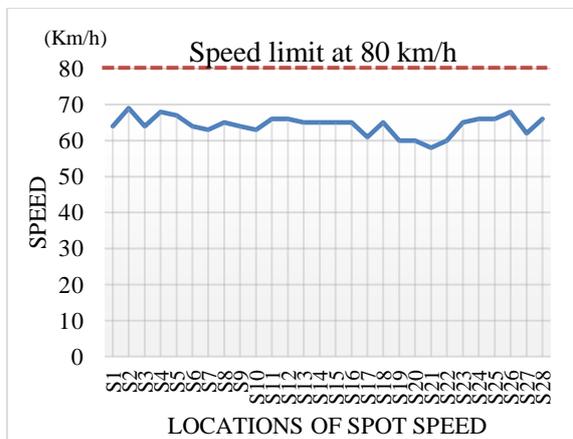


Fig. 7 85th percentile speed of motorcycles after speed camera installation

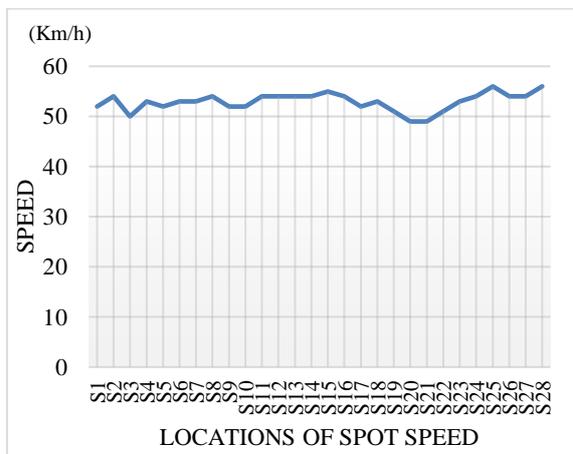


Fig. 8 Mean speed of motorcycles after speed camera installation

Table 4 Speeds of motorcycles by location (before and after installation of speed enforcing cameras)

Location No.	Before*		After	
	85 th percentage speed _{MC} (km/h)	Mean speed _{MC} (km/h)	85 th percentage speed _{MC} (km/h)	Mean speed _{MC} (km/h)
1	64	50	64	52
2	67	54	69	54
3	69	61	64	50
4	69	58	68	53
5	67	55	67	52
6	60	51	64	53
7	60	52	63	53
8	63	55	65	54
9	69	51	64	52
10	71	58	63	52
11	68	58	66	54
12	69	59	66	54
13	71	57	65	54
14	67	51	65	54
15	63	52	65	55
16	66	58	65	54
17	63	50	61	52
18	68	53	65	53
19	73	57	60	51
20	68	53	60	49
21	59	51	58	49
22	69	56	60	51
23	60	47	65	53
24	65	49	66	54
25	70	57	66	56
26	72	55	68	54
27	58	50	62	54
28	79	60	66	56
Mean	67	54	64	53

Note: *previous study [12]

Table 5 Comparison between speeds of motorcycles before-after project implementation

	Difference		t
	Mean	S.D.	
Before 85 th percentage speed _{MC}	2.4	4.8	2.6**
- After 85 th percentage speed _{MC}			
Before Mean speed _{MC}	1.3	3.9	1.7
- After Mean speed _{MC}			

Note: *Significant at 90% confidence level, **Significant at 95% confidence level, ***Significant at 99% confidence level.

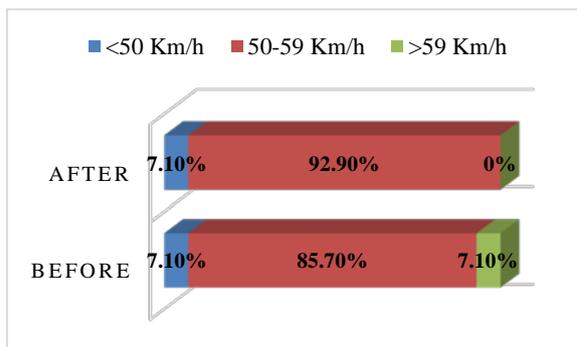


Fig. 9 Distribution of speeds of motorcycles before and after installation of speed enforcing camera

4. CONCLUSIONS AND RECOMMENDATIONS

This study is to explore the change of speed of motorcycles after the installation of a speed enforcement camera. The results demonstrate that the 85th percentile speed of motorcycles significantly decreased after the installation of speed enforcement cameras, whereas the mean speed of motorcycles was constant.

The speed law of Thailand currently limits the speed in urban areas at 80 km/h for motorcycles and passenger cars. The high speed of motorcycle riding, due to the high limit at 80 km/h, may cause greater violence in road accidents [7, 18]. The future study should determine the appropriate speed limit for motorcycles and other vehicles by considering injury related criteria. For example, in Sweden, establishing the speed limit can explain the evolution of setting or considering of the following factors: starting in 1960, drivers' behavior at 85 percentile; later, accident-related criteria; and from social-economic criteria to consideration in certain areas; and finally injury-related criteria (1990), which was the main item taken under consideration [19].

5. ACKNOWLEDGMENTS

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6. REFERENCES

[1] Tanaboriboon Y. and Satiennam T., Traffic accidents in Thailand. IATSS RESEARCH, Vol. 29, No. 1, 2005, pp. 88-100.
 [2] World Health Organization. Helmets :A road safety manual for decision- makers and practitioners. Geneva, Switzerland, 2006.
 [3] World Health Organization Global Status Report on Road Safety 2009. Geneva,

Switzerland, 2009.

[4] World Health Organization. Global Status Report on Road Safety 2013. Geneva, Switzerland, 2013.
 [5] World Health Organization. Global Status Report on Road Safety 2015. Geneva, Switzerland, 2015.
 [6] F.A.O. Fernandes R.J. and Alves D.S., Motorcycle helmets-A state of the art review. Accident Analysis and Prevention 2013, Vol. 56, pp. 1-21.
 [7] Kumphong J., Satiennam T. and Satiennam W., A correlation of traffic accident fatalities, speed enforcement and the gross national income of Thailand and its cross-border countries. International Journal of Technology, Vol. 7, 2016, pp. 1141-1146.
 [8] Kumphong J., Satiennam T. and Satiennam W., A Study of Social Norms and Motorcycle Helmet Use Intentions among Student Riders in University: A comparison of the Theory of Reasoned Action and the Theory of Planned Behavior. Conference proceedings, in Proc. 12th Int. Conf. on the Eastern Asia Society for Transportation Studies, Vol. 11, 2017, pp. 1-14.
 [9] Kumphong, J., Satiennam, T. and Satiennam, W., Correlations among motorcycle-related deaths, helmet law enforcement and helmet usage for ASEAN countries. International Journal of GEOMATE, Sept. 2018, Vol.15, Issue 49, pp. 72 -77.
 [10] Royal Thai Police. Injuries and Deaths Report 2006-2013. Thailand; 2013. (In Thai)
 [11] Bunjaweht P. and Sutiwipakorn V., A study of the use of traffic calming strategy in Thailand. Conference proceedings, in Proc. 3rd the Nine National Transport Conference Research (NTC3), Thailand, 2006. (In Thai)
 [12] Kumphong J., A study of relations between the speed of vehicles with road characteristics and accident severity. Master thesis in the Department of Civil Engineering, Faculty of Engineering, Khon Kaen University, 2016. (In Thai)
 [13] Road Safety Thai. The study of the automatic speed enforcement measures: A case study of the urban arterial road in Khon Kaen City, Phase I. Khon Kaen University; 2015. (In Thai)
 [14] Kumphong J. and Satiennam T., Study of vehicle's speed of cities in Greater Mekong Subregion. Conference proceedings, in Proc. 8th Asian Transportation Research Society (ATRANS) Symposium: Young Researcher's Forum, 2015. (In Thai)
 [15] Ichikawa M., Chadbunchachai W. and Marui E., Effect of the helmet act for motorcyclists in Thailand. Accident Analysis and Prevention, Vol. 35, 2003, pp. 183-189.

- [16] Nakahara S., Chadbunchachai W., Ichikawa M., Tipsuntornsak N. and Wakai S., Temporal distribution of motorcyclist injuries and risk of fatalities in relation to age, helmet use, and riding while intoxicated in Khon Kaen, Thailand. *Accident Analysis and Prevention*, Vol. 37, 2005, pp. 833-842.
- [17] Park H M., Comparing Group Means: The T-test and One-way ANOVA Using STATA, SAS, and SPSS. The Trustees of Indiana University, 2005. (http://stat.smmu.edu.cn/DOWNLOAD/ebook/statistics_course.pdf)
- [18] da Costa D.G.N, Malkhamah S. and Suparma L.B., Use of the safety factor and margin of safety in motorcyclist accident risk management. *International Journal of Technology*, Vol. 9, 2016, pp. 737-750.
- [19] World Health Organization. *Speed Management*. Geneva, Switzerland, 2008.

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